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Contents

1	Introduction to Public Health	1
2	Public Health dentistry	22
3	General Epidemiology	42
4	Epidemiology, Etiology and Prevention of Dental Caries	83
5	Epidemiology, Etiology and Prevention of Periodontal Disease	110
6	Epidemiology, Etiology and Prevention of Oral Cancer	133
7	Epidemiology, Etiology and Prevention of Malocclusion	158
8	Behavioral Sciences in Dentistry	180
9	Oral Health Education and Health Promotion	204
10	School Dental Health Program	221

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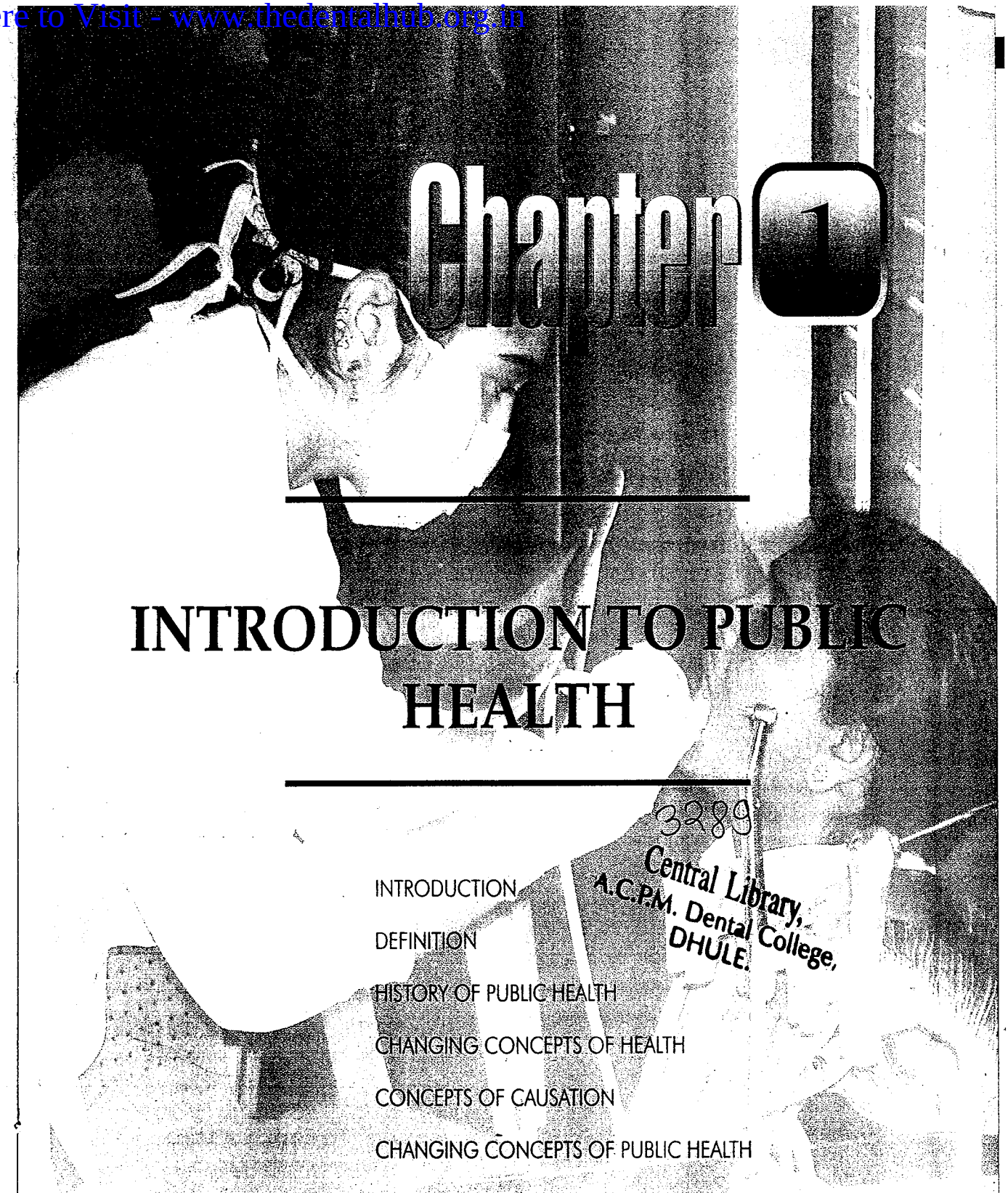
11	Fluorides in Preventive Dentistry	236
12	Survey Procedures in Dentistry	282
13	Indices in Dental Epidemiology	311
14	Research Methodology and Biostatistics	360
15	Planning and Evaluation	400
16	Dental Manpower	411
17	Finance in Dental Care	421
18	Caries Activity / Susceptibility Tests	431
19	Pit and Fissure Sealants	440
20	Atraumatic Restorative Treatment (ART)	447

Click here to Visit - www.thedentalhub.org.in



21	Environment and Health	458
22	Nutrition and Oral Health	476
23	Occupational Hazards and Infection Control in Dentistry	488
24	Ethics in Dentistry	503
25	Law and Dentistry	515
26	The Dentists Act of India	528
27	Indian Dental Association and Dental Council of India	539
28	Health Agencies around the World	546
29	Establishing and Managing a Dental Office	563
30	Definitions / Descriptions	573
31	Index	584

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Chapter 1

INTRODUCTION TO PUBLIC HEALTH

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INTRODUCTION

DEFINITION

HISTORY OF PUBLIC HEALTH

CHANGING CONCEPTS OF HEALTH

CONCEPTS OF CAUSATION

CHANGING CONCEPTS OF PUBLIC HEALTH

PRIMARY HEALTH CARE

PUBLIC HEALTH IN INDIA

CONCEPT OF PREVENTION

CONCLUSION

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INTRODUCTION

Public health is the study and practice of managing threats to the health of a community. The goal of public health is to improve lives through the prevention or treatment of disease.

Human beings have continuously made changes in their way of life. This has brought them into contact with a number of disease producing factors in the environment.

DEFINITION

HEALTH

Medical systems in the world have defined Health in their own ways since time immemorial.

Indian medicine propagates the 'tridosha theory' of disease. According to it the doshas or the humors are vata (wind), pitta (gall) and kapha (mucus). When these are in perfect balance and harmony, a person is said to be healthy.

Chinese medicine is based on two principles, Yang and Yin. Yang is believed to be an active masculine principle and yin a negative feminine principle. The balance between these two opposing forces means good health.

Greek medicine postulated that health prevailed when the four humors – Phlegm, yellow bile, blood and black bile were in equilibrium.

The Webster's English Dictionary defines health as "the soundness or the general wholesomeness of the body".

WHO definition of Health:

"Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity".

The bibliographic citation for this definition is:

Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June, 1946; signed on 22 July 1946 by the representatives of 61 States and entered into force on 7 April 1948.

PUBLIC HEALTH

Knutson defined public as "of or pertaining to the people of a community, state or nation".

He offered a simple yet comprehensive definition of public health as "Public health is peoples health. It is concerned with the aggregate health of a group, a community, a state or a nation".

Winslow (1920) defines **Public Health** as

" the science and art of preventing disease, prolonging life and promoting physical and mental efficiency through organized community effort for the sanitation of the environment, the control of communicable infections, the education of the individual in personal hygiene, the organization of medical and nursing services for the early diagnosis and preventive treatment of disease and the development of the social machinery to insure everyone a standard of living adequate for the maintenance of health, so organizing these benefits as to enable every citizen to realize his birthright of health and longevity".

HISTORY OF PUBLIC HEALTH

Public health has a long and interesting history. In 1796 Edward Jenner inoculated an 8 year old boy called James Phipps, using cowpox (a mild relative of the deadly smallpox virus). He inserted pus taken from a cowpox pustule and inserted it into an incision on the boy's arm. He was testing the theory; drawn from the folklore of the countryside, that milkmaids who suffered the mild disease of cowpox never contracted smallpox, one of the greatest killers of the period, particularly amongst children. Jenner subsequently proved that having been inoculated with cowpox, Phipps was immune to smallpox.

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Miasma theory of disease

The miasmatic theory of disease began in the middle ages and continued to the mid 1800s, when it was used to explain the spread of cholera in London and in Paris. This theory held that diseases such as cholera or the Black Death were caused by miasma (Greek language: "pollution"), considered to be a poisonous vapor or mist that is filled with particles from decomposed matter (miasmata) that could cause illnesses and is identifiable by its nasty, foul smell, which came from the decomposed material. Disease was said to be preventable by cleansing and scouring of the body and items.

Despite Anton van Leeuwenhoek's observations of microorganisms, in the year 1680 , the modern era of public health did not begin until the 1880s, with Robert Koch's germ theory.

Robert Koch gave the Koch's Postulates which were first used in 1875 to demonstrate that anthrax was caused by the bacterium Bacillus anthracis. These postulates are still used today to help determine if a newly discovered disease is caused by a microorganism.

The science of epidemiology was however founded by John Snow.

The germ theory of disease, is a theory that proposes that microorganisms are the cause of many diseases. Dr. John Snow contributed to the formation of the germ theory when he traced the source of the 1854 cholera outbreak in the Soho neighborhood of London. The statistical analysis of the affected cases showed that the drinking water was the vessel for transmission of the disease. He found that cases occurred in homes which obtained their water from the Broad Street pump, which was at the center of the outbreak.

Modern public health

As the prevalence of infectious diseases in the developed world decreased through the 20th century, public health began to put more focus on chronic diseases such as cancer and heart disease.

During the 20th century, the dramatic increase in average life span is widely credited to public health achievements such as vaccination programs and control of infectious diseases, effective safety policies such as improved family planning, anti-smoking measures and programs designed to decrease chronic disease.

The growing field of population health has broadened the focus of public health from individual behaviors and risk factors to population level issues such as inequality, poverty, and education. Modern public health is often concerned with addressing determinants of health across a population, rather than advocating for individual behavior change. There is a recognition that health is affected by many factors including where people live, genetics, income, educational status and social relationships - these are known as "social determinants of health." A social gradient in health runs through society, with those that are poorest generally suffering the worst health. The new public health seeks to address these health inequalities by advocating for population-based policies that improve the health of the whole population in an equitable fashion.

CHANGING CONCEPTS OF HEALTH

An understanding of health is the basis of all health care. Health has evolved over the centuries as a concept from an individual concern to a world – wide social goal. The changing concepts are,

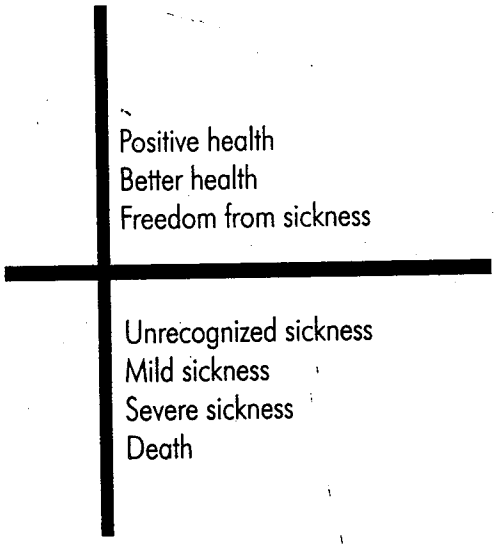
1. Biomedical concept: In this concept, health is viewed as absence from disease, i.e., if a person is free from disease, he is considered healthy. It is based on the germ theory of disease. This concept does not take into consideration the environmental, social and cultural

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determinants of health. However, developments in medical science have come to the conclusion that this concept is inadequate.

2. Ecological concept: This concept views health as a dynamic equilibrium between man and his environment and disease a maladjustment of the human organism to environment. This concept focuses on imperfect man and imperfect environment. Improvement in human adaptation to his environment can lead to longer life expectancies and a better quality of life.
3. Psychosocial concept : This concept reveals that health is not just a biomedical phenomenon but is also influenced by social, psychological, cultural, economic and political factors. Thus health is considered both a biological and a social phenomenon.
4. Holistic concept : It is a synthesis of all the above concepts and implies that all sectors of society have an affect on health. It recognizes the strength of social, economic, political and environmental influences on health. The emphasis is on the promotion and protection of health.

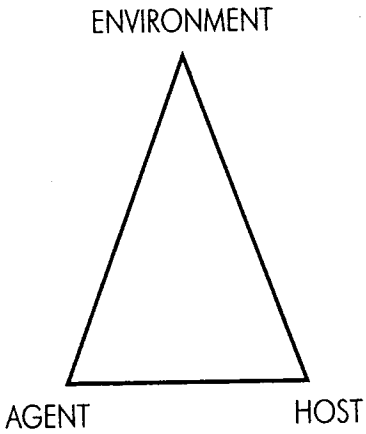
Health and disease lie along a continuum and there is no single cut off point. The lowest point on the health – disease spectrum is death and the highest point corresponds to the WHO definition of positive health.



CONCEPTS OF CAUSATION

1.EPIDEMIOLOGICAL TRIAD

The occurrence and manifestations of any disease, whether communicable or non communicable are determined by the interactions between the agent, the host and the environment, which together constitute the epidemiological triad.



The agent

The agent is defined as "an organism, a substance or a force, the presence or lack of which may initiate a disease process or may cause it to continue".

They may be classified as,

a) Living or biological agents (Eg: Bacteria, virus, fungi)
b) Non living or inanimate

- Nutrient agents (Eg:Protein,fat, carbohydrate)
- Chemical agents- They can be,

External (Eg: Lead, arsenic)

Internal (Eg: Urea in renal failure, Ketone bodies in diabetes)

- Physical agents (Eg: Atmospheric pressure, temperature)

The host

The host is the man himself. The characteristics of a human being that determine how he reacts to the agents in the environment are called "host factors". The host factors are,

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1. Demographic characteristics: Age, sex, ethnicity
2. Biological characteristics: Genetic background, physiologic and biochemical characteristics, immune status, nutritional status.
3. Socio-economic characteristics: Social class, religion, education, marital status.
4. Life Style: Living habits, food habits etc.

In terms of infectious disease epidemiology, host is defined as " a person or an animal that affords subsistence or lodgement to an infectious agent under natural conditions".

The environment

Environment is the source or reservoir for the agents of disease. It helps in the transmission of agents to the host, bringing about their contact and interaction. During such interaction, the environment may be favorable to man and unfavorable to the agent or vice versa. Thus there is a constant attempt towards adjustment and re-adjustment between man and the causative agents within the same environment.

The environment of man is of two types,

Internal

The internal environment of man pertains to "each and every component part, every tissue, organ and organ system and their harmonious functioning within the system". Internal environment is directly related to internal health. Fault in functioning of one or more component parts results in disharmony or disease.

External

It is defined as "all that which is external to the individual human host."

Macro-environment is another term used to denote external environment.

Micro-environment is the term sometimes used to denote one's personal environment comprised by the individual's way of living and life style. Man is making a constant endeavor to maintain health by adjustment to all sorts of agents in the external environment. When the host [man] is well adjusted, he is in a state of comfort or health. Maladjustment of body creates an imbalance or disharmony, which is responsible for discomfort or disease.

Generally, the environment can be studied under three headings:

a) Physical environment: is the space around man containing gases, liquids and solids.

b) Biological environment: means the universe of all living things that surround man. It comprises both animals and plants. They may be reservoirs of disease germs (rats in case of plague), they may be transmitters of disease agents (mosquitoes) or they may be the causative agents of disease (bacteria or viruses).

c) Social environment: comprises all human beings around man and their activities and interactions. It includes social and economic factors.

Social factors pertain to the society in which man lives. They provide stimuli that effect the physical, mental and social state of man to which he must adjust. Eg: The customs of society, attitude of colleagues.

Economic factors refer to the material assets and gains of the human society. They determine the economic status of man, which in turn affects his health. Thus, low economic status means less diet, poor housing and less resources for medical aid.

2. MULTIFACTORIAL CAUSATION

This concept was put forth by Pettenkofer of Munich (1819 - 1901). "Modern" diseases of civilization like coronary heart disease and cancers could not be explained on the basis of the 'single cause idea', because they were due to multiple factors. This concept offers multiple approaches for the prevention of disease.

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3. NATURAL HISTORY OF DISEASE

This model signifies the way in which a disease evolves over time from the period of its earliest stage to its termination as recovery or death.

It consists of 2 phases:

1. Period of pre pathogenesis – The process in the environment. The disease agent has not yet entered man, but the factors which favor its interaction with the human host are present in the environment
2. Period of pathogenesis – The process in man. This phase begins with the entry of the disease agent into the human host. The final outcome may be recovery, disability or death.

4. WEB OF CAUSATION

This term was coined by MacMahon and Pugh. It is applicable in certain diseases, especially chronic diseases, where the causative agent may be unknown or uncertain and the disease is the result of interaction of multiple factors. Removal of some of them or even one of them (important link) may be sufficient to control disease.

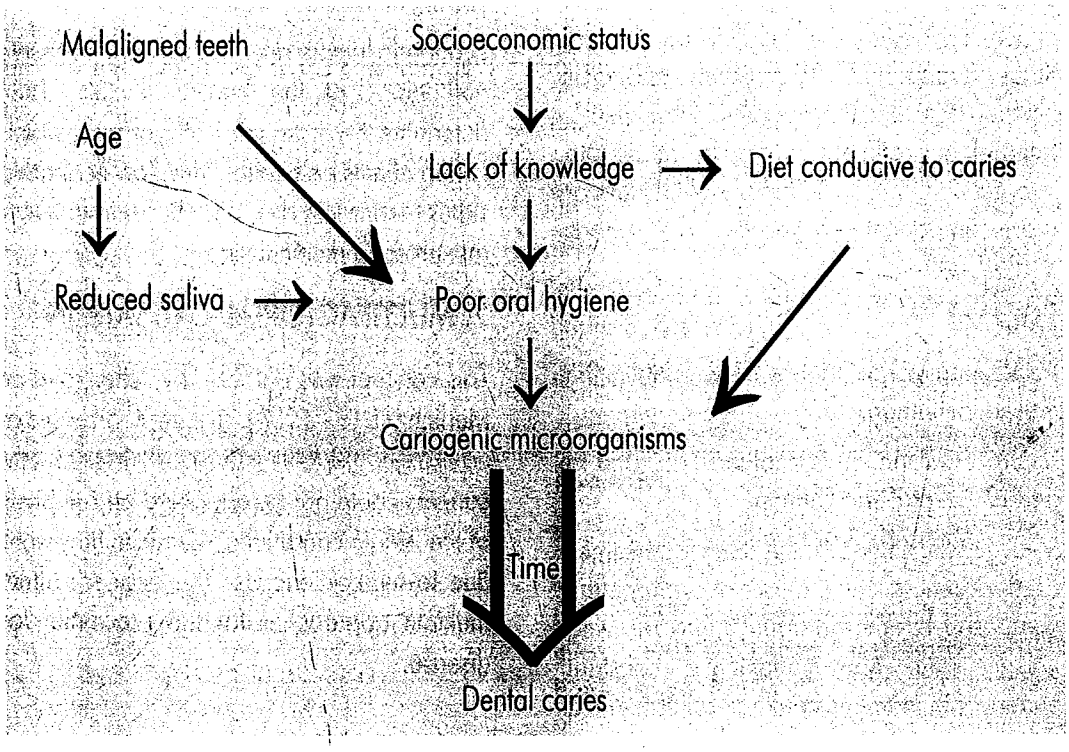
5. RISK FACTORS & RISK GROUPS

The term "risk factor' means

- An attribute or exposure that is significantly associated with the development of a disease.
- A determinant that can be modified by intervention, thereby reducing the possibility of occurrence of disease or other specified outcomes.

Risk groups are those who are exposed to risk factors.

Risk factors are often suggestive, but absolute proof of cause and effect between a risk factor and disease is usually lacking. That is, the presence of a risk factor does not imply that the disease will occur and in its absence, the disease will not occur. However, they are observable or identifiable prior to the event they predict. A combination of risk factors in the same individual may be purely additive or synergistic [multiplicative] e.g. smoking and occupational exposure [shoe leather, rubber, dye and chemical industries] were found to have an additive effect as risk factors for bladder cancer. On the other hand, smoking was found to be synergistic with other risk



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factors such as hypertension and high blood cholesterol. [The effects are more than additive.]

Risk factors may be truly causative [e.g. smoking for oral cancer]; they may be merely contributory to the undesired outcome [e.g. lack of oral hygiene is a risk factor for dental caries] or they may be predictive only in a statistical sense [e.g. poor socio-economic status for poor oral health].

Some risk factors can be modified, e.g. smoking, hypertension etc. They are amenable to intervention and are useful in the care of the individual.

Some risk factors cannot be modified, e.g. age, sex, race, family history, genetic factors etc. They are not subject to change. They act as signals in alerting health professionals to the possible outcomes.

Risk factors may characterize the individual (e.g. age, gender), the family (e.g. substandard housing), the community (e.g. presence of malaria) and the environment (e.g. air pollution). The degree of risk in these cases is indirectly an expression of need. Therefore it is stated that a risk factor is a proxy for need – indicating the need for promotive and preventive health services.

Risk approach

It is an approach developed and promoted by WHO to identify precisely the "risk groups" or "target groups" [e.g. at-risk persons, chronically ill, handicapped, elderly, children, pregnant mothers] in the population by certain defined criteria and direct appropriate action to them first.

It has been summed up as "something for all, but more for those in need — in proportion to the need". The risk approach is a managerial device for increasing the efficiency of health care services within the limits of existing resources.

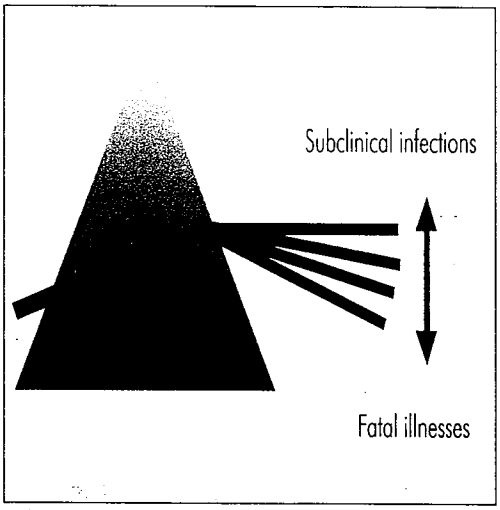
Epidemiological methods are needed to identify the risk factors and the risk groups.

6. SPECTRUM OF DISEASE

It is a graphic representation of the variations in the manifestation of disease.

It may be defined as the sequence of events that occur in the human host from the time of contact with the etiologic agent up to the point of the ultimate outcome, which may be fatal in extreme cases.

The spectrum extends from – the subclinical to the fatal. Progression through the spectrum can be decelerated or halted by preventive or therapeutic measures.

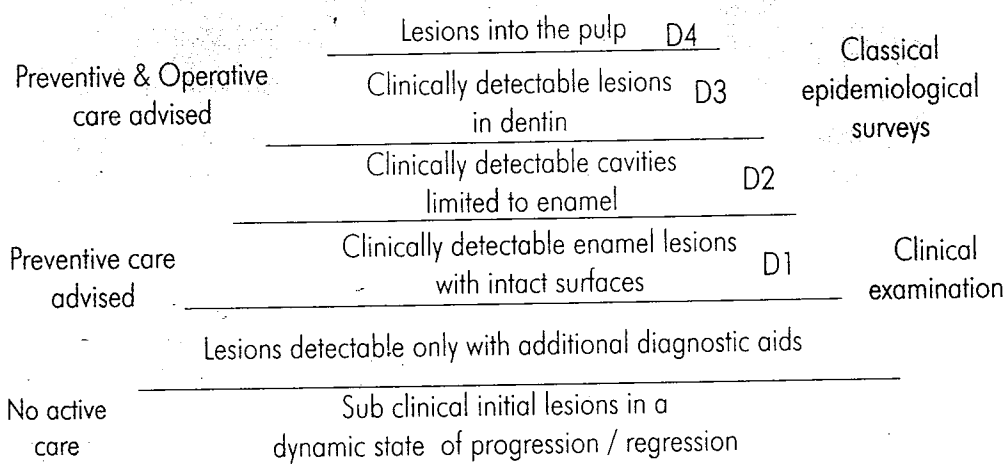


7. ICEBERG OF DISEASE

Health professionals see only a small part of the illness in the community, just as only a small part of an iceberg is visible above the surface of the water. This is what is called " the tip of the iceberg", as information on the submerged portion is not available. But the inapparent cases are important for their role in transmission. Since many inapparent infections can be transmitted and can produce disease in others, it is not sufficient to direct disease management procedures solely to clinically apparent cases.

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ICEBERG OF DENTAL CARIES



CHANGING CONCEPTS IN PUBLIC HEALTH

In the history of public health, 4 distinct phases may be demarcated:

Disease control phase: (1880 – 1920)

During the 19th century, disease control phase was a matter aimed at the control of man's physical environment. E.g. water supply, sewage disposal etc. These measures were not aimed at the control of any specific disease. However, these measures vastly improved the health of the people due to disease and death control. It was largely a matter of sanitary legislation and sanitary reforms aimed at the control of mans physical environment

Health promotional phase: (1920 - 1960)

At the beginning of the 20th century, a new concept, the concept of health promotion, began to take shape. It was realized that public health had neglected the citizen as an individual. So to overcome this, in addition to disease control activities, one more goal was added to public health, that is, health promotion of individuals. It was initiated as personal health services such as mother and child health services, school health services, industrial health services, mental health and rehabilitation services. Public health departments began expanding their programs toward health promotional activities. Two great movements were initiated for human development during the first half of the 20th century, namely,

-Provision of basic health services through the medium of primary health centres and sub centres for the rural and urban areas. The concept of health centre was first quoted in 1920, by Lord Dawson of England. In 1931, the League of Nations Health Organization called for the establishment of health centres.

-The second great movement was the community development program to promote village development through the active participation of the whole community and on the initiation of the community. Although this program failed to survive, establishment of Primary Health Centres and Sub Centres provided the much needed infrastructure for health services, especially in rural areas.

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Social engineering phase: (1960 - 1980)

With advances in preventive medicine and practice of public health, the pattern of disease began to change in the developed world. Many of the acute illness problems were solved, new health problems in the form of chronic disease began to emerge, e.g. cancer, diabetes, cardiovascular diseases, alcoholism. These problems could not be tackled by the traditional approaches to public health such as isolation, immunization and disinfection, nor could these be explained on the basis of the Germ theory of disease. A new factor " Risk factors" as determinants of these disease came into existence. Unlike the swift death brought about by acute infectious disease, chronic disease placed a chronic burden on society. This led public health more towards social factors. Public health entered a new phase in 1960's described as the social engineering phase. Social and behavioral aspects of disease and health were given a new priority. Public health moved into the preventive and rehabilitative aspects of chronic diseases and behavioral problems.

Health for all phase :(1981-2000)

Most people in the developed countries enjoy all the determinants of good health; adequate income, nutrition, education, sanitation, safe drinking water and comprehensive health care. In contrast, only 10-20% of the population in developing countries enjoy ready access to health services of any kind. The neglected 80% of the world's population too have an equal claim to health care, protection from the killer diseases of childhood and to primary health care for mothers and children.

Against this background the 30th World Health Assembly resolved in May 1977 that " the main social target of governments and WHO in the coming decades should be the attainment by all citizens of the world by the year 2000 of a level of health that will permit them to lead a socially and economically productive life." This culminated in the international objective of HEALTH FOR ALL by the year 2000.

On 12th September 1978, the joint WHO-UNICEF International Conference at Alma - Ata called for acceptance of the WHO goal of Health for All by 2000 AD and proclaimed Primary Health Care as a way to achieving Health for All.

In 1981, the 34th World Health Assembly formulated and adopted the Global Strategy for Health for all.

With the adoption of the goal of "health for all", a new public health became evident world-wide, which may be defined as" the organized application of local, state, national and international resources to achieve health for all", i.e. attainment of all people of the world by the year 2000 of a level of health that will permit them to lead a socially economically productive life.

MILLENNIUM DEVELOPMENT GOALS

At the Millennium Summit in September 2000 at New York, world leaders from 189 countries gathered to adopt the UN Millennium Declaration, committing their nations to a new global partnership to reduce extreme poverty and setting out a series of time-bound targets, with a deadline of 2015, that have become known as the Millennium Development Goals (MDGs).

The UN Millennium Project was commissioned by the United Nations Secretary-General in 2002 to develop a concrete action plan for the world to achieve the Millennium Development Goals and to reverse the grinding poverty, hunger and disease affecting billions of people. In 2005, the independent advisory body headed by Professor Jeffrey Sachs, presented its final recommendations to the Secretary-General.

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The UN Millennium Development Goals

Goal 1 : Eradicate extreme poverty and hunger

Reduce by half the proportion of people living on less than a dollar a day .

Reduce by half the proportion of people who suffer from hunger

Goal 2: Achieve universal primary education

Ensure that all boys and girls complete a full course of primary education

Goal 3: Promote gender equality and empower women

Eliminate gender disparity in primary and secondary education preferably by 2005, and at all levels by 2015

Goal 4: Reduce child mortality

Reduce by two thirds the mortality rate among children under five

Goal 5 : Improve maternal health

Reduce by three quarters the maternal mortality ratio

Goal 6 : Combat HIV / AIDS, malaria and other diseases

Halt and begin to reverse the spread of HIV/AIDS

Halt and begin to reverse the incidence of malaria and other major diseases

Goal 7: Ensure environmental sustainability

Integrate the principles of sustainable development into country policies and programs; reverse loss of environmental resources

Reduce by half the proportion of people without sustainable access to safe drinking water

Achieve significant improvement in lives of at least 100 million slum dwellers, by 2020

Goal 8: Develop a global partnership for development

Develop further an open trading and financial system that is rule-based, predictable and non- discriminatory, includes a commitment to good governance, development and poverty reduction - nationally and internationally

Address the least developed countries' special needs. This include tariff-and quota-free access for their exports; enhanced debt relief for heavily indebted poor countries; cancellation of official bilateral debt; and more generous official development assistance for countries committed to poverty reduction

Address the special needs of landlocked and small island developing states

Deal comprehensively with developing countries debt problems through national and international measures to make debt sustainable in the long term

In cooperation with the developing countries, develop decent and productive work for youth

In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries

In cooperation with the private sector, make available the benefits of new technologies especially information and communications technologies

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HEALTH FOR ALL IN THE 21ST CENTURY

In May 1998, the World Health Organization adopted a resolution in support of the new global Health for All policy. The new policy, Health for All in the 21st Century, succeeds the Health for All by the Year 2000 strategy launched in 1977.

In the new policy, the worldwide call for social justice is elaborated in key values, goals, objectives, and targets. The 10 global health targets are the most concrete end points to be pursued. They can be divided into three subgroups (see box)—four health outcome targets, two targets on determinants of health, and four targets on health policies and sustainable health systems. All member states are supposed to set their own targets within this framework, based on their specific needs and priorities.

HEALTH FOR ALL IN THE 21ST CENTURY - Global health targets

Health outcome	
1.Health equity, childhood stunting	By 2005, health equity indices will be used within and between countries as a basis for promoting and monitoring equity in health. Initially, equity will be assessed on the basis of a measure of child growth.
2.Survival, maternal mortality rates, child mortality rates, life expectancy	By 2020, the targets agreed at world conferences for maternal mortality rates (<100/100 000 live births), under 5 years or child mortality rates (<45/1000 live births), and life expectancy (>70 years) will be met.
3.Reverse global trends of five major pandemics	By 2020, the worldwide burden of disease will be reduced substantially. This will be achieved by implementing sound disease control programs aimed at reversing the current trends of increasing incidence and disability caused by tuberculosis, HIV/AIDS, malaria, diseases related to tobacco, and violence or trauma.
4.Eradicate and eliminate certain diseases	Measles will be eradicated by 2020. Lymphatic filariasis will be eliminated by the year 2020. The transmission of Chagas' disease will be interrupted by 2010. Leprosy will be eliminated by 2010 and trachoma will be eliminated by 2020. In addition, vitamin A and iodine deficiencies will be eliminated before 2020.
Determinants of health	
5. Improve access to water, sanitation, food and shelter	By 2020, all countries, through intersectoral health action, will have made major progress in making available safe drinking water, adequate sanitation, and food and shelter in sufficient quantity and quality, and in managing risks to health from major environmental determinants, including chemical, biological, and physical agents.
6.Measures to promote health	By 2020, all countries will have introduced, and be actively managing and monitoring, strategies that strengthen health enhancing lifestyles and weaken health damaging ones through a combination of regulatory, economic, educational, organizational and community based programs.

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Health policies and sustainable health systems	
7.Develop, implement, and monitor national Health for All policies	By 2005, all member states will have operational mechanisms for developing, implementing, and monitoring policies that are consistent with the Health for All policy.
8. Improve access to comprehensive, essential health care.	By 2010, all people will have access throughout their lives to comprehensive, essential, quality health care, supported by essential public health functions.
9. Implement global and national health information and surveillance systems	By 2010, appropriate global and national health information, surveillance, and alert systems will be established.
10. Support research for health	By 2010, research policies and institutional mechanisms will be operational at global, regional, and country levels.

PRIMARY HEALTH CARE

The concept of 'Primary Health Care' came into existence, following a Joint WHO-UNICEF International Conference at Alma Ata, USSR, on 12th September 1978. The Alma -Ata conference called for acceptance of the WHO goal of Health for All by 2000 AD and proclaimed primary health care as a way to achieving Health for All.

Primary health care is an approach to health care, which integrates at the community level all the factors required for improving the health status of the population.

The services provided are,

- Simple and efficient with regard to cost, techniques, and organization,
- Readily accessible to those concerned and contributes to improving the living conditions of individuals, families and the community as a whole.

Primary health care is the first level of contact of individuals, the family and the community with the national health system, where essential health care is provided.

Definition

Primary health care is defined as "Essential health care based on practical, scientifically sound and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost that the community and the country can afford to maintain at every stage of their development in the spirit of self-determination".

The primary health care approach is based on principles of social equity, nation-wide coverage, self-reliance, intersectoral coordination, and people's involvement in the planning and implementation of health programs in pursuit of common health goals. This approach has been described as "health by the people" and "placing people's health in people's hands". The concept of primary health care has been accepted by all countries as the key to the attainment of health for all by 2000 AD. The concept involves a concentrated effort to provide the rural population of developing countries with at least the bare minimum of health services.

Characteristics of primary health care

1. It is essential health care, which is based on practical, scientifically sound and socially acceptable methods and technology.
2. It should be rendered universally acceptable to individuals and the families

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in the community through their full participation.

3. Its availability should be at a cost, which the community and country can afford to maintain at every stage of their development in a spirit of self-reliance and self-development.
4. It requires joint efforts of the health sector and other health related sectors like, education, food and agriculture, social welfare, animal husbandry, housing, etc.

According to the Alma-Ata Declaration, Primary health care

a) Reflects and evolves from the economic conditions and socio-cultural and political characteristics of the country and is based on the application of the relevant results of social, biomedical and health services research and public health experience
b) Addresses the main health problems in the community, providing promotive, preventive, curative and rehabilitative services accordingly
c) Involves, in addition to the health sector, all related sectors and aspects of national and community development, in particular agriculture, animal husbandry, food, industry, education, housing, public works, communications and other sectors; and demands the coordinated efforts of all those sectors
d) Should be sustained by integrated, functional and mutually-supportive referral systems, leading to the progressive priority to those most in need
e) Requires and promotes maximum community and individual self-reliance and participation in the planning, organization, operation and control of primary health care, making fullest use of local, national and other available resources, and to this end develops, through appropriate education, the ability of communities to participate
f) Relies, at local and referral levels, on health workers, including physicians, nurses, midwives, auxiliaries, community workers, as well as traditional practitioners, suitably trained socially and technically to work as a health team and to respond to the expressed health needs of the community

Elements / components of primary health care

The Alma Ata declaration has outlined 8 essential components of primary health care,

1. Education about prevailing health problems and methods of preventing and controlling them.
2. Promotion of food supply and proper nutrition.
3. An adequate supply of safe water and basic sanitation.
4. Maternal and child health care, including family planning.
5. Immunization against infectious diseases.
6. Prevention and control of endemic diseases.
7. Appropriate treatment of common diseases and injuries.
8. Provision of essential drugs.

Principles of primary health care

1. **Equitable distribution:** The first key principle in the primary health care strategy is equity or equitable distribution of health services, i.e. health services must be shared equally by all people irrespective of their ability to pay and all rich or poor, urban or rural must have access to health services. At present, health services are mainly concentrated in major towns and cities, and the worst hit are the needy and vulnerable groups of population in rural areas and urban slums and this is termed as 'social injustice'. Primary health care aims to redress this by shifting the centre of gravity of health care system from cities to rural areas and bring these services to as near the people's

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homes as possible.

2. **Community participation:** The involvement of individuals, families, and communities in promotion of their own health and welfare is an essential ingredient of primary health care. The community must involve in the planning, implementation and maintenance of health services, besides maximum reliance on local resources such as manpower, money and materials.
   In India this has being tried successfully using village health guides and trained dais. They provide primary health care by overcoming cultural and communication barriers, in ways that are acceptable to the community. In China, 'community participation is in the form of bare-foot doctors'.
3. **Intersectoral coordination (Multisectoral approach):** An important element of intersectoral coordination is planning, i.e. planning with the other sectors to avoid unnecessary duplication of activities. The declaration of Alma-Ata states that "primary health care involves in addition to the health sector, all related sectors and aspects of national and community development, in particular agriculture, animal husbandry, food, industry, education, housing, public works, communication and other sectors". In order to achieve such co-operation, the administrative system of a country has to be reviewed, their resources reallocated and suitable legislation introduced to ensure that coordination can take place.
   The major reason for lack of success of many oral health programs is the fact that they operate in isolation, separate from general health care structure. Oral health could better be integrated into general health programs by tackling common causes, by including oral health in general health education. Moreover if oral health is to improve, more attention must be given to policies and strategies that require multisectoral co-operation and action.
   Eg.Increase the availability of fluoride & reduce the sugar exposures from medicines and other products.
4. **Appropriate technology:** Appropriate technology has been defined as "technology that is scientifically sound, adaptable to local needs, and acceptable to those who apply it and those for whom it is used, and that can be maintained by the people themselves in keeping with the principle of self reliance with the resources the community and country can afford". This applies to using costly equipments, procedures and techniques when cheaper, scientifically valid and acceptable ones are available. Example: Neem stick, mango leaf for tooth brushing are effective when used in a proper way.

The term "appropriate" signifies that beside being scientifically sound, the technology is also:

- Effective
- Acceptable to those who apply it
- Acceptable to those who use it
- In keeping with local culture
- Capable of further development
- Simple to design and use
- Easily understood by people
- Easily understood by health volunteers

5. **Focus on prevention:**

   Treatment of illness and rehabilitation are important since communities rightly expect treatment services and may be less interested in other services unless accompanied by curative services.
   Health services should however not only be curative but should also promote health and healthy lifestyles with emphasis on prevention.

PUBLIC HEALTH IN INDIA

Various national health committees have been formed by the Government of India

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from 1946 till date to provide advice about health and disease. Some of them are:

1. **Bhore Committee (1946):**
   This committee, known as "the Health Survey and Development Committee" was appointed in 1943 with Sir. Joseph Bhore as its chairman.
   It suggested one Primary Health Centre for a population of 40,000. This committee used the term 'Comprehensive Health Care' for the first time, meaning provision of integrated preventive, curative and promotional health services from 'Womb to Tomb'.
2. **Mudaliar Committee (1962):**
   This committee, known as "the Health Survey and Planning Committee" was appointed in 1959 with Dr. A. L. Mudaliar as its chairman.
   Its purpose was to survey the progress made in the field of health since the submission of the Bhore Committee's report and to recommend future development of health services.
   This committee found the quality of services at Primary health centres inadequate and advised strengthening of existing centres.
3. **Kartar Singh Committee (1973) :**
   This committee, known as "the Committee on multipurpose workers under health and family planning" was appointed in 1972 with Mr. Kartar Singh as its chairman.
   The Committee in its report recommended one health centre for a population of 50,000.
4. **Shrivastav Committee (1975):**
   This committee, known as "the group on medical education and support manpower" was appointed in 1974 with Mr. Shrivastav as its chairman.
   The committee recommended the creation of health workers from within the community itself. It also felt that one male and one female health worker should be available for every 5,000 population.
   The committee also recommended that primary health care should be provided by specially trained workers from within the community itself so that the health of the people is placed in the hands of the people themselves. This led to the launching of the Rural Health Scheme in 1977 for training community health workers.
5. **Rural Health Scheme (1977):**
   The rural health scheme which emerged out of the recommendations of the Shrivastav committee is based on a 4 tier system of services provided at the level of the village, the subcentre, the Primary Health Centre (PHC) and the Community Health Centre (CHC).

A. Village level

a) Village Health Guides Scheme
b) Training of local dais
c) Anganwadi worker (ICDS scheme)

a) Village Health Guides Scheme :

This scheme was introduced on 2nd October, 1977, and launched in all states except Kerala, Karnataka, Tamil Nadu, Arunachal Pradesh, and Jammu and Kashmir which had alternative rural health schemes systems.

A village health guide is a person with an aptitude for social service and is not a government functionary. The health guides are now mostly women. They are chosen by the community in which they work and serve as links between the community and the governmental infrastructure (i.e. they bridge the cultural and communication gap between the rural people and the organized health sector).

They should,

- Be permanent residents of the local community.
- Have a minimum formal education of at least up to VI standard.
- Be acceptable to all sections of the

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community.
- Be able to spare at least 2-3 hours every day for community health work.

After selection, they undergo training in the nearest primary health centre for 200 hours spread over a period of 3 months and receive Rs 200/- per month as stipend.

Duties assigned include :

- Treatment of simple ailments and activities in first aid
- Mother and child health including family planning
- Health education and sanitation

They do community health work of about 2-3 hours daily and get paid an honorarium of Rs 50/- per month and drugs worth Rs 600/- per annum.

The target is to have one village health guide for each village or 1000 rural population.

b) Local Dais:

Under the Rural Health Scheme, an extensive program was undertaken to train all categories of local dais (traditional birth attendants) to improve their knowledge in the elementary concepts of maternal and child health and sterilization. Training is at PHC, subcentre or MCH (Maternal and Child Health) centre for 2 days a week and remaining 4 days they accompany the Health Workers (female) to the villages, for a total of 30 working days. During training each Dai is required to conduct at least 2 deliveries under the guidance of a health worker, emphasis being on asepsis so that home deliveries are conducted under safe hygienic conditions thereby reducing maternal and infant mortality. They are expected to play a vital role in propagating small family norm.

After training, she is entitled to receive Rs. 10 per delivery and Rs. 3 for each infant registered by her.

c) Anganwadi worker :

The Integrated Child Development Services Scheme (ICDS) was started on 2nd October 1975.The administrative unit for a ICDS project is a Community Development Block in rural areas, a tribal development bock in tribal areas and a group of slums in urban areas. Anganwadi covers a population of 1000 in rural and urban and 700 in tribal areas. The child development project officer is in charge of each ICDS project

An anganwadi is run by an anganwadi worker who is selected from the community she is expected to serve, and is trained for 4 months in various aspects of health, nutrition and child development. She is paid Rs 1000 per month as honorarium for services rendered which include health check-up, immunization, supplementary nutrition, health education, non -formal preschool education and referral services. Anganwadi helpers get Rs. 500 per month.

The work of an anganwadi worker is supervised by Mukhya Sevikas who cover 20 – 25 anganwadis.

B. Sub-centre level

The sub-centre is the peripheral outpost of the existing health delivery system in rural areas. One sub-centre covers a population of 5000 in general and 3000 in hilly, tribal and backward areas. The functions of a sub-centre are limited to mother and child health care, family planning and immunization. There are two functionaries at the level of the subcentre : one male and one female multipurpose health worker. One health assistant (HA) will supervise the work of 6 health workers. Six subcentres are located in each PHC area.

C. Primary health centre level

The Bhore committee in 1946 gave the

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concept of primary health centre as a basic health unit to provide, as close to the people as possible, an integrated, curative and preventive health care to the rural population with emphasis on preventive and promotive aspects of health care. One PHC for every 30000 rural population in the plains and one PHC for every 20000 population in hilly, tribal and backward areas has been proposed for effective coverage.

At present, each primary health centre covers a population of 1,00,000 and is spread over about 100 villages. The PHCs are established and maintained by the State Governments under the Minimum Needs Program (MNP) and Basic Minimum Services Program (BMS). A PHC acts as a referral unit for 6 Sub Centres. There are 23,236 PHCs functioning as on September 2005 in the country as compared to 23,109 in September 2004.

Functions of the Primary Health Centre (PHC)

The functions of the Primary Health Centre in India covers all the 8 "essential" elements of Primary Health Care as outlined in the Alma - Ata Declaration.

They are,

1. Medical care
2. Maternal and child health (MCH) including family planning
3. Safe water supply and basic sanitation
4. Prevention and control of locally endemic diseases
5. Collection and reporting of vital statistics
6. Education about health
7. National health programs
8. Referral services
9. Training of health guides, health workers, local dais and health assistants
10. Basic laboratory services

Staffing pattern for PHC	Number
Medical Officer	1
Pharmacist	1
Nurse midwife	1
Female health worker	1
Block extension educator	1
Male Health Assistant	1
Female Health Assistant	1
Upper Division Clerk	1
Lower Division Clerk	
Laboratory Technician	1
Driver	1
Class IV workers	4

D. Community Health Centre (CHC) level

Community health centres are established by upgrading the PHCs, each CHC covering a population of 80000 to 120000 (one in each community development block) with 30 beds and specialists in surgery, medicine, obstetrics and gynecology, and pediatrics with X-ray and laboratory facilities. A CHC may be headed by a medical officer or by a Community Health Officer, a non-medical staff selected from amongst the supervisory category of staff at the PHC.

Staffing pattern for CHC	Number
Medical Officer	4
Pharmacist	1
Nurse midwife	7
Dresser	1
Laboratory Technician	1
Radiographer	1
Ward boys	2
Dhobi	1
Sweepers	3
Mali	1
Chowkidar	1
Ayah	4
Peon	1

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Urban primary health care

In order to improve the out reach of Primary Health Care, especially family planning and MCH services, in the urban slums or places inhabited by poor people, the Krishnan Committee has given recommendations for urban primary health care services in 1982.

Four types of health posts, depending upon the population of the area, are to be established under a scheme called "urban revamping scheme".

HEALTH POST	POPULATION COVERED
Type A	<5000
Type B	5000-10000
Type C	10000 to 25000
Type D	25000-50000

CONCEPTS OF PREVENTION

The goal of prevention is to promote health, to preserve health, to restore health when it is impaired and to minimize suffering and distress. Prevention can be studied under three levels,

1. Primary prevention
2. Secondary prevention
3. Tertiary prevention

Primary prevention:

Is defined as "action taken prior to the onset of disease, which removes the possibility that a disease will ever occur". Intervention is in the pre-pathogenesis phase.

Primary prevention is far more than preventing the occurrence of disease and prolonging life, it includes the concept of "positive health" – a concept that encourages achievement and maintenance of "an acceptable level of health that will enable every individual to lead a socially and economically productive life".

Primary prevention is a "Holistic" approach designed to promote health or to protect against specific disease "agents" and hazards in environment.

Advantages of primary prevention,

- Low cost
- Safe
- The individual is not yet exposed to pain and suffering.

The approaches for primary prevention recommended by WHO:

- Primordial prevention:
  It is the prevention of the emergence or development of risk factors in countries or population groups in which they have not yet appeared. The main intervention is by individual and mass education.
  Eg: Efforts directed towards discouraging children from adopting harmful lifestyles.
- Population (mass) strategy:
  It is directed at the whole population irrespective of individual risk levels so as to bring about behavioral and lifestyle changes.
  Eg:A small reduction in the average oral hygiene of a population would produce a large reduction in the incidence of dental caries.
- High-risk strategy:
  It aims to bring preventive care to individuals at special risk.

These three approaches are complimentary and should be implemented together to have an impact on the population.

Intervention is any attempt to intervene or interrupt the usual sequence in the development of disease in man. The modes of intervention in primary prevention are –

1. Health promotion
   "It is the process of enabling people to increase control over, and to improve health". It is not directed against any particular disease, but is intended to strengthen the host through a variety of interventions like,
- Health education
- Environmental modifications
- Nutritional interventions
- Lifestyle and behavioral changes

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2. Specific protection

It is the provision of conditions for normal mental and physical functioning of the human being individually and in the group. It includes the promotion of health, the prevention of sickness and curative and restorative medicine in all its aspects.

Example: Fluorides and pit and fissure sealants for caries prevention.

Secondary prevention:

Is defined as "action which halts the progress of a disease at its incipient stage and prevents complications".

The specific interventions are early diagnosis and adequate treatment.

The earlier a disease is diagnosed and treated, the better it is from the point of view of prognosis and preventing further complications or long term disability. Strictly speaking, early diagnosis and treatment cannot be considered prevention since the disease process has already started. However, it has been included under prevention because this mode of intervention will intercept the disease and prevent further complications.

Advantages:

Important in reducing the high mortality and morbidity of certain diseases like hypertension.

Disadvantages: Expensive.

Patient is already subjected to pain and suffering and the community to loss of productivity.

Tertiary prevention:

It is intervention in the late pathogenesis phase. It is defined as "all measures available to reduce or limit impairments and disabilities, minimize suffering caused by existing departures from good health and to promote the patient's adjustment to irremediable conditions".

Treatment, even in the late stages of the disease, may prevent sequelae and limit disability.

The modes of intervention are,

1. Disability limitation

The objective of disability limitation is to prevent or halt the transition of the disease process form impairment to handicap

Disease → Impairment
↓
Handicap ← Disability

Impairment is any loss or abnormality of psychological, physiological or anatomical structure or function.

Eg: Loss of teeth due to disease in a teacher.

Disability is any restriction or lack of ability to perform an activity in the manner or within the range considered normal for a human being.

Eg: Inability to talk or pronounce certain words clearly.

Handicap is a disadvantage for a given

Type of rehabilitation	Action	Example
Medical rehabilitation	Restoration of function	Provision of dentures
Psychological rehabilitation	Restoration of personal dignity and confidence	Educating and motivating him to use the denture effectively
Vocational rehabilitation	Restoration of the capacity to earn a livelihood	Getting a job again
Social rehabilitation	Restoration of family and social relationship	He is now ready to fulfill the role required of him by his family and society

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individual, resulting from an impairment or a disability, that limits or prevents the fulfillment of a role that is normal for that individual.

Eg: The teacher loses his job and becomes unemployed.

2. Rehabilitation

It is the combined and coordinated use of medical, vocational, social and educational measures for training and retraining the individual to the highest possible level of functional ability. It reduces the impact of the disabling condition and helps the person to participate actively and join the main stream.

CONCLUSION

Public health is concerned with the health problems of the community and providing promotive, preventive, curative and rehabilitative services as required. Tremendous social changes are taking place in the country and in the world. Attitudes towards health care have also changed with a growing concern that health care is a basic human right.

Now is the time for both governmental and non-governmental agencies to examine its policies in relation to education, clinical practice, research and administration, so as to produce a primary health service available to total populations in the countries of the world. Every able member of the profession should be considering not only whether certain methods can be useful, but how to make them useful for the entire population and not just for the privileged few.

DEMOGRAPHIC DATA OF INDIA

GEOGRAPHY	
Location	The Indian peninsula is separated from mainland Asia by the Himalayas. The Country is surrounded by the Bay of Bengal in the east, the Arabian Sea in the west, and the Indian Ocean to the south. India occupies a major portion of the south Asian subcontinent.
Geographic Coordinates	Lying entirely in the Northern hemisphere, the Country extends between 8° 4' and 37° 6' latitudes north of the Equator, and 68°7' and 97°25' longitudes east of it.
Indian Standard Time	GMT + 05:30
Area	3.3 million sq km Area of Karnataka state is1,91,791sq km
Border Countries	Afghanistan and Pakistan to the north-west; China, Bhutan and Nepal to the north; Myanmar to the east; and Bangladesh to the east of West Bengal. Sri Lanka is separated from India by a narrow channel of sea, formed by Palk Strait and the Gulf of Mannar.
Coastline	7,516.6 km encompassing the mainland, Lakshadweep Islands, and the Andaman & Nicobar Islands.
States and Union Territories	There are 28 states and 7 Union territories in the country
Districts	There are 604 Districts. The State of Karnataka is divided into 27 Districts

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PEOPLE

Population	India's population, as on 1 March 2001 stood at 1,028 million (532.1 million males and 496.4 million females). Estimate for 2008: 1.13 billion.
Population Growth Rate	The average annual exponential growth rate stands at 1.93 per cent during 1991-2001.
Birth Rate	The Crude Birth rate according to the 2001 census is 24.8
Death Rate	The Crude Death rate according to the 2001 census is 8.9
Life Expectancy Rate	63.9 years (Males); 66.9 years (Females) (As on Sep 2005)
Sex Ratio	933 according to the 2001 census
Ethnic Groups	All the five major racial types - Australoid, Mongoloid, Europoid, Caucasian, and Negroid find representation among the people of India
Religions	According to the 2001 census, out of the total population of 1,028 million in the Country, Hindus constituted the majority with 80.5 %, Muslims came second at 13.4%, followed by Christians, Sikhs, Buddhists, Jains, and others.
Literacy (15 and over can read and write)	According to the provisional results of the 2001 census, the literacy rate in the country stands at 64.84 per cent, 75.26% for males and 53.67% for females.

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DHULE.

GOVERNMENT

Country Name	Republic of India; Bharat Ganrajya
Government Type	Sovereign Socialist Democratic Republic with Parliamentary system of Government.
Capital	New Delhi
Administrative Divisions	28 States and 7 Union Territories
Independence	15th August 1947 (From the British Colonial Rule)
Constitution	The Constitution of India came into force on 26th January 1950.
Legal System	The Constitution of India is the fountain source of the legal system in the country.
Executive Branch	The President of India is the Head of the State, while the Prime Minister is the Head of Government, and runs office with the support of the Council of Ministers who form the Cabinet Ministry
Legislative Branch	The Indian Legislature comprises of the Lok Sabha and the Rajya Sabha forming both the houses of the Parliament.
Judicial Branch	The Supreme Court of India is the apex body of the Indian legal system, followed by other High Courts and Subordinate Courts.

ECONOMY

Total health expenditure per capita	(Intl $, 2003): 82
Total health expenditure as % of GDP	(2003): 4.8

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Chapter 2

PUBLIC HEALTH DENTISTRY

INTRODUCTION
DEFINITION
MILESTONES
CHARACTERISTICS OF PUBLIC HEALTH WORK
TOOLS OF DENTAL PUBLIC HEALTH
THE EPIDEMIOLOGIST
DUTIES OF A PUBLIC HEALTH DENTIST
IDEAL PUBLIC HEALTH MEASURE
FORMS OF DENTAL SERVICES
PUBLIC HEALTH PROBLEM
PROCEDURAL STEPS IN DENTAL PUBLIC HEALTH
PRIVATE PRACTICE & PUBLIC HEALTH DENTISTRY
ORAL HEALTH GOALS
NATIONAL ORAL HEALTH POLICY
THE INDIAN ASSOCIATION OF PUBLIC HEALTH DENTISTRY (IAPHD)
CONCLUSION

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INTRODUCTION

The history of mans fight for health begins with what little is known about his earliest existence when he was completely at the mercy of nature with no effective means of combating its hazards. Then came the slow process of learning that occupied man for centuries as he advanced in civilization. Research in medical & dental sciences has resulted in a dramatic acceleration in health knowledge. However it is rather ironical that even today dental diseases are the most common diseases and are still progressing.

This is because conventional dentistry has traditionally been curative rather than preventive. The need of the hour is a public health approach which includes a population based strategy for prevention, an intersectoral strategy for health promotion and the application of evidence based dentistry at the community level.

In public health dentistry, the individual patient is not the sole object of study. The entire community is in focus. This includes not only the sufferers from the disease, in all degrees of severity, from the subclinical to the fatal, but also those persons who are left disabled in the wake of disease.

DEFINITION

Dental Public Health: " The science and art of preventing and controlling dental diseases and promoting dental health through organized community efforts. It is that form of dental practice which serves the community as a patient rather than the individual. It is concerned with the dental health education of the public, with applied dental research and with the administration of group dental care programs as well as the prevention and control of dental diseases on a community basis."

Given by The American Board of Dental Public Health by adapting Winslow's definition (Adopted May 1976)

Oral Health

The World Health Organization (1982) defined oral health as "the retention throughout life of a functional, aesthetic and natural dentition of not less than 20 teeth and not requiring a prosthesis".

An individual may be considered as healthy if he/she has no caries or periodontal disease. However, a large majority of the population would be considered unhealthy as oral diseases are common and often untreated

An alternative definition of oral health given by U.K Department of Health (1994) is as follows:

'Oral health is a standard of health of the oral and related tissues which enables an individual to eat, speak and socialize without active disease, discomfort or embarrassment and which contributes to general well-being'

MILESTONES

Early Civilization

Efforts towards the prevention of dental disease dates back to 2600 years before Christ where an inscription on the tomb of Hesy-Re, an Egyptian scribe reads that he was "the greatest of those who deal with teeth and of physicians." This is the earliest known reference to a person identified as a dental practitioner and is often called "the first dentist".

2500 BC— Chinese civilization - H Wang-Ti devotes a chapter in his book to dental and gingival diseases.

1500 BC— Egypt: Ebers papyrus - describes oral diseases and offers a number of prescriptions for strengthening of teeth and gums.

480 BC— Hippocrates of Cos: The father of

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modern medicine discussed the functions and eruption of teeth and also the etiology of periodontal diseases.

15 BC— Aulus cornelius celsus (Roman) referred to the disease that effects the soft parts of the mouth and their treatment. Paul of Aegina (Roman) differentiated between Epulis and Parulis.

9th century A.D— The Arabs were interested in the care of teeth rather than in their extraction and replacement, and mouth hygiene was a well established technique. They used a small wooden stick, the end of which was often chewed, the wood fibres being used as a brush called "Siwak".

Late 10th century A.D— The first recognition for removal of calcareous deposits as important in control of periodontal diseases is mentioned by Abulcasis.

14th century – Guy de Chauliac records a fairly definite set of rules for oral hygiene based on Arab writings involving a number of dietary prohibitions including "viscous food such as figs and confectionery made with honey" and also directions for cleansing the teeth with a dentifrice.

Late 1400's— The first modern idea of a toothbrush is invented in China by the Chinese.

1640—Tooth brush is introduced into the Western world.

1723—Pierre Fauchard, a French surgeon publishes "The Surgeon Dentist", a treatise on teeth (Le Chirurgien Dentiste). Fauchard is credited as being the Father of Modern Dentistry because his book was the first to describe a comprehensive system for the practice of dentistry including basic oral anatomy and function, operative and restorative techniques, and denture construction.

1776— The first known case of at he post—mortem dental forensics. Paul Revere, a dentist, verifies the death of his friend, Dr. Joseph Warren in the Battle of Breed's Hill, when he identifies the bridge that he constructed for Warren.

1789—Frenchman Nicolas Dubois de Chemant receives the first patent for porcelain teeth.

1790—John Greenwood, son of Isaac Greenwood and one of George Washington's dentists, constructs the first known dental foot engine. He adapts his mother's foot treadle spinning wheel to rotate a drill.

1790—Josiah Flagg, a prominent American dentist, constructs the first chair made specifically for dental patients. To a wooden Windsor chair, Flagg attached an adjustable headrest, plus an arm extension to hold instruments.

1801—Richard C. Skinner writes the Treatise on the Human Teeth, the first dental book published in America.

1825—Samuel Stockton begins commercial manufacture of porcelain teeth. His S.S. White Dental Manufacturing Company establishes and dominates the dental supply market throughout the 19th century.

1833—The Crawcour brothers introduce amalgam in US and advertise it as a substitute for gold restorations. The American Society of Dental Surgeons denounced the use of amalgam and this is known in dental history as "amalgam wars".

1832—James Snell invents the first reclining dental chair.

1839—The American Journal of Dental Science, the world's first dental journal, begins publication.

1839—Charles Goodyear invents the vulcanization process for hardening rubber. The resulting Vulcanite, an inexpensive

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material easily molded to the mouth, makes an excellent base for false teeth, and is soon adopted for use by dentists. In 1864 the molding process for vulcanite dentures is patent Horace Hayden and Chapin Harris establish the world's first dental school, the Baltimore College of Dental Surgery, and originate the Doctor of Dental Surgery (DDS) degree. (The school merges with the University of Maryland School of Dentistry in 1923).

1840—The American Society of Dental Surgeons, the world's first national dental organization, is founded. (The organization dissolves in 1856 a enacts the first dental practice act, regulating dentistry in the United States.

1844—Horace Wells, a Connecticut dentist, discovers that nitrous oxide can be used as an anesthesia and successfully uses it to conduct several extractions in his private practice. He conducts the first public demonstration of its use as an anesthetic in 1845 but the demonstration is generally considered a failure after the patient cries out during the operation. In 1846, another dentist (and a student of Wells), William Morton, takes credit for the discovery when he conducts the first successful public demonstration of the use of ether as an anesthesia for surgery.

1854—The earliest known dental laboratory in the U.S., Sutton & Raynor, opens in New York City.

1857—The first patent for a toothbrush by H. N. Wadsworth in the United States

1859—Twenty-six dentists meet in Niagara Falls, New York, and form the American Dental Association.

1864— Sanford C. Barnum, develops the rubber dam, a simple device made of a piece of elastic rubber fitted over a tooth by means of weights, which solves the problem of isolating a tooth from the oral cavity.

1866—Lucy Beaman Hobbs graduates from the Ohio College of Dental Surgery, becoming the first woman to earn a dental degree.

1867—The Harvard University Dental School, the first university-affiliated dental institution, is founded. The school calls its degree the Dentariae Medicinae Doctorae (DMD).

1871—James B. Morrison patents the first commercially manufactured foot-treadle dental engine. Morrison's inexpensive, mechanized tool supplies dental burs with enough speed to cut enamel and dentin smoothly and quickly, revolutionizing the practice of dentistry.

1871—George F. Green receives a patent for the first electric dental engine, a self-contained motor and handpiece.

1877—The Wilkerson chair, the first pump-type hydraulic dental chair, is introduced.

1884— M.L.Rhein of New York city urges dentists to teach their patients proper tooth brushing method. He coins the term "Oral Hygiene".

1885— Dr. C. Edmund Kells of New Orleans hires the first dental assistant as a lady in attendance, so that female patients can respectfully come to his clinic unattended.

1892—Dr. Washington Sheffield of New London, Connecticut manufactures toothpaste in a collapsible tube and calls it Dr. Sheffield's Creme Dentifrice.

1895— Wilhelm Conrad Röntgen, a German physicist, discovers the x-ray.

1896—A prominent New Orleans dentist C. Edmond Kells takes the first dental x-ray of a living person in the U.S.

1899—Edward Hartley Angle classifies the various forms of malocclusion.

At the turn of the century, a well known dental

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histologist, J. Leon Williams introduces a slogan "A clean tooth never decays" which becomes the slogan of the oral hygiene campaign of the following two decades
1900—Federation Dentaire Internationale (FDI) is formed.

1901— Dr. Frederick Mckay discovers Colorado Stains in colorado springs, USA.

1905— Dr. Alfred C Fones of Bridgeport, Connecticut, trains Mrs. Irene Newman to undertake oral prophylaxis.

1913—Alfred C. Fones opens the Fones Clinic For Dental Hygienists in Bridgeport, Connecticut, the world's first oral hygiene school. Dr. Fones, uses the term "dental hygienist," to become known as the Father of Dental Hygiene.

1921—The first training school for dental nurses come into existence in New Zealand in Willington, at the urging of T. A. Hunter

1926—The Carnegie Foundation-sponsored Gies Report, the first comprehensive report on the state of dental education, is published and has an immediate impact on the dental profession.

1931— "Fluoride" is identified by H.V. Churchill in New Kensington, Pennsylvania, Smith M.C, Lantz EM, Smith H V in Arizona and by Velu H, Balozet L, in France

1931—Shoe leather survey is carried out by Trendley H Dean

1938—The nylon toothbrush made with synthetic bristles, is introduced by DuPont.

1945—The water fluoridation era begins when the city of Grand Rapids, Michigan, add sodium fluoride to their public water systems.

1948 – The World Health Organization (WHO) was formed
1950s—The first fluoride toothpastes are marketed.

1955—Michael Buonocore describes the acid etch technique, a simple method of increasing the adhesion of acrylic fillings to enamel.

1956— The oral Health Unit was established in WHO
1957—John Borden introduces a high-speed air-driven contra-angle handpiece. The airotor obtains speeds up to 300,000 rotations per minute.

1958—A fully reclining dental chair is introduced.

1959—The first electric toothbrush, the Broxodent, is introduced by the Bristol-Myers Company (now Bristol-Myers Squibb) at the centennial of the American Dental Association

1960s—Lasers are developed and approved for soft tissue procedures.

The early 1960's witnesses the development of department of community and social dentistry. The first of these units were established at Michigan and Detroit in 1962 and at Alabama and Kentucky in 1963.

1966— Medicare (title XVIII of social security act) brings medical care to the aged of the U.S without regard to income. This does not include Dentistry but the Medicaid (title XIX) does.

1969— WHO establishes the WHO oral epidemiological data bank which collects data on dental health and dental needs in many countries around the globe.

1982— International conference on the declining prevalence of dental caries is organized by Forsyth Dental Center, Boston in June.

1996— WHO establishes an Internet online oral health database, supported by the WHO Collaborating Centre in oral health at Malmo University, Sweden, and the University of Niigata, Japan. The WHO Oral Health

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Country/Area Profile Program (CAPP) aims at presenting information on oral diseases in individual countries, including data on oral health services, programs, dental education and human resources.

Milestones in the Indian Context

1000 BC (Indian civilization) – Sushrutha Samhita – numerous descriptions of severe periodontal disease with loose teeth and purulent discharge.

Charaka Samhita - Stressed on tooth brushing - the stick for tooth brushing, should be bitter, pungent or astringent. One of its ends should be chewed in the form of a brush and should be used twice a day taking care that gums are not injured. Neem twigs (Datun) are used even today.

The Father of dentistry in India is considered to be Dr. Rafiuddin Ahmed, who was born on December 24, 1890 and later became the 1st president of the Indian Dental Association (then known as All India Dental Association).

1920— Dr. R. Ahmed founded the first dental college of India, which was financed by starting the New York Soda Fountain in Calcutta.

1925— Dr. R. Ahmed establishes the Bengal Dental Association and establishes the Indian Dental Journal.

1939— Dr. R. Ahmed helps to form the Bengal Dentists Act, which was the first dental governmental regulation in India

1948— Dentist act is passed by the Indian parliament in close association with All India (Now, Indian) Dental Association on the 29th of March 1948. This Act was introduced to regulate the profession of dentistry in India. The Act was amended on 1st July 1955 to make the law applicable to the state of Jammu and Kashmir.

1971— Mr. Orango started the Department of Community Dentistry at Government Dental College, Bangalore under Dr. Mohandas Bhat.

1988— National Oral Health Care Program, (NOHCP) a project of DGHS and Ministry of Health & Family Welfare is initiated to improve the oral health of the masses and to prevent/ reduce the burden of oral disease in the country.

1995— The redrafted Oral Health Policy is accepted in principle as a part of the National Health Policy during the Fourth Conference of Central Council of Health & Family Welfare.

2002-2003— National oral health survey was carried out by the Dental Council of India.

CHARACTERISTICS OF PUBLIC HEALTH WORK

1. Recognition of group responsibility

Public health work exhibits a certain number of characteristics that are different from individual practice in the same field. Most important is the fact that public health work must be done in areas where group responsibility is recognized. This concept led first to quarantine and isolation procedures and later to mass preventive measures.

2. Public health work relies on team effort

Large groups of people can be handled much easier as a team, in institutional surroundings with systematic allocation of many procedures to properly supervised auxiliary personnel. Also, many processes involved in prevention lend themselves particularly well to teamwork.

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3. Prevention of disease is the main goal

Prevention is a major objective of public health programs because of 3 reasons.

The first reason is ethical. That prevention of disease is an even greater good in life than the cure of the disease.

The second reason is the advantage of teamwork

The third reason is cost-efficiency, since prevention is economical than cure.

4.Concept of medical indigence

Medical indigence constitutes an inability to pay large bills for medical care. This situation is chiefly found in the case of chronic diseases, where the life savings of otherwise independent people are easily wiped out. E.g. The treatment procedures for cancer is expensive. Public health dentistry makes oral health care available to every individual irrespective of their socioeconomic status, by obtaining governmental or non governmental funding.

5. Disease is considered a multi-factorial problem

Public health work deals with all sorts of problems involving the host population and the environment beyond the range of the individual professional. The disease is no longer considered a phenomenon caused by one agent within the individual patient, but can be studied on a community-wide basis and can be recognized as a multi-factorial problem.

6. Dependence on the biostatistical method

The presence of a disease in an individual patient can usually be described on a yes or no basis. This same disease would probably be present at all times in a large population group, its frequency affected by a multiplicity of factors.

Since changes in the prevalence of disease can be measured only by observations over a number of years, the time factor becomes important to accurately measure rates. Mathematical measurement of probability becomes necessary to find out whether differences between rates are real or are merely chance phenomenon.

7. Public health worker deals with the healthy as well as the apparently healthy.

The public health worker in his efforts to attain prevention of disease deals with healthy or apparently healthy people as well as with the sick. This brings a cheerful, hopeful atmosphere to the work.

In addition, it also brings with it certain problems. The worker must go looking for minimal disease, instead of waiting for frank disease to come to him. He must adapt himself to those testing methods, which can be used effectively on large populations. He must also learn to take more satisfaction from the recognition and interception of early disease than from the control of advanced disease.

From the public's point of view, it requires a stretch of the imagination to realize the need for periodic health examination and to accept preventive measures, especially for those diseases, which do not have disabling or fatal effects.

8. Adaptation of programs to community culture

When public health agencies become involved in the delivery of care to people in disadvantaged or isolated locations, attention should be given to the location of and transportation to health care facilities. Care should be brought as

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close as possible to where the people are normally concentrated, hence the advantage of neighborhood health centers, or of school based dental care facilities for school children.

Whenever certain health measures which are contrary to accepted cultural patterns are introduced in the community, people are known to react in an apparently strange manner. The social sciences such as cultural anthropology and social psychology helps in understanding why people react in this manner, thus helping in adapting public health programs to community culture.

TOOLS OF DENTAL PUBLIC HEALTH

1. Epidemiology

It is a scientific study of factors, conditions related to disease as they occur in people. The word epidemiology is derived from the word epidemic (epi = among, demos = people and logos = study).

Last in 1988 defined epidemiology as "the study of the distribution and determinants of health-related states or events in specified populations and the application of this study to the control of health problems"

The aims of epidemiology are to minimize or eradicate the disease or health problem and its consequences and to promote the well being of society as a whole.

2. Biostatistics

Statistics is the science of compiling, classifying and tabulating numerical data and expressing the results in a mathematical or graphical form. Biostatistics is that branch of statistics concerned with mathematical facts and data relating to biological events.

Medical statistics is a further specialty of biostatistics, when the mathematical facts and data are related to health and prevention of disease.

The uses of biostatistics are the following ;

- To define normalcy.
- To test whether the difference between two populations, regarding a particular attribute is real or a chance occurrence.
- To study the correlation or association between two or more attributes in the same population.
- To evaluate the efficacy of vaccines, sera etc. by control studies.
- To locate, define and measure the extent of morbidity and mortality in the community.
- To evaluate the achievements of public health program
- To fix priorities in public health programs.

3.Social sciences

Social sciences usually include sociology, cultural anthropology and psychology.

The public health worker, when he embarks upon organized community effort, is very dependent upon the group behavior of the individuals, determined by their culture. It is one of the important developments in public health during the last decade that the social scientists have been called in to aid in adapting new health programs to existing cultural patterns.

The social scientist becomes necessary when effort and effect do not match each other and we want to know why. He helps us in the assessment of the process, our program is using or plans to use in finding out how well this process fits with the socio-cultural system of the group with which we are working.

4.Principles of administration

The dentist with a leadership role in public health program needs to know many of the principles by which large

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enterprises are administered. There are two main areas into which administrative work may be divided – Organization and Management.

Organization deals with the structure of an agency and the way people are arranged into working groups within it.

Management is concerned with the handling of personnel and operations in such a way that the work of the agency gets done.

5.Preventive dentistry

It is, in its broadest sense, all of dentistry and encompass those practices by individuals and communities that affect oral health status. An interesting concept in thinking about preventive measures for any disease is that of "levels of prevention". These are primary, secondary and tertiary.

Primary prevention includes – Health Promotion (health education) and Specific Protection (immunization, hygiene)

Secondary prevention involves – Early diagnosis and prompt treatment.

Tertiary prevention involves – Disease control which includes disability limitation, which is prevention to the extent that the sequelae and complications of the disease are minimized.

THE EPIDEMIOLOGIST

Any person who researches into the occurrence of disease or disability in groups of people, is called as an "Epidemiologist".

According to Smillie, an epidemiologist should have the following qualifications,

1. He should be familiar with statistical techniques.
2. He should be well grounded in the diagnosis of disease.
3. He should be thorough with the history of medicine, particularly that portion which relates to epidemics of disease.
4. He should have good knowledge of bacteriology, immunology and physiology in relation to the various environmental factors that may influence the health of individuals.
5. He must have a real knowledge of the principles of prevention. The epidemiologist is essentially a planner. It is he, who must determine when an epidemic of disease starts and when it has ceased to exist. He should design measures, which will prevent future epidemics.

DUTIES OF A PUBLIC HEALTH DENTIST

1. Health education and motivation of the individual or community for improving their oral health and for availing dental services.
2. Delivering dental treatment to the community through organized dental health camps especially in rural areas and for the dentally indigent.
3. Providing dental prophylaxis and other oral hygiene measures, including instructions in home care of the mouth.
4. Application of caries preventive measures such as topical applications of fluorides, pit and fissure sealants as well as delivering dental care for children through the school health programs.
5. Demonstration of new dental preventive methods and procedures to the community.
6. Conducting dental public health activities and field experiences for dental students.
7. Participating in community activities like

- Proposal to build a new school building.
- Fluoridation of drinking water supply.
- Expansion of recreational facilities for children.
- Building a community health centre.
- To discuss community health problems.

IDEAL PUBLIC HEALTH MEASURE

All ideal public health measures should be –

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1. Of proven efficacy in the reduction of the targeted disease.
2. Medically and dentally safe.
3. Easily and efficiently implemented, utilizing a relatively small amount of materials, supplies and equipment.
4. Readily administered by non-dental personnel
5. Attainable by beneficiaries regardless of their socio-economic, educational, income and occupational status.
6. Readily available and accessible to large numbers of individuals.
7. Inexpensive, therefore affordable by the majority.
8. Uncomplicated and easily learned by the utilizers.
9. Administered with maximum acceptance and minimum compliance on the part of the patient.

FORMS OF DENTAL SERVICES

1. Private practitioners, i.e. dentists and dental auxiliaries.
2. Non-governmental dentists and dental auxiliaries partly or entirely remunerated by the government.
3. Dentists and dental auxiliaries employed by the government such as defence services
4. Health insurance

Central Library, 3289
A.C.P.M. Dental College,
DHULE.

There is no universal governmental health insurance in India. It is at present limited to Industrial workers and their families

- Employees State Insurance Scheme (ESI): This was introduced in 1948 based on the principle of contribution by the employee and the employer, with grants from the central and state governments. The act covers all employees drawing wages not exceeding Rs. 7500 per month. It provides coverage to employees and their dependents in case of sickness, maternity and employment injury.
- Central government health scheme: It provides health insurance, to Central Government employees.

5. Private institutions

Forms of dental services as defined by A.W Jong is

1. Services provided by dentist and dental auxiliaries and financed by the patient or a source other than the government.
2. Services provided by non-government dentists and dental auxiliaries partly or entirely remunerated by the government.
3. Services provided by dentists and dental auxiliaries employed by the government such as military personnel.

PUBLIC HEALTH PROBLEM

The criteria which determine what constitutes a public health problem are:

1. A condition or situation that is a widespread actual or potential cause of morbidity or mortality, i.e., a disease or other threat to health is widespread.
2. Consequences to the community are severe.
3. There is a body of knowledge about this situation that, if applied, would prevent, ameliorate or cure this condition or situation, i.e., it is known how to prevent, alleviate or cure this condition.
4. The costs, both financial and psychological, to the community are great.
5. There is a perception on the part of the public, the public health authorities or the government that the condition is a public health problem.

Once a public health problem is identified, programs can be designed to tackle it.

PROCEDURAL STEPS IN DENTAL PUBLIC HEALTH

1. Survey

The survey constitutes the first step in the

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present day public dental health procedure. The focus of attention in a survey is the population rather than an individual.

Surveys are methods for collection of data, analyzing and evaluating them in order to determine the amount of disease problems in a community and also to identify cases that have not been identified.

Various parameters may be included in a survey like the assessment of the socioeconomic status of the community, the nature of distribution of the community, the health problems of the community, the resources available for eliminating the problem and attitudes of the community towards oral health.

2. Analysis

The second procedural step in dental public health is analysis of the data collected from a survey. Information collected through a survey is subjected to an analysis in order to define the characteristics of specific health problems in the community. Since in dental public health, the health care provider is interacting with groups of people it is necessary to arrange or organize the data in such a way that meaningful figures are obtained. The science of statistics is applied to arrive at the common descriptive constants like the mean, median, mode and standard deviation in order to achieve a correct diagnosis or to arrive at an accurate analysis.

3. Program Planning

After the problem and its characteristics are analyzed, the next step is program planning. The main objective of any public health professional is to have the designed program accepted by the community and that the people should show an interest in it.

Here it is the community that makes the decision of accepting or rejecting the program. The decision made by the community usually reflects the relative values they place on solving the particular problem in comparison to other problems in the community, which are in need of attention. Hence it has to be ensured that the community is well informed about the program and that they participate in all the steps involved.

4. Program operation

When a specific public health program has to be adopted for a community, a public health team, which constitutes of professionals in various disciplines, has to be employed for executing the program.

This can be best illustrated with the example of water fluoridation in a community with high prevalence of dental caries and a low level of fluoride content in their water supply. To fluoridate the water, several disciplines have to work together as a team. The dentists will have the responsibility of preparing the baseline data with regard to the prevalence of dental caries. The engineers will design the equipments needed for fluoridating the water supply, whereas the chemists will analyze the water samples for its fluoride content. The public health authorities and the water works department will have the responsibility of addition of fluoride into the water supply and the periodical maintenance of the same.

5. Financing

Financing in public health programs are usually through the funds provided by the governments or by the local or state authorities. Before the starting of a public health program, the public health personnel have to identify the source for securing the funds and also should plan for the management of the same. Many public dental health programs have been conducted successfully through the financial aid provided by local foundations and local service clubs.

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6. Program Appraisal

This is the final step in any public health program where the effectiveness of the program is assessed. The baseline data collected prior to the introduction of the public health program serves as an indicator against which the effectiveness of the program can be assessed. The dimensions used for program appraisal are efficiency, appropriateness, adequacy, possible side effects etc.

The public health dentist is accountable to the community for the periodic appraisal of the program.

PRIVATE PRACTICE & PUBLIC HEALTH DENTISTRY

Although the individual practitioner and the public health professional are both concerned with patients and disease, their approaches are different.

Knutson has outlined the following differences between the procedures employed by a clinician in treating a individual patient and a public health dentist providing community health care. According to Knutson it is the nomenclature of the activities that varies while the procedure is basically the same

INDIVIDUAL PATIENT	COMMUNITY
1. Examination	Survey
2. Diagnosis	Analysis
3. Treatment planning	Program planning
4. Treatment	Program operation
5. Payment for service	Finance
6. Evaluation	Appraisal

	PRIVATE PRACTICE	PUBLIC HEALTH DENTISTRY
1.	The individual dental practitioner usually deals with one patient at a time	The public health professional deals with an entire group or population. He considers disease as a mass phenomenon
2.	The patient comes to the practitioner	The public health practitioner goes to the patient
3.	The patients can & do pay for the services rendered	The public health professional usually has to depend on outside sources for funding of the expenses
4.	Services provided are usually immediate & visible	Deals with issues focusing on prevention, which may prove to be beneficial in the long run Eg, fluoridation programs, health education
5.	The individual practitioner is concerned only about the patient suffering from the Disease	The public health professional takes into account, not only persons suffering from disease, but also those not suffering from it. He makes a community diagnosis to provide community measures for prevention and control
6.	The individual practitioner is more concerned with the period of pathogenesis	For the public health professional, the period of pre pathogenesis is more important
7.	The individual practitioner's concern about the environment is very limited	The public health professional studies in detail the environmental aspects of disease

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ORAL HEALTH GOALS

WHO and FDI goals for oral health

In 1981, WHO and the FDI World Dental Federation jointly formulated goals for oral health to be achieved by the year 2000.

A review of these goals established that they had been useful and, for many populations, had been achieved or exceeded. However, for a significant proportion of the world's population, they remained only a remote aspiration. Nonetheless, the Oral Health Goals had stimulated awareness of the importance of oral health in general. Therefore, even though not all countries had achieved the goals, they provided a key focus for the effort.

Indian goals for oral health

In 1984, the Indian Dental Association formulated the Oral Health Goals for India and strategies to achieve them by the year 2000 A. D with participation from WHO, FDI and APDF/APRO

Indian goals for oral health

For dental caries

GOAL 1	Age group of 5yr	Present dft rate of 7 to 8 should be brought down to dft 3-4.
GOAL 2	Age group of 12-13yrs	Percentage of caries free teeth should be increased. Present average DMFT of 4.5 should be reduced to 2.5
GOAL 3	Age group of 15-9yrs	Mean number of sound teeth should be increased to 24.
GOAL 4	Age group of 35-44yrs	Percentage of people with natural teeth should increase to 75-80% from the present 40 %

For periodontal disease

GOAL 1	Age group 1-14	- Preschool children - < 6 yr - 50 % shall be free from gingival bleeding. -School going children – 6-14 yrs - 50 % shall be free from gingival bleeding & calculus. -At 14 yrs - Not more than 10 % shall exhibit pocketing greater than 3 mm
GOAL 2	Age group 15-29	-60 % shall not exhibit pocketing exceeding 4 mm with particular emphasis between 25 & 29 yrs.
GOAL 3	Age Group 30-44	-40 % shall not exhibit pocketing exceeding 5 mm.
GOAL 4	Age Group 45-59	-30 % shall not exhibit pocketing exceeding 6 mm.
GOAL 5		-A data based system for monitoring changes in oral health to be established

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WHO and FDI goals for oral health

GOAL 1	50% of 5-6 year-olds to be free of dental caries.
GOAL 2	The global average to be no more than 3 DMFT at 12 years of age.
GOAL 3	85% of the population should retain all their teeth at the age of 18 years.
GOAL 4	A 50% reduction in edentulousness among the 35-44-year-olds, compared with the 1982 level.
GOAL 5	A 25% reduction in edentulousness at the age of 65 years and over, compared with the 1982 level.
GOAL 6	A database system for monitoring changes in oral health to be established.

Global Goals for Oral Health for the year 2010

(Hobdell MH, Myburgh NG, Kelman M, Hausen H.)

GOAL 1	A complete electronic global, nation-based WHO database for oral health and coordinated general health database will be established
GOAL 2	90 % of 5 yr old will be caries free
GOAL 3	Children will not have more than 2 DMFT at 12 yrs.
GOAL 4	75 % of the 20 yr olds will be caries inactive
GOAL 5	75 % of the 20 yr old will not develop destructive periodontal disease
GOAL 6	More than 75 % of all children and young adults will have sufficient knowledge of etiology and prevention of oral diseases to motivate self-diagnosis and self care

The FDI, WHO and IADR global goals for oral health 2020

(Martin Hobdell, Poul Erik Petersen, John Clarkson, Newell Johnson)

- These goals present a range of possible areas that need to be taken into consideration when each country develops its plans for oral health
- There should be a clear understanding of what resources are available or might become available once the plan is adopted officially
- Prioritization of the oral problems of the community should be done
- This will help in identifying those type of interventions that are most appropriate and sustainable under the prevailing circumstances

GOALS:

1	To minimize the impact of diseases of oral and craniofacial origin on health and psychological development, giving emphasis to promoting oral health and reducing oral disease amongst populations with the greatest burden of such conditions and diseases
2	To minimize the impact of oral and craniofacial manifestations of systemic diseases on individuals and society and to use these manifestations for early diagnosis, prevention and effective management of systemic diseases

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OBJECTIVES:

1	To reduce mortality from oral and craniofacial diseases
2	To reduce morbidity from oral and craniofacial diseases and thereby increase the quality of life
3	To promote sustainable, priority driven policies and programs in oral health systems that have been derived from systematic reviews of best practices
4	To develop accessible cost-effective oral health systems for the prevention and control of oral and craniofacial diseases
5	To integrate oral health promotion and care with other sectors that influence health, using the common risk factor approach.
6	To develop oral health programs that will empower people to control determinants of health
7	To strengthen systems and methods for oral health surveillance, both processes and outcomes
8	To promote social responsibility and ethical practices of care givers
9	To reduce disparities in oral health between different socioeconomic groups within a country and inequalities in oral health across countries
10	To increase the number of health care providers who are trained in accurate epidemiological surveillance of oral diseases and disorders

TARGETS

By the year 2020, the following will have been achieved over baseline:

1	Pain	-A reduction of X% in episodes of pain of oral and craniofacial origin ·A reduction of X% in the number of days absent from school, employment and work resulting from pain of oral and craniofacial origin ·A reduction of X% in the number of people affected by functional limitations (Eg: missing teeth, traumatized incisors) ·A reduction of X% in the prevalence of moderate and severe social impacts on daily activities resulting from pain, impairments and esthetics
2	Functional disorders	·A reduction of X% in the numbers of individuals experiencing difficulties in chewing, swallowing and speaking / communicating
3	Infectious diseases	·To increase by X% the numbers of health care providers competent to recognize and minimize the risks of transmission of infectious diseases in the oral health care environment
4	Oro-pharyngeal cancer	·To reduce by X% the prevalence of oro-pharyngeal cancer

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		·To improve by X% the 5-year survival rate of treated cases ·To increase early detection by X% ·To increase rapid referral by X% ·To reduce exposure to risk factors by X% with special reference to tobacco, alcohol and improved nutrition ·To increase by X% the number of affected individuals receiving multi-disciplinary specialist care
5	Oral manifestations of HIV infections	·To reduce by X% the prevalence of opportunistic oro-facial infections ·To increase by X% the number of health providers who are competent to diagnose and manage the oral manifestations of HIV infection ·To increase by X% the numbers of policy makers who are aware of the oral implications of HIV infection
6	Noma	·To increase by X% data on Noma from populations at risk · To increase early detection by X% ·To increase rapid referral by X% ·To reduce exposure to risk factors by X% with special reference to immunization coverage or measles, improved nutrition and sanitation ·To increase by X% the number of affected individuals receiving multidisciplinary specialist care
7	Trauma	·To increase early detection by X% ·To increase rapid referral by X% ·To increase the number of health providers who are competent to diagnose and provide emergency care by/to X/Y% ·To increase by X% the number of affected individuals receiving multidisciplinary specialist care where necessary
8	Craniofacial anomalies	·To reduce exposure to risk factors by X% with special reference to tobacco, alcohol, teratogenic agents and improved nutrition ·To increase access to genetic screening and counseling by X% ·To increase early detection by X% ·To increase rapid referral by X% ·To increase by X% the number of affected individuals receiving multidisciplinary specialist care ·To increase early detection of seriously handicapping malocclusions and their referral by X%
9	Dental caries	·To increase the proportion of caries free 6-year-olds by X% ·To reduce the DMFT particularly the D component at age 12 years by X%, with special attention to high-risk groups within populations, utilizing both distributions and means ·To reduce the number of teeth extracted due to dental caries at ages 18, 35-44 and 65-74 years by X%

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10	Developmental anomalies of teeth	·To reduce the prevalence of disfiguring dental fluorosis by X% as measured by culturally sensitive measures and with special reference to the fluoride content of food, water and inappropriate supplementation ·To reduce the prevalence of acquired developmental anomalies of teeth by X% with special reference to infectious diseases and inappropriate medications ·To increase early detection by X% for both hereditary and acquired anomalies ·To increase referral by X% for both hereditary and acquired anomalies
11	Periodontal diseases	·To reduce the number of teeth lost due to periodontal diseases by X% at ages 18, 35-44 and 65-74 years with special reference to smoking, poor oral hygiene, stress and inter-current systemic diseases ·To reduce the prevalence of necrotizing forms of periodontal diseases by X% by reducing exposure to risk factors such as poor nutrition, stress and immuno- suppression ·To reduce the prevalence of active periodontal infection (with or without loss of attachment) in all ages by X% ·To increase the proportion of people in all ages with healthy periodontium by X%
12	Oral mucosal diseases	·To increase the number of health care providers who are competent to diagnose and provide emergency care by X% ·To increase early detection by X% ·To increase rapid referral by X%
13	Salivary gland disorders	·To increase the number of health care providers who are competent to diagnose and provide emergency care by X% ·To increase early detection by X% · To increase rapid referral by X%
14	Tooth loss	·To reduce the number of edentulous persons by X% at ages 35- 44 and 65-74 years ·To increase the number of natural teeth present by X% at ages 18, 35-44 and 65-74 years ·To increase the number of individuals with functional dentitions (21 or more natural teeth) by X% at ages 35-44 and 65-74 years
15	Health care services	·To establish evidence-based plans to create human resources that can provide care that are appropriate to the cultural, social, economic and morbidity profiles of all groups within the population
16	Health care information systems	·To increase the proportion of the population with access to adequate oral health care by / to X / Y% ·To increase the proportion of the population covered by satisfactory information systems by/to X / Y%

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THE NATIONAL ORAL HEALTH POLICY

The National Oral Health Policy has been formulated by the "Dental Council of India", through the inputs of two national workshops organized in 1991 and 1994 at Delhi and Mysore respectively. These workshops considered the recommendations of national workshops on oral health goals for India, Bombay 1984 and a draft oral health policy prepared by Indian Dental Association in 1986. As a follow up measure of these efforts, the core committee appointed by the Ministry of Health and Family Welfare, could succeed to move the resolution in the fourth conference of the Central Council of Health and Family Welfare in the year 1995. The Council has brought out a ten point resolution,

1. There is an urgent need for an Oral Health Policy for the nation as an integral part of the National Health Policy.
2. Special, well coordinated, National Oral Health Program be launched to provide oral health care, both in the rural as well as in the urban areas due to deteriorating oral health conditions in the country as revealed by various epidemiological studies. Dentist/population ratio in the rural areas is only 1:300,000, whereas, 80% of the children and 60% of the adults suffer from dental caries. More than 90% of the adult community after the age of 30 years suffer from periodontal disease which also has its inception in childhood. In addition, 35% of all body cancers are oral cancers. A large segment of the adult population is toothless due to the crippling nature of dental diseases and about 35% of the children suffer from malaligned teeth and jaws affecting proper functioning. In view of these facts, it is important to launch preventive, curative and educational oral health care program integrated into the existing system utilizing the existing health and educational infrastructure in the rural, urban and deprived areas.
3. A post of full time Dental Advisor at appropriate level in the Directorate General of Health Services (Dte.G.H.S.) should be created as a first step towards strengthening the technical wing of the Dte.G.H.S.
4. Studies have revealed that dental diseases have been increasing both in prevalence and severity over the last few decades. There is, therefore, an urgent need to prevent the rising trend of dental disease in India. The method used for primary prevention of dental diseases aims at achieving primary prevention of periodontal diseases and oral cancers.
5. The council, therefore, resolves that preventive and promotive oral health services be introduced from the village level onwards and accordingly a pilot project on oral health care may be launched by the Ministry of Health and Family Welfare during 1995-96 in five districts, one each in five States.
6. The Council further resolves that legislative measures be adopted to ensure a statutory warning on the wrappers and advertisement of sweets, chocolates and other retentive sugar eatables TOO MUCH EATING SWEETS MAY LEAD TO DECAY OF TOOTH. Similar measures are also called for tobacco and pan masala related products.
7. The Council recommends that a National Training Centre be established or the existing centres be strengthened for training of various categories of oral health care personnel.
8. The Council also resolves that all District Hospitals and Community Health Centres have dental clinics. All dental

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colleges should have courses on Dental Hygienists and Dental Technicians.

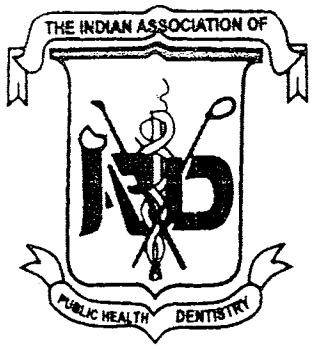
9. The Council further resolves that the pilot project may be extended to all the states at the rate of one district in every state.
10. The Council also resolves that there is an urgent need to have a National Institute for Dental Research to guide oral health research appropriate to the needs of the country.

The Ministry of Health and Family Welfare, Government of India accepted in principle the National Oral Health Policy in the year 1995 to be included in the National Health Policy. In pursuance to National Oral Health Policy, a 'National Oral Health Care Program' has been launched as a "Pilot Project" to cover five States (Delhi, Punjab, Maharashtra, Kerala and North eastern States) for its implementation. To begin with, one district in each of these States was chosen to test run the strategies evolved through 2 national and 4 regional workshops organized in the country.

THE INDIAN ASSOCIATION OF PUBLIC HEALTH DENTISTRY (IAPHD)

In the early 1990's, a small group of like-minded people shared a common dream of enhancing the discipline of public health dentistry in India. They felt the need for providing a common platform for exchange of views and information and development of meaningful and effective preventive programs for the community. India is a developing country where 74% of the population reside in rural areas, with only 20% of the health professionals to serve them. Most of the health care facilities including oral health are oriented towards treatment or curative aspects rather than prevention or health promotion. With this background the need culminated in formation of association registered as INDIAN ASSOCIATION OF PUBLIC HEALTH DENTISTRY with the aim of enhancing oral health of the Indian community through team effort.

The emblem



The emblem of the Indian Association of Public Health Dentistry is a symbolic expression of the service to humanity by improving the oral health of the public. The crown of the molar represents the weapon of the oral cavity i.e. teeth. The mouth mirror and probe represents the oral health survey of human beings in any area, i.e. rural or urban or semi urban. The lotus represents enlightenment, brightness and is the symbolic representation of the national flower indicating improvement of overall health.

The central wand with entwined snakes symbolizing Greek and Roman Gods of Health, called Hermes and Mercury, is adapted as the symbol of modern medical science. This carries symbols of the emblem of the staff of Aescalapius with wings of serpents encircling around it. The staff of Aescalapius stands for the captor of authority and represents the professional authority of the association. The serpents show the power of healing. Since serpents were regarded as sacred by Aescalapius, he is symbolized in modern medicine by a staff with two serpents entwined around the staff in opposite directions. The wings of the staff represents the spread of knowledge.

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The association conducts National Conferences and P. G. Conventions every year. The association also conducts competitive essay writing for undergraduate students, the prizes for the best essay being given at the conference. Prizes are also awarded for scoring the highest marks in the subject of Preventive and Community Dentistry during the undergraduate course.

CONCLUSION

Public health dentistry offers to whole populations a means of preventing dental disease and maintaining a mouth with sound teeth and healthy supporting gums and bone throughout the life of an individual.

The world, both in the technically advanced and developing countries, is undergoing a social revolution in community health and it is suggested by Mahler, Director General of WHO (1978), that this revolution can be considered under four headings covered by the word STEP - social, technical, economic and political.

1) Social :

The community itself must take the principal role in dental health care activities.
It is the dental profession's responsibility to teach and motivate whole communities to carry out daily preventive dental health routines and to co-operate by becoming involved in the planning, operation and maintenance of primary dental health care services. The people must be motivated to use preventive measures themselves from birth to old age to keep healthy teeth in a healthy mouth.

2) Technical:

3289

Dental health is not a specific entity but an integral part of national development. Dental schools must produce dentists who are also able to render primary oral health care. This is in accordance with the dental health policy statement of the FDI, which "encourages member associations and dental personnel to give priority to the broad application of all known procedures for preventing oral diseases and conditions through their own programs of oral health education or through appropriate community or government sponsored programs".
In India, oral health education should be made part of the training program of health guides, health workers, anganwadi workers and school teachers. Dentists or medical doctors with appropriate oral health information should act as leaders of the whole health team and should impart the oral health education.

3) Economical:

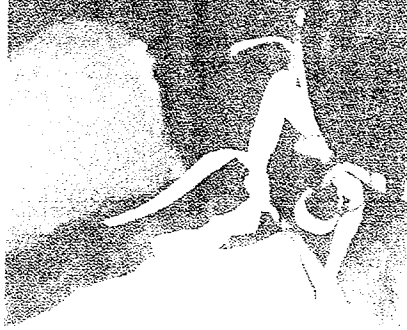
Those responsible for dental health care services must develop systems which utilize the resources available to provide a level of dental health care for everyone. Many countries show that a high proportion of their dental health budget is spent on a small proportion of the population. A sound dental health manpower program must be integrated with the planning of the health services in each country, to be equally spread over the entire population.

4) Political:

Primary health care cannot be developed without the full support of national resources. Every country must budget for and supply the infrastructure and resources needed in order to provide a health service based on primary health care to its people.
For primary dental health care to become a practical proposition, every country must show the political will to examine its health priorities in relation to the social needs of its total population. It then needs a practical plan to cover the whole country, which will receive the support of the people.

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Chapter 3

GENERAL EPIDEMIOLOGY

INTRODUCTION

DEFINITION

HISTORY

AIMS OF EPIDEMIOLOGY

PRINCIPLES OF EPIDEMIOLOGY

TOOLS OF MEASUREMENT

EPIDEMIOLOGICAL METHODS

- DESCRIPTIVE EPIDEMIOLOGY
- ANALYTICAL EPIDEMIOLOGY
- EXPERIMENTAL EPIDEMIOLOGY

USES OF EPIDEMIOLOGY

ASSOCIATION AND CAUSATION

CONCLUSION

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INTRODUCTION

The word epidemiology is derived from the Greek word, Epidemic. Epi = upon, demos = people and logos = study or science.

Epidemiology covers not only the study of disease distribution and causation but also of health and health related events occurring in human populations. By identifying risk factors of chronic diseases, evaluating treatment modalities and health services, epidemiology provides new opportunities for prevention, treatment planning and improving the effectiveness and efficiency of health services.

DEFINITION

Parkin (1873) defines epidemiology as "the branch of medical science which deals with the treatment of epidemics ".

MacMahon (1960) defines epidemiology as "the study of the distribution and determinants of disease frequency in man".

John M. Last (1988) defines epidemiology as "the study of the distribution and determinants of health related states or events in specified populations, and the application of this study to the control of health problems".

The definition given by Last is found to be the one most commonly used in literature.

HISTORY

Epidemiology has its origins in the idea first expressed by Hippocrates, that environmental factors can influence the occurrence of disease. The first known epidemiologist was Hippocrates (460-375 B.C). He was probably the first to apply reason to the study of the phenomena of diseases and epidemics. " No disease," he said," is sent by evils or demons, but is the result of natural causes"; each disease has its own and manifest cause. He conceived the relationship between habit, physique, weather and disease.

The scientific method which was lost to the world of medicine for 500 years after the death of Hippocrates, was revived by Claudius Galen (130 - 200 A.D), a Greek, who lived in Rome. Galen wrote that " reason alone discovers some things; experience alone discovers some things; but to find others, requires both experience and reason".

In the 17th century, Thomas Sydenham, (1624 - 1689) a London physician, stressed the importance of careful clinical observation. He wrote the history of disease and was called the "father of english medicine, or the English Hippocrates ".

As a pioneer in the field of epidemiology, John Snow (18131858) is considered as the "Father of Epidemiology". Dr. John Snow developed an interest in the epidemic of cholera in London, in August 1854. He investigated many instances of its occurrence in sporadic cases and outbreaks in the period between 1848 and 1854. He traced the source of the 1854 cholera outbreak in the Soho neighborhood of London. The statistical analysis of the affected cases showed that the drinking water was the vessel for transmission of the disease. He found that cases occurred in homes which obtained their water from the Broad Street pump, which was at the center of the outbreak.

The report published in 1855 is a remarkable example of closely reasoned inferences from careful observations, which led to the determination of cause of cholera and its modes of transmission. This stands as the first ever conducted epidemiological study. John Snow's achievement was based on his logical organization of observations, his recognition of a natural experiment, and his quantitative approach in analyzing the occurrence of a disease in a human population. Snow's investigation of the cholera epidemic occurred years before the identification of the vibrio that causes cholera.

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Similar reasoning was employed by William Budd (1811 - 1880) who carried out a study on typhoid fever.

One of the first dental field studies was reported in Britain in the Naval Chronicle of 1803. Sir John Lincour had collected details of the health habits and dental state of 96 old men all aged over 80 years (ex-service pensioners).

Edwin Saunders, a young dentist carried out what was probably the first systematic dental epidemiology in Britain, studying eruption of teeth between ages of 9 and 13. In 1837 he addressed his findings to parliament in a report entitled, "The teeth a test of age", considered with reference to the factory children.

Towards the end of the 19th century, the public health aspects of dentistry were investigated by William Fisher. Following the publication of his paper, "compulsory attention to the teeth of school children" (Fisher, 1885), a committee was appointed by the British Dental Association to investigate child dental health by epidemiological methods. The studies were carried out between 1890 and 1897, and the subsequent reports were an important step towards the initiation and development of a School Dental Service.

The story of the association of fluoride in drinking water with typical enamel opacities and prevalence of dental caries is an excellent example of epidemiological techniques. The effect of all these epidemiological studies was to produce a major public health advance to the control of caries by the artificial adjustment of fluoride deficient drinking water to the optimum level.

Epidemiologists are constantly in the field observing disease and conditions in the populations, seeking unexpected differences between groups that may provide another public health advance.

AIMS OF EPIDEMIOLOGY

The International Epidemiological Association has listed three main aims of epidemiology, which was put forward by Lowe & kostrzewski in 1973 as follows:

1) To describe the size and distribution of the disease problems in human populations
2) To provide the data essential for the planning, implementation and evaluation of health services for the prevention, control and treatment of diseases and for the setting up of priorities among those services
3) To identify etiological factors in the pathogenesis of disease.

PRINCIPLES OF EPIDEMIOLOGY

The principles of epidemiology as a scientific field of science are related to the basic principles of science. The four important principles are:

1. Exact Observation (strict, vigorous, accurate, precise)
2. Correct Interpretation (free from error)
3. Rational Explanation (intelligent, sensible, reasonable)
4. Scientific Construction (by expert knowledge and technical skill)

TOOLS OF MEASUREMENT IN EPIDEMIOLOGY

The most commonly used tools of measurement in epidemiology are;

1) Rates
2) Ratios
3) Proportions

1. RATE

A rate is the frequency of a disease or characteristic expressed per unit size of the population or group in which it is observed. The time at or during which the cases are observed is a further specification needed for epidemiologic purposes.

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A rate measures the occurrence of some particular event (development of disease or the occurrence of death) in a population during a given time period. It is a statement of the risk of developing a condition. Rates are obtained by collecting the number of cases of a particular condition (numerator) and dividing this figure by the total population at risk (denominator).

Rate

$$\frac{\text{Number of events (deaths or disease) in a specified period}}{\text{Population at risk of experiencing the event or disease}} \times 10^n$$

As seen in the formula, three items of information are necessary for a rate to have epidemiologic usefulness - the numerator of the fraction (the number of persons affected), the denominator (the population among whom the affected persons are observed) and a specification of time. The denominator is commonly called the related or reference population.

For e.g.: Let us take the prevalence of caries in 5000 school going children. During oral examination out of this 5000 children 2000 children had caries, therefore, the prevalence rate of caries

$$= \frac{2000}{5000} \times 1000 = 400/1000$$

In rate the numerator also forms a part of the denominator. In the 5000 school going children which is the denominator, 2000 have the disease and 3000 are normal. In a rate there is a multiplier. Here it is 1000. It is expressed per 1000 or some other round figure selected so as to avoid fractions

The different categories of rates are the following;

a. Crude Rates :These rates are the actual observed rates such as the birth and death rates.
b. Specific Rates : These rates are the actual observed rates of diseases due to specific causes or diseases occurring in specific groups or diseases during specific time periods.
c. Standardized Rates : These rates are obtained by direct or indirect method of standardization or adjustment like the age and sex standardized rates.

The common examples for rates are; birth rate, death rate, fertility rate, reproduction rate, growth rate, marriage rate etc.

2. RATIO

Ratio denotes the relation in size between two random quantities. In a ratio, the numerator is not a part of the denominator.

Eg: The incidence of gingivitis in pregnant women is 20/1000 and in non pregnant women it is 10/1000 then the gingivitis ratio in written as

gingivitis in pregnant women : gingivitis in non pregnant women.

That is 20 : 10 or 2:1.

In simpler terms, the ratio can be expressed as the result of one quantity divided by the other and is usually represented by the formula

$$A : B \text{ or } \frac{A}{B}$$

E.g: The ratio of dentist to population in a state in India is 1: 10,000 or 1/ 10,000, which means that for every 10,000 people there is one dentist.

3. PROPORTION

A proportion is a ratio which expresses the relation in magnitude of a part of the whole. In a proportion, the numerator is always a part of the denominator. It is usually expressed in a percentage. For eg:

$$\frac{\text{The no. of school children with dental caries at a certain time}}{\text{The total no. of children in the school at the same time}} \times 100$$

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BASIC MEASUREMENTS IN EPIDEMIOLOGY

The basic requirement of epidemiology is a definition of what is to be measured and what criteria or standards are to be used for measuring it.

The most commonly used measurements in epidemiology are;

1. Measurement of Mortality.
2. Measurement of Morbidity.

MEASUREMENT OF MORTALITY

Mortality is the condition of being mortal, or susceptible to death.

As a major component of population change, mortality is an integral part of demography. Most epidemiological studies begin with the mortality data, as they are relatively easy to collect and as they provide the starting point for majority of epidemiological studies. The level of mortality in a region or of a subpopulation is also used as a public health indicator.

The various measures of mortality are,

a) Crude Death Rate : It is defined as "the number of deaths per 1000 people in a population in a given year". It is considered as the simplest measure of mortality and is given by the formula;

$$\text{Crude death rate} = \frac{\text{Number of deaths during the year in a population}}{\text{Mid-year population}} \times 1000$$

It measures the rate at which deaths occur from various diseases or causes in a given population during a specified period.

b) Specific Death Rate: A specific death rate measures the number of deaths among people in a category per 1000 people in that category in a given year. The specific death rates can be a) cause or disease specific as in the case of cancer, myocardial infarction, road accidents etc. and b) related to specific groups like sex-specific death rate. The specific death rates can be expressed in formulas such as;

$$\text{Specific death rate due to oral cancer} = \frac{\text{Number of deaths from oral cancer during an year}}{\text{Mid-year population}} \times 1000$$

c) Age-Specific Death Rate : It is the death rate specific to a given age group. It can be represented by the formula,

$$\text{Specific death rate in the age group of 45 - 65 years} = \frac{\text{Number of deaths in persons aged 45 - 65 years during an year}}{\text{Mid-year population of persons aged 45-65 years}} \times 1000$$

d) Case Fatality Rate : Case fatality rate represents the killing power of a disease. This is usually used in cases of acute infectious diseases. It is given by the formula,

$$\text{Case fatality rate} = \frac{\text{Total number of deaths due to a specific disease}}{\text{Total number of cases due to the same disease}} \times 100$$

e) Proportional Mortality Rate: It is defined as "the number of deaths due to a particular cause per 100 or 1000 total deaths". These rates are used when population data are not available.

f) Standardized Rates : It is defined as "the overall rates adjusted for the effects of differences in population composition" (such as in age, sex). This is done in cases where we want to compare the death rates of two populations, with different age composition. The standardization can be done by two methods: Direct

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Standardization and Indirect Standardization.

g) Infant Mortality Rates : The number of deaths among infants under one year of age per 1000 live births. (Conventionally births and deaths are measured in the same year). For a cohort based measure, the rate includes the death under one year of age per 1000 live births.

FACTORS AFFECTING MORTALITY RATE

The following are the various factors that affect the mortality rates;

1. Birth rate : A high birth rate is often associated with a high infant mortality rate and maternal mortality rate. Conversely, a low birth rate is related to low mortality rates.
2. Density of population: High population density generally indicates an aggregation of industry, over crowded and inferior housing, poverty and large families, and an increased risk of infection and accidents. Alternatively low population density implies the healthier environment of rural areas or well- to-do urban districts.
3. Geographical: Lowest mortality rates occur in temperate parts of the world and in the most quiet and undisturbed areas of individual countries.
4. Season: Winter with its cold, snow, wet, wind and fog influences mortality rates. High humidity is also found to have its effect on mortality.
5. Epidemic experience: National mortality rate will exceed expectation if a serious epidemic affects the community. Local mortality rates are unfavorably affected by a local epidemic or similar occurrence
6. Secular variation: Incidence of some diseases and mortality therefrom varies in time. Such secular variation may be due to influence of many factors including Alterations in diagnostic criteria, variation in size or make up of population and in level of detection of disease, apart from any real change in incidence or mortality experience.

MEASUREMENT OF MORBIDITY

WHO has defined 'Morbidity' as "any departure, subjective or objective, from a state of physiological well-being".

According to the WHO Expert Committee on Health Statistics, morbidity can be measured based on three units, such as,

a) Persons who were ill.
b) The illnesses or diseases these persons experienced.
c) The duration of these illnesses or diseases.

USES OF MORBIDITY DATA

1. They are used to describe the extent and nature of the disease in the community, and thus assist in the establishment of priorities.
2. They are useful in providing more comprehensive and more accurate and clinically relevant information on patient characteristics that can be obtained from mortality data and are therefore essential for basic research.
3. They serve as a starting point for etiological studies, and thus play a crucial role in disease prevention.
4. They are needed for monitoring and evaluating disease control activities.

Three aspects of morbidity namely, the frequency, the duration and the severity can be measured using the morbidity rates and ratios.

The disease frequency is measured by means of 'Incidence' and 'Prevalence'.

INCIDENCE

Incidence can be defined as "the number of new cases of a specific disease occurring in a

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defined population during a specified period of time". In other words, the incidence of a disease is the number of new cases of the disease, which come into being during a specified period of time. The incidence rate is this number per specified unit of population. Incidence is usually expressed as a rate, that is, cases per population per time. It can range from zero to infinity. Incidence can be represented by the formula;

Incidence =

$$\frac{\text{Number of new cases of a specific disease during a given time period}}{\text{The population at risk}} \times 1000$$

For example if there had been 590 new cases of oral cancer reported in a population of 75,000 in a year, the incidence rate of oral cancer would be

$$= \frac{590}{75{,}000} \times 1000$$

= 7.87 per 1000 per year. Incidence rate is the rate of occurrence of new cases arising in population conveniently expressed per unit time interval, for example per year. The two different varieties of incidence are,

- Episode incidence
- Cumulative incidence

Episode incidence is the rate of occurrence of new episodes of a disease arising in population. This can be usefully applied to conditions where previous episodes may only be weakly reported.

Cumulative incidence is similar to incidence but the time interval is expressed as a fixed period and result is expressed as a proportion.

In practice, it is not possible to measure incidence directly, since the exact time of onset of an illness is uncertain. Instead, such occurrences as onset of symptoms, time of diagnosis, or date of notification or hospitalization is measured.

SPECIAL INCIDENCE RATES

The special incidence rates are the

- Attack rate and
- Secondary attack rate

Attack Rate:

It is an incidence rate which is used only when the population is exposed to risk for a limited period of time as in the case of an epidemic. Attack rate gives information on the number of cases in the population at risk and can be represented by the formula

Attack rate =

$$\frac{\text{Number of new cases of a specific disease during a specified time interval In a population}}{\text{The total population at risk during the same time interval}} \times 100$$

Secondary Attack Rate

It is a measure in which the numerator consists of the number of cases of a disease, which occur within the same household following the occurrence of a first or primary case. It can be defined as "the number of persons exposed to the risk factor for developing the disease within the range of the incubation period following exposure to a primary case".

It is usually used in studies of infectious disease and there is a stated or implied time limitation that, on the basis of the incubation period of the particular disease, indicates that the secondary cases probably derived from the primary case.

USES OF INCIDENCE RATES

1. It gives clues to research into the etiology and pathogenesis of disease.
2. It helps with the study of distribution

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of disease.

3. It helps in taking action to control the disease.
4. It is useful in evaluating the efficacy of preventive and therapeutic measures.

An increase in the incidence rate of a disease is indicative of failure or ineffectiveness of the preventive or control program for that particular disease. It might also suggest the need for a new disease control or preventive program. Any change or fluctuation in the disease incidence is suggestive of a change in the etiology of the disease like the change in the agent, host and environmental characteristics.

PREVALENCE

The term 'disease prevalence' is used to indicate all current cases (both old and new) existing in a given population at a given point in time, or over a period of time".

Last has given a broader definition of prevalence as "the total number of all individuals who have an attribute or disease at a particular time (or during a particular time period) divided by the population at risk of having the attribute or disease at this point in time or midway through the period". It is usually expressed as a percentage of the population, and can range from 0 to 100%.

Prevalence is of two types,

- Point Prevalence and
- Period Prevalence.

Point Prevalence:

It can be defined as "the number of all current cases (both old and new) of a specific disease at one point in time in relation to a defined population". The 'point in time' in point prevalence can be either a day or few days or even few weeks, depending upon the time taken to examine the sample of the population.

The point prevalence is the frequency of the disease at a designated point in time.

$$\text{Point Prevalence} = \frac{\text{Total number of all current cases (old \& new) of a specific disease at a given point in time}}{\text{Estimated total population at the same point in time}} \times 100$$

The numerator includes all persons having the disease at the given moment, irrespective of the length of the time, which has elapsed from the beginning of the illness to the time when the point prevalence is measured. The denominator is the total population (affected and unaffected) within which the disease is ascertained. In contrast to incidence rates, which measure events, point prevalence rates are measures of what prevails or exists.

Period Prevalence :

Period prevalence can be defined as "the total number of existing cases (old and new) of a specific disease during a defined period of time (e.g. annual prevalence) expressed in relation to defined population.

Period Prevalence is a measure that expresses the total number of cases of a disease known to have existed at some time during a specified period. It is the sum of the point prevalence (the number of cases existent at the beginning of the period) and the incidence (the number of cases coming into existence during the period).

$$\text{Period Prevalence} = \frac{\text{Total number of existing cases of a specific disease during a given period of time interval}}{\text{Estimated mid-interval population at risk}} \times 100$$

For eg: If we had conducted a survey on the oral health status of 15,000 school children in a city, in January 1998 and found that 3750 school children had gingivitis, the prevalence of gingivitis in this population of school children in January 1998 will be =

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$$\frac{3750}{15,000} \times 100 = 25\%.$$

Limitations of prevalence rate

Prevalence is not the ideal measure for studying disease etiology or causation of disease.

Uses of prevalence rates :

1. Prevalence rates are useful in estimating the magnitude of disease or health problems in the community.
2. Prevalence rates are helpful in identifying the potential high-risk populations.
3. Prevalence rates are useful in administrative and planning purposes like, assessing manpower needs in health services, delivery of health services etc.

The prevalence rate is increased by:

1. Longer duration of the disease.
2. Prolongation of life of patients without cure.
3. Increase in new cases. (Increase in incidence)
4. In-migration of cases.
5. Out-migration of healthy people.
6. In-migration of susceptible people.
7. Improved diagnostic facilities. (Better reporting of cases).

The prevalence rate is decreased by:

1. Shorter duration of the disease.
2. High case-fatality rate from the disease.
3. Decrease in new cases. (Decrease in incidence).
4. In-migration of healthy people.
5. Out-migration of cases.
6. Improved cure rate of cases.

Relationship between prevalence & incidence

Prevalence is dependent on two factors, the incidence and duration of the disease. Assuming that the population is stable, the incidence value and the duration is unchanging, a relationship can be brought out as,

Prevalence = Incidence X Mean duration.
$(P = I X D)$

From the above relationship, we can bring out a converse relationship as;

$$\text{Incidence} = \frac{\text{Prevalence}}{\text{Duration}}$$

$$\text{Duration} = \frac{\text{Prevalence}}{\text{Incidence}}$$

From the above equation, $P = I X D$, it can be made out that, as the duration of the disease increases, the greater will be it's prevalence.

Changes in prevalence from one time period to another, can result from changes in incidence, changes in duration of disease or both.

EPIDEMIOLOGICAL METHODS

The three types of epidemiological studies or methods are,

1. Descriptive Epidemiology
2. Analytical Epidemiology
3. Experimental Epidemiology

The three types of epidemiological methods complement one another. The descriptive and analytical studies are often called as 'observational studies'.

The work done by McKay, Dean and others in discovering the occurrence of mottled enamel and later correlating these findings to the fluoride content of water and finally with the occurrence of dental caries, represents the " Descriptive Stage "of the study. The hypothesis they formulated that the adjustment of the water supply to 1 part per million of fluoride provides safe and acceptable caries control, represents the stage of " Formulation of Hypothesis ".

The studies done on the caries - fluorine

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hypothesis in areas of natural fluoride water constitutes the " Analytic Phase ".

The construction of citywide field trials of water fluoridation and the devising of better mechanical means for both fluoridation and defluoridation of large and small water supplies constitutes the " Experimental Phase " of epidemiology.

DESCRIPTIVE EPIDEMIOLOGY

Descriptive studies are usually the first phase of any epidemiological investigation. These studies are concerned with the observation of the distribution of the disease or any health related events in human populations and the identification of the characteristics with which the disease or condition under study seems to be associated. Descriptive epidemiology is used to aid in the conceptualization and quantification of the disease status of the community.

A descriptive study is one that attempts to do no more than describe the pattern of occurrence of a disease or a condition relative to other characteristics of the population. For example, a study conducted for measuring the degree of dental caries in a school district relative to the age, sex and socioeconomic characteristics of the children, without attempting to explain why those particular distributions were found would be a descriptive study.

The various steps involved in a descriptive study are,

1. Defining the population to be studied.
2. Defining the disease under study.
3. Describing the disease in terms of
   a) Time
   b) Place
   c) Person
4. Measurement of the disease.
5. Comparing with known indices.
6. Formulating an etiological hypothesis.

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1. DEFINING THE POPULATION TO BE STUDIED

This forms the first step in a descriptive epidemiological study. The population selected for the study has to be defined in terms of the total number and the composition of the individuals within the population in terms of characteristics such as, age, sex, occupation, culture, socio-economic characters etc.

The "defined population" can either be the total population in a geographic area or a representative sample taken from that population. It can also be special groups such as the age and sex groups, school children, factory workers, hospital patients etc. The population thus defined should be large enough to make characteristics like age, sex etc. meaningful. The population or the community selected for the study should always remain stable, without any migration into or out of the area.

The most essential ingredient of a descriptive epidemiological study is the participation of the people of the community chosen for the study. Another important ingredient is the presence of a health facility in close proximity to the community, which can cater to the patients requiring medical services. The concept of a 'defined population' is very much important in any epidemiological study. The importance of it is that it forms the population at risk, which provides the denominator for calculating the rates of frequency and distribution of the disease.

2. DEFINING THE DISEASE UNDER STUDY

After the population to be studied is defined, the next step is to define the disease under study. The disease needs to be defined with an 'operational definition' which is a definition with which the disease or condition can be identified and measured in the defined population with a degree of accuracy. This

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type of a definition will be precise and valid for the epidemiologist and helps him to identify people with the disease from those who do not have the disease. The diagnostic methods adopted for the study should be acceptable and applicable to the population to be studied

An operational definition clearly indicates the criteria by which the disease can be measured. In the study of diseases which do not have pathognomonic signs and symptoms, the epidemiologist will have to frame his own definition, keeping the objectives of his study in view and aiming at a degree of accuracy, sufficient for this purpose.

3. DESCRIBING THE DISEASE UNDER STUDY

This step is used to describe the occurrence and distribution of the disease by the time of its occurrence, the place of occurrence and the persons who are affected with the disease.

3A. TIME DISTRIBUTION

Time may be measured in terms of hours, days, week, month, year, etc. Three types of time fluctuations or time trends have been observed in the occurrence of disease, which are as follows,

1. Short-term fluctuations
2. Periodic fluctuations.
3. Long-term fluctuations or secular trends.

SHORT-TERM FLUCTUATIONS

The best example of a short-term fluctuation is an 'epidemic'. An epidemic can be defined as "the occurrence of cases of an illness or other health related events in a region or a community clearly in excess of normal expectancy".

There are three major types of epidemics, which can be classified as follows,

A. Common source epidemics :
   a) Single exposure or 'point source' epidemics.
   b) Continuous or multiple exposure epidemics.
B. Propagated epidemics :
   a) Person-to-person.
   b) Arthropod vector.
   c) Animal reservoir.
C. Slow or Modern epidemics

Common source epidemics

a) Single exposure or 'point source' epidemics.

"Point source epidemics" are the response of a group of people to a source of infection or contamination to which they were exposed almost simultaneously. The resultant cases all develop within one incubation period of the disease. Point epidemics results in large and fleeting excess in disease frequency. An example of a single exposure or point source epidemic will be food poisoning. The contaminated food stuff results in an outbreak of food poisoning in those people who have consumed it from the single source.

The common-source epidemics need not be always due to exposure to an infectious agent. It can also result from other causes like the environmental pollution for which the 'Bhopal gas tragedy' in India is a classic example. If the epidemic continues over one incubation period, there are chances of either a continuous or multiple exposure to a common source or a propagated spread.

b) Continuous or multiple exposure epidemics.

These are the common source epidemics in which the exposure from the same source might be prolonged - can be continuous, repeated or intermittent - need not be at the same place or at the same time. Example of this type of epidemic is a well of contaminated water. In this case, the resulting epidemic tends to be more extended or irregular.

An epidemic may also be initiated from a

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common source and then continue as a propagated epidemic.

Propagated epidemics

a) Person-to-person.
b) Arthropod vector.
c) Animal reservoir.

Propagated epidemics are most often of infectious origin and usually results from person to person transmission of the infectious agent. Epidemics of hepatitis A and poliomyelitis are examples of propagated epidemics due to person to person transmission. This type of epidemic usually exhibits a gradual rise and then tails off over a much longer period of time. The process of transmission of the infectious agent continues until the number of susceptible persons becomes reduced or the susceptible persons are no longer exposed to infected persons.

The propagated type of epidemic usually occurs in places where large number of susceptible individuals are aggregated or where there is a regular supply of new susceptible persons, which tends to lower the herd immunity.

Slow or modern epidemics

The concept of an epidemic in the past was to describe an acute outbreak of infectious disease. More recently importance has been given to 'excessive prevalence' as the basic implication in an epidemic. This characteristic is exemplified by many noninfectious diseases as well as by diseases known to be associated with microorganisms.

The time distribution of epidemic cases can be represented graphically as an "epidemic curve". The epidemic curve is suggestive of a time relationship with exposure to a suspected source and a cyclical or seasonal pattern which indicates a particular infection and the common source or the propagated spread of the disease.

Eg: HIV/AIDS

PERIODIC FLUCTUATIONS

Periodic fluctuations in the time distribution is of two types,

1. Seasonal variations / trends

Seasonal variations or trends is a prominent feature of infectious disease occurrence. For example, measles and varicella are usually found with their peak incidence during the early spring season. Similarly, upper respiratory tract infections show an increase during the winter season and the gastrointestinal tract infections have a seasonal rise during summer months. The seasonal variation in disease occurrence can be attributed to changes in environmental conditions like, temperature, humidity, rainfall, overcrowding etc.

2. Cyclic trends :

Certain diseases appear in cycles, which may be spread over short periods of time like, days, weeks, months or years. As an example, incidence of measles appeared in cycles of major peaks every 2-3 years, before vaccines were invented against it. Non-infectious conditions also show periodic fluctuations, e.g., automobile accidents are known to be more frequent on week ends, especially on saturdays.

LONG - TERM OR SECULAR TRENDS

Secular changes refers to changes in disease frequency that occur gradually over long periods of time. Oral cancer is an example of a disease which has shown a consistent upward trend during the past 50 years in many of the developed countries, whereas, diseases like tuberculosis, typhoid fever, polio and diphtheria have shown a downward trend.

3B. PLACE DISTRIBUTION

Variation in the frequency of different diseases from place to place has long been identified. Knowledge of the geographic

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distribution of disease has obvious utility for administrative purposes and has contributed importantly to many hypotheses of etiology. The study of the pattern of disease distribution among different populations reveals variations in disease pattern not only between countries, but also within the same country. The geographic pattern of disease provide clues about the etiology of disease.

The distribution of disease according to place can be classified as,

International variations

Descriptive studies conducted world-wide have shown that the pattern of disease occurrence varies from country to country. It is a known fact that cancer prevails in every part of this world. However, there exists differences in the incidence of various types of cancer in different parts of the world. Certain types of cancers are more commonly seen in some parts of the world while some other parts have less incidence or no incidence at all.

Oral cancer has the highest incidence in countries like India, Bangladesh, Srilanka and Pakistan, whereas, it is relatively rare in the western world. The World Health Organization has played a major role in the improvement and dissemination of international statistics related to health.

National variations

It is observed that variations in disease occurrence exist within the same country or national boundaries. Death statistics and notifications of infectious diseases are the major source of data for comparisons within countries. In India, a wide number of conditions like endemic goitre, malaria and fluorosis, show national variation with some parts of the country affected more and other parts less affected or not affected at all. This information is helpful in identifying the affected areas to be demarcated and to provide necessary health care services.

Rural-urban variations

It is a well established fact that health and disease are not equally distributed in urban and rural populations. Diseases like chronic bronchitis, lung cancer, cardio-vascular diseases, drug addiction, psychological problems and accidents are usually found to be more in the urban areas, whereas, skin and zoonotic infections and soil transmitted helminthes are found more commonly in rural areas. The variations in the disease pattern can be attributed to factors like, differences in the social classes, population density, levels of sanitation, deficiencies in medical care, levels of education and other environmental factors which influence the occurrence of disease.

Local distributions

Distribution of disease can also vary within cities or towns. Inner and outer city-variations in disease frequency are best studied with the aid of 'spot maps' or 'shaded maps'. These maps show at a glance areas of high or low frequency, the boundaries and patterns of disease distribution. For example if the map shows "clustering" of cases, it may suggest a common source of infection or a common risk factor shared by all the cases.

MIGRANT STUDIES

If it is observed that a disease is associated with residence in a particular geographic area or region, it is of interest to know what duration of residence in the area is necessary for the acquisition of susceptibility to the disease and how long the susceptibility is maintained by residents after leaving the area. This information may help to pinpoint the age at which the responsible factors are operative, as well as to provide information on the length of the latent period.

Migration of human populations on a large scale from one country to another country provides the opportunity to evaluate the role of possible genetic and environmental factors

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in the occurrence of disease in a population.

Migrant studies are usually of two types,

a) Comparing the rate of occurrence of disease and the death rate for migrants with those of their kin who have stayed at home. Such type of a migrant study permits the comparison of genetically similar groups, living under different environmental conditions or exposures. If the rate of disease occurrence and death rates in migrants are similar to that of the country of adoption over a period of time, it can be attributed to the environment.

b) Comparing the migrants with the local population of the host country provides valuable information on the genetically different groups living in a similar environment. If the rates of disease occurrence and death rates among the migrants are similar to their country of origin, it can be attributed to genetic factors.

3C. PERSON DISTRIBUTION

In descriptive epidemiology, the disease is further described by defining the persons affected by the disease in terms of their age, sex, occupation, ethnic origin, marital status, social class, habits, family history and other host factors. These factors help in understanding the natural history of disease. The host factors which influence the disease pattern in an individual are,

Age

In most diseases the variations in frequency that occurs between different age groups are greater than those found with any other variable. Knowledge of age associations is important for two reasons : first, it may assist in understanding the factors responsible for the development of disease and second, age may produce indirect effects that must be taken account of. Certain diseases are more prevalent in specific age groups. For example, measles usually occurs in childhood, cancer in the middle age and atherosclerosis in old age. Dental caries is generally believed to be a "disease of childhood".

Knowledge of age associations is also useful for administrative purposes like helping assign services to needy parts of population or community.

Bimodality

Is the occurrence of two separate peaks in the age incidence of a disease. It indicates, first of all, that the material is not homogenous - that the entity under examination might probably be divided into two. Bimodality even suggests the existence of causal differences other than that on which the classification of disease is based.

An example of a disease exhibiting 'bimodality' is dental caries, which is usually found in children as pit and fissure caries and in the older age group as root caries.

Gender

Various dental diseases and conditions have shown variation in their frequency between males and females. In the case of oral cancer, studies have reported that females have less incidence than males.

Ethnic group / ethnicity

This term is usually used to designate subgroups of a population that, because of a common ancestral or cultural background, have a genetic or environmental milieu, or both, more homogenous than that of the population at large. The homogenicity may be expressed in a disease pattern that differs from the usual illness pattern of the general population. The term ethnic group usually implies some degree of common ancestry in the group, but it may not necessarily account for a particular group's distinctive disease

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pattern.

The ethnic group can be identified in terms of race, religion, place of birth or combinations of the three. In some countries like USA, the most frequently used criterion of ethnic group is their race, whereas, in some other countries like India, religion has been used as an index of ethnic group.

The example for diseases exhibiting variations in their frequency with regard to ethnicity include tuberculosis, coronary heart disease, cancer and sickle cell anemia.

Occupation

Occupation is of greater usefulness in formulating causal hypothesis than age, gender or ethnic group. Occupation can be used in a number of ways,

a) as a measure of socioeconomic status
b) for identification of risks associated with exposure to agents peculiar to certain occupations.
c) to identify groups whose general patterns of life vary because of the different demands made by their occupation.

Certain diseases are known by names that are associated with their occupational origin like Chimney sweepers cancer, Wool-sorters disease, Farmer's lung etc. Occupation determines the special circumstances such as the working environment peculiar to particular occupations. This is well supported by the fact that certain occupations influence or alter the habit patterns of people engaged in that particular occupation, e.g., patterns of sleep, habits like smoking and alcoholism, etc. Sedentary life styles are also associated with certain diseases like heart diseases.

Occupational habits like holding of nails in the mouth as done by carpenters or upholstery workers, thread biting among tailors and the pressure of reed or other mouth piece upon the teeth of players of musical instruments have been found to be conducive to periodontal disease.

Socioeconomic status

The association of disease with socioeconomic status vary according to the measure of socioeconomic status used. Various epidemiological studies have shown that frequency and distribution of disease is different in the upper and lower social classes. The individuals belonging to the upper social classes exhibit a longer life expectancy and better health and nutritional state than the individuals belonging to the lower social classes. Diseases like dental caries, coronary heart disease, hypertension and diabetes mellitus are more prevalent among the individuals of upper class whereas periodontal disease, skin and zoonotic diseases are more prevalent among the lower class individuals.

Marital status

Many diseases exhibit associations with marital status. Married persons are found to have lower mortality rates as compared to the single, widowed or divorced persons. The reasons attributed for this can be that married persons are more healthier and are generally more secure and protected. However, marital status can be a risk factor for certain diseases such as carcinoma of the cervix which is relatively rare among nuns. Another use of the information on marital status in epidemiologic studies is in investigating the possible influence of a common environment on the health of marital partners.

Behavior

The focus of research in this particular field has been on habits like cigarette smoking, usage of other forms of tobacco, alcoholism, drug abuse, sedentary lifestyle and overeating. The diseases, which can be attributed mainly due to the behavior of the individuals (with regard to the habits) are coronary heart disease, cancers, hypertension, obesity etc.

Certain infectious diseases like typhoid,

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cholera and diarrhoeal disorders are spread through the movement of people in masses as in the case of pilgrimages.

4. MEASUREMENT OF DISEASE

The measurement of disease is done in terms of mortality and morbidity indicators. The morbidity can be expressed in terms of "incidence" and "prevalence". The incidence of a disease can be obtained using a "longitudinal study" and the prevalence can be obtained from a "cross-sectional study".

Cross-sectional studies (Prevalence studies)

The simplest in concept and execution is the cross-sectional study. In this, a set of individuals are chosen who may be a representative sample of the general population or of people in a particular community or a sample of members of some special subgroup - school children, the armed forces, workers in a particular industry, etc. The measurements of exposure and effect are made at the same time providing information on the relationship between a disease and other variables of interest, as they exist at one point of time. Cross-sectional studies are relatively easy and economical to carry out.

Longitudinal studies

In simpler words, it can be said that, longitudinal studies are cross-sectional studies done for a longer duration by repeating periodically. In a longitudinal study, the same individuals are examined upon repeated occasions and the changes within the group recorded in terms of elapsed time between observations.

Longitudinal studies are extremely useful for,

1. Studying the natural history of the disease and its outcome
2. Identifying the risk factors associated with the disease
3. Calculating the incidence rate of the disease.

Longitudinal studies provide valuable information but are difficult to organize and are more time consuming when compared with cross-sectional studies.

5. COMPARING WITH KNOWN INDICES

The essence of any epidemiological study is to make comparisons and to ask questions. By making comparisons between different populations and subgroups of the same population, it is often possible to reach a conclusion with regard to the disease etiology and also to identify groups or subgroups which are potentially at high risk for the development of certain diseases.

6. FORMULATION OF AN ETIOLOGICAL HYPOTHESIS

This is the final step in a descriptive epidemiological study. By studying the determinants and distribution of a disease, it is possible to formulate a hypothesis related to the disease etiology.

Hypothesis can be defined as " a supposition arrived at from by observation or by reflection". The hypothesis can be tested using the techniques of analytical epidemiology after which it may be accepted or rejected.

An epidemiologic hypothesis should specify,

1. The population - the characteristics of the persons to whom the hypothesis applies.
2. The cause being considered - the environmental exposure.
3. The expected effect - the disease.
4. The dose-response relationship - the amount of the cause needed to lead to a stated incidence of the effect.
5. The time response relationship - the time period that will elapse between exposure to the cause and observation of the effect.

For example: "Smoking 40-50 beedis per day, will result in leukoplakia among 4% of

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beedi smokers after 10 years".

USES OF DESCRIPTIVE EPIDEMIOLOGY

1. Provides data with regard to the types of disease problems and their magnitude in the community.
2. Provides information on the etiology of a disease and helps in the formulation of an etiological hypothesis.
3. Provides data required for the planning, organizing and evaluating preventive and curative services.
4. Leads the path for further research with regard to a particular disease problem.

ANALYTICAL EPIDEMIOLOGY

They are the second major type of epidemiological studies. The focus here is the individual within a population unlike descriptive epidemiology which focuses on the entire population. It is designed primarily to establish the causes of disease by investigating association between exposure to a risk factor and the occurrence of disease. The objective is to test the hypothesis. They are of 2 types,

a. Case control study
b. Cohort study

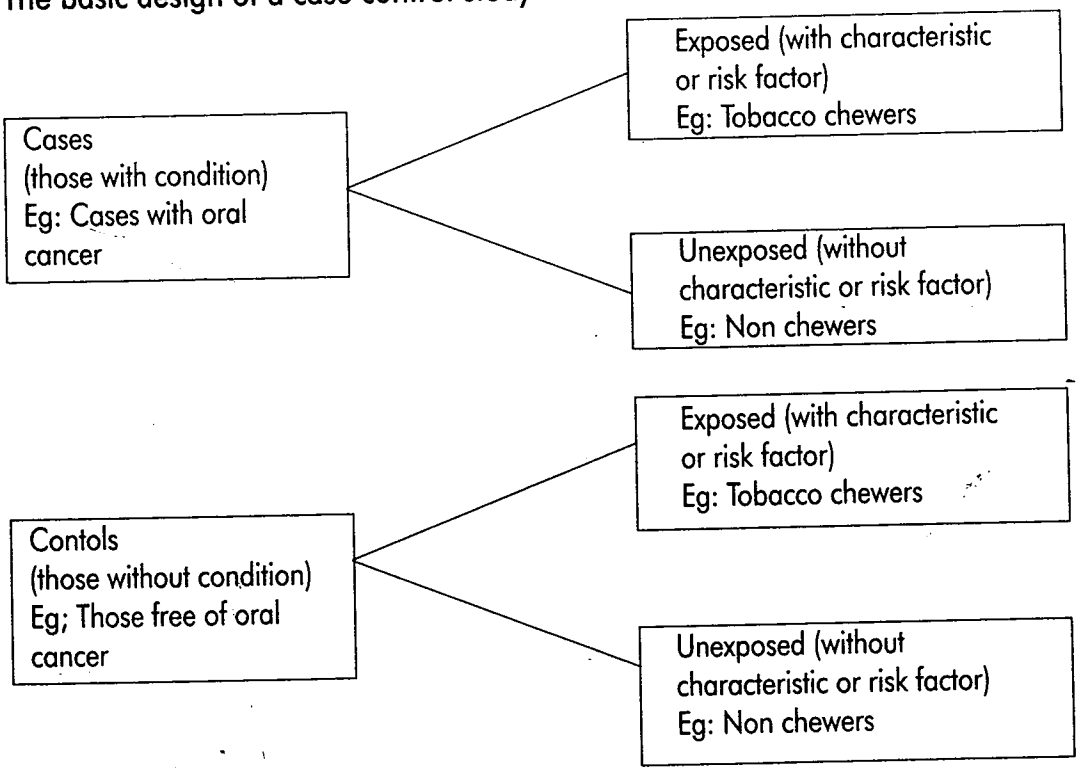
CASE-CONTROL STUDY

Case control studies, (also referred to as case-referent, retrospective or trohoc (cohort spelt backwards studies) are a common first approach to test causal hypothesis. The case control method has three distinct features:

1. both exposure and outcome (disease) have occurred before the start of the study
2. the study proceeds backwards from effect to cause; and
3. it uses a control or comparison group to support or refute an inference

The design is backward-looking (retrospective), based on the exposure histories of cases and controls. E.g. if it is our intention to test the hypothesis that "tobacco chewing causes oral cancer", using the case

The basic design of a case control study



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control method, the investigation begins by assembling a group of oral cancer cases and a group of suitably matched controls. One then explores the past history of these two groups for the presence or absence of tobacco chewing, which is suspected to be related to the occurrence of oral cancer. If the frequency of tobacco chewing is higher in cases than in controls, an association is said to exist between tobacco chewing and oral cancer.

Basic steps

There are four basic steps in conducting a case control study:

1. Selection of cases and controls
2. Matching
3. Measurement of exposure, and
4. Analysis and interpretation

1. Selection of cases and controls

The first step is to identify a suitable group of cases and a group of controls.

(A) Selection of cases

Definition of a case:

The prior definition of what constitutes a "case" is crucial to the case control study. It involves two specifications:

(i) Diagnostic criteria: The diagnostic criteria of the disease and the stage of disease, if any, to be included in the study must be specified before the study is undertaken. While investigating cases of cancer, cases should be histologically the same. Once the diagnostic criteria are established, they should not be altered or changed till the study is over.

(ii) Eligibility criteria: The second criterion is that of eligibility. A criterion customarily employed is the requirement that only newly diagnosed (incident) cases within a specified period of time are eligible than old cases or cases in advanced stages of the disease (prevalent cases). It eliminates the possibility that long term survivors of a disease were exposed to the investigated risk factor after the onset of disease.

Sources of cases:

(i) HOSPITALS: It is often convenient to select cases from hospitals. The cases may be drawn from a hospital admitted during a specified period of time. The entire case series or a random sample of it is selected for the study.

(ii) GENERAL POPULATION: In a population-based case control study, all cases of the study disease occurring within a defined geographic area during a specified period of time are ascertained, often through a survey, a disease registry or hospital network. The entire case series or a random sample of it is selected for the study. The cases should be fairly representative of all cases in the community.

Cases may also be taken from incident cases in an ongoing cohort study or in an occupational cohort (called a nested case control study)

(B) Selection of controls

The controls must be free from the disease under study. They must be as similar to the cases as possible, except for the absence of the disease under study. As a rule, a comparison group is identified before a study is done, comprising of persons who have not been exposed to the disease. Difficulties may arise in the selection of controls if the disease under investigation occurs in subclinical forms whose diagnosis is difficult. Selection of an appropriate control group is therefore an important prerequisite, for it is against this, we make comparisons, draw inferences and make judgements about the outcome of the investigation.

Sources of controls:

a) HOSPITAL CONTROLS: The controls may be selected from the same hospital as the cases, but with different illnesses other than

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the study disease. For example, if we are going to study oral cancer patients, the control group may comprise patients with cancer breast, cancer of the digestive tract, or patients with non-cancerous lesions and other patients. Usually it is unwise to choose a control group from a group of patients with one disease. This is because hospital controls are often a source of "selection bias". Many hospital patients may have diseases which are also influenced by the factor under study. For example, if one was studying the relationship of smoking and oral cancer and chooses lung cancer cases as controls, the relationship between smoking and oral cancer may not be demonstrated since smoking is a risk factor for lung cancer also. Ideally the controls should have undergone the same diagnostic work-up as cases, but have been found to be negative. But this may not be acceptable to most controls.

b) RELATIVES: The controls may also be taken up from relatives (spouses and siblings). Sibling controls are unsuitable where genetic conditions are under study.

c) NEIGHBOURHOOD CONTROLS: The controls may be drawn from persons living in the same locality as cases, persons working in the same factory or children attending the same school.

d) GENERAL POPULATION: Population controls can be obtained from defined geographic areas, by taking a random sample of individuals free of the study disease. Great care must be taken in the selection of controls to be certain that they accurately reflect the population that is free of the disease of interest.

Number of controls / control groups

If many cases are available and a large study is contemplated and the cost to collect case and control is about equal, then one tends to use one control for each case. If the study group is small (say under 50) as many as 2, 3, or even 4 controls can be selected for each study subject.

The number of control groups may vary. It is sometimes desirable to have more than one control group, representing a variety of disease conditions other than that under study and/or non-hospitalized groups. Use of multiple controls confers three advantages:

- If the frequency of the attribute or risk factor does not differ from one control group to another, but is consistently lower than that among the cases, this increases the internal consistency of the association
- If a control group is taken of patients with another disease, which is independently associated with the risk factor, the difference in the frequency of the factor between cases and controls may well be masked. In such a case, the use of another control group will save the research project
- Multiple controls provide a check on bias

2. Matching

The controls may differ from the cases in a number of factors such as age, sex, occupation, social status, etc. An important consideration is to ensure comparability between cases and controls. This involves what is known as "matching". Matching is defined as "the process by which we select controls in such a way that they are similar to cases with regard to certain pertinent selected variables (e.g., age) which are known to influence the outcome of disease and which, if not adequately matched for comparability, could distort or confound the results".

A "confounding factor" is defined as "one which is associated both with exposure and disease, and is distributed unequally in study and control groups". More specifically a "confounding factor" is one that, although associated with "exposure" under investigation, is itself, independently of any such association, a "risk factor" for the disease. Two examples are cited to explain confounding.

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a) In the study of the role of alcohol in the etiology of oesophageal cancer, smoking is a confounding factor because (i) it is associated with the consumption of alcohol and (ii) it is an independent risk factor for oesophageal cancer. In these conditions, the effects of alcohol consumption can be determined only if the influence of smoking is neutralized by matching.

3289

b) Age could be a confounding variable. Supposing, we are investigating the relationship between tobacco chewing and oral cancer, if the women consuming tobacco were younger than those in the comparison group, they would necessarily be at lower risk of oral cancer since this disease becomes increasingly common with increasing age. This "confounding" effect of age can be neutralized by matching so that both the groups have an equal proportion of each age group. In other words, matching protects against an unexpected strong association between the matching factor (e.g., age) and the disease (e.g., oral cancer). In a similar fashion other confounding variables will have to be matched.

While matching it should be borne in mind that the suspected etiological factor or the variable we wish to measure should not be matched, because by matching, its etiological role is eliminated in that study.

Types of matching

Group matching (frequency matching):

This may be done by assigning cases to sub categories (strata) based on their characteristics (e.g., age. occupation, social class) and then establishing appropriate controls. The frequency distribution of the matched variable must be similar in study and comparison groups.

Pair matching (One to one basis or individual matching):

For example, for each case, a control is chosen which can be matched quite closely. Thus, if we have a 50-year old mason with a particular disease, we will search for 50-year old mason without the disease as a control. Thus one can obtain pairs of patients and controls of the same sex, age, etc.

The disadvantage of matching is the tendency for overmatching i.e. matching on numerous variables. The matching variable is eliminated from consideration, and therefore it cannot be investigated for etiological association with the disease. For example, if we matched for alcohol in a study of oral cancer, we would not know whether alcohol consumption was a risk factor for oral cancer.

Use of unmatched controls

Many epidemiologists prefer to conduct studies without matching, and use statistical methods to adjust for possible confounding during analysis, because of the increased precision and the ability to investigate any possible interaction effects. The use of unmatched controls, obtained through random sampling, allows greater flexibility in studying various interactions. What is most important is that information on potential confounding factors should be collected in the study, so that these can be adjusted in the analysis.

3. Measurement of exposure and other factors

Definitions and criteria about exposure (or variables which may be of etiological importance) are just as important as those used to define cases and controls. This may be obtained by

- interviews
- questionnaires
- studying past records of cases such as hospital records, employment records, etc.

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- clinical or laboratory examination

Information about exposure should be obtained in precisely the same manner for both for cases and controls. Investigator should not know whether a subject is in case or control group (Blinding).

4. Analysis and interpretation

The final step is analysis, to find out

(a) Exposure rates among cases and controls to suspected factor

(b) Estimation of disease risk associated with exposure (Odds ratio)

(a) EXPOSURE RATES

A case control study provides a direct estimation of the exposure rates (frequency of exposure) to a suspected factor in disease and non-disease groups. E.g. In a case control study of tobacco chewers and oral cancer,

Exposure rates

a. Cases = a/(a+c) = 33/35 = 94.2%
b. Controls = b/(b+d) = 55/82 = 67.0%

The next step will be to ascertain whether there is a statistical association between exposure status and occurrence of oral cancer. This question can be resolved by calculating the P value. The particular test of significance will depend upon the variables under investigation. Since we are dealing with discrete variables (smoking and lung cancer; exposure and disease) the results are usually presented as rates or proportions of those present or absent in the study and in the control group. The test of significance usually adopted is the standard error of difference between two proportions or the Chi square test. On the other hand, if we are dealing with continuous variables (e.g., age, blood pressure), the data will have to be grouped and the test of significance used is likely to be the standard error of difference between two means, or the t-test. According to convention, if P is less than or equal to 0.05, it is regarded as "statistically significant". The smaller the P value, the greater the statistical significance or probability that the association is not due to chance alone. However, statistical association (P value) does not imply causation. Statement of P value is thus an inadequate, although common end-point of case control studies.

(b) ESTIMATION OF RISK

"Relative Risk" (RR) or "risk ratio", is defined as the ratio between the incidence of disease among exposed persons and incidence among non-exposed. It is given by the formula:

$$\text{Relative risk} = \frac{\text{Incidence among exposed}}{\text{Incidence among non-exposed}} = \frac{a}{(a+b)} \div \frac{c}{(c+d)}$$

A typical case control study does not provide incidence rates from which relative risk can be calculated directly, because there is no appropriate denominator or population at risk, to calculate these rates. In general, the

Example of a case control study of smoking and lung cancer

	Cases (with oral cancer)	Controls (without oral cancer)
Tobacco chewers (at least 5 in a day)	33 (a)	55 (b)
Non-chewers	2 (c)	27 (d)
Total	35 (a+c)	82 (b+d)

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relative risk can be exactly determined only from a cohort study.

Odds Ratio (OR),

It is a measure of the strength of the association between risk factor and outcome. Odds ratio is closely related to relative risk. The derivation of odds ratio is based on three assumptions: (a) the disease being investigated must be relatively rare. In fact, the majority of chronic diseases have a low incidence in the general population; (b) the cases must be representative of those with the disease, and (c) the controls must be representative of those without the disease.

Odds Ratio = ad / bc

If the odds ratio is estimated at 8.1. This implies that the risk of oral cancer was 8.1 times greater in individuals who chewed tobacco than in those who did not chew tobacco.

Bias in case-control studies

Bias is any systematic error in the determination of the association between the exposure and disease. The possibility of bias must be considered when evaluating a possible cause and effect relationship.

1. Selection bias

Selection bias is a distortion of the estimate of effect resulting from the manner in which the study population is selected. The cases and controls may not be representative of cases and controls in the general population.

Special types of selection bias

a) Prevalence-incidence bias
(Selective survival)

This type of bias can be introduced into a case-control study as a result of selective survival among the prevalent cases. In selecting cases, we are having a late look at the disease; if the exposure occurred years before, mild cases that improved, or severe cases that died would have been missed and not counted among the cases. This bias is not often a problem in cohort studies and experiments, but is quite common in case-control studies. Example: The high case-fatality rate in the early stages of clinically manifested coronary artery disease may invalidate the study of possible etiological factors, since the persons available for study as cases are the survivors (severe cases are absent). Likewise, myocardial infarction may be silent. Clinical features may be absent, and the biochemical and electro - cardiographic changes in myocardial infarction may return to normal after an infarct (these mild cases will not appear among cases for study). The type of bias introduced into the study may be cleared by contrasting a cohort study (where the disease is identified in all its forms)

b) Admission rate (Berkson's / Berkesonian) bias

It is termed after Dr. Joseph Berkson who recognized this problem. This type of bias is due to selective factors of admission to hospitals, and occurs in hospital-based studies. Many case-control studies collect cases from hospitals, and identify controls from among patients in the hospital admitted for unrelated events. The diseased individuals with a second disorder, or a complication of the original disease, are more likely to be represented in a hospital-based sample than other members of the general population. The causes of bias include the burden of symptoms, access to care, and popularity of certain institutions (particularly with respect to current practices of admission). Differential rates of admission will be reflected in biased estimates of the relative risks. This type of bias is more common in observational studies, in particular case-control studies.

2. Information bias

(In measurement of exposure or outcome)

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a. Memory or recall bias: When cases and controls are asked questions about their past history, it may be more likely for the cases to recall the existence of certain events or factors than the controls who are healthy persons. For example, those who have had a myocardial infarction might be more likely to remember and recall certain habits or events than those who have not. Thus cases may have a different recall of past events than controls.
b. Telescopic bias: If a question refers to recent past (say last month), episodes that occurred longer ago may also be reported
c. Interviewer's bias/exposure suspicion bias: Bias may also occur when the interviewer knows the hypothesis and also knows who the cases are. This prior information may lead him to question the cases more thoroughly than controls regarding a positive history of the suspected causal factor. A useful check on this kind of bias can be made by noting the length of time taken to interview the average case and the average control. This type of bias can be eliminated by double-blinding.

3. Bias due to confounding

Mention has already been made about confounding as an important source of bias. This bias can be removed by matching in case control studies.

Advantages of case-control studies

a. Relatively easy to carry out
b. Rapid and inexpensive (compared with cohort studies)
c. Requires comparatively few subjects
d. Particularly suitable to investigate rare diseases or diseases about which little is known.
e. No risk to subjects
f. Allows the study of several different etiological factors (e.g., tobacco chewing, alcohol and genetic factors in oral cancer)
g. Risk factors can be identified. Rational prevention and control programs can be established
h. No attrition problems, because case control studies do not require follow-up of individuals into the future
i. Ethical problems minimal

Disadvantages of case-control studies

a. Problems of bias since it relies on memory or past records, the accuracy of which may be uncertain; validation of information obtained is difficult or sometimes impossible
b. Selection of an appropriate control group may be difficult
c. We cannot measure incidence, and can only estimate the relative risk
d. Does not distinguish between causes and associated factors. Temporality is a serious problem in many case-control studies where it is not possible to determine whether the attribute led to the disease/condition, or vice versa
e. Not suited for the evaluation of therapy or prophylaxis of disease
f. Another major concern is the representativeness of cases and controls

COHORT STUDY

(prospective study, longitudinal study, incidence study, and forward-looking study)

Cohort study is another type of analytical (observational) study which is usually undertaken to obtain additional evidence to refute or support the existence of an association between suspected cause and disease. The distinguishing features of cohort studies are

a. the cohorts are identified prior to the appearance of the disease under investigation
b. the study groups, so defined, are observed over a period of time to determine the frequency of disease among them

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c. the study proceeds forward from cause to effect

Concept of cohort

The term "cohort" is defined as a group of people who share a common characteristic or experience within a defined time period (e.g., age, occupation, exposure to a drug or vaccine, pregnancy, insured persons, etc.). Thus a group of people born on the same day or in the same period of time (usually a year) form a "birth cohort". Persons exposed to a common drug, vaccine or infection within a defined period constitute an "exposure cohort".

The comparison group may be the general population from which the cohort is drawn, or it may be another cohort of persons thought to have had little or no exposure to the substance in question, but otherwise similar.

Framework of a cohort study

In contrast to case control studies which proceed from 'effect 'to cause", the basic approach in cohort studies is to work from 'cause to effect". That is, in a case control study, exposure and disease have already occurred when the study is initiated. In a cohort study, the exposure has occurred, but the disease has not.

Indications for cohort studies

a. when there is good evidence of an association between exposure and disease, as derived from clinical observations and supported by descriptive and case control studies
b. when exposure is rare, but the incidence of disease high among exposed, e.g., special exposure groups like those in industries, exposure to X-rays, etc
c. when attrition of study population can be minimized, e.g., follow-up is easy, cohort is stable, co-operative and easily accessible
d. when ample funds are available

In assembling cohorts, the following general considerations are taken into account:

a. The cohorts must be free from the disease under study
b. Both the groups should be equally susceptible to the disease under study (for example, males over 35 years would be appropriate for studies on lung cancer).
c. Both the groups should be comparable with respect to all the possible variables, which may influence the frequency of the disease.
d. The diagnostic and eligibility criteria of the disease must be defined beforehand

The groups are then followed, under the same identical conditions, over a period of time to determine the outcome of exposure (e.g., onset of disease, disability or death) in both the groups. If it is found that the incidence of the disease in the exposed group is significantly higher than in the non-exposed group, it would suggest that the disease and suspected cause are associated. Since the approach is prospective, that is, studies are planned to observe events that have not yet occurred, cohort studies are frequently referred to as "prospective" studies.

A well-designed cohort study is considered the most reliable means of showing an association between a suspected risk factor and subsequent disease because it eliminates many of the problems of the case control study.

Types of cohort studies

Three types of cohort studies have been distinguished on the basis of the time of occurrence of disease in relation to the time at which the investigation is initiated and continued:

1. Prospective cohort studies
2. Retrospective cohort studies
3. A combination of retrospective and prospective cohort studies (ambispective)

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1. Prospective cohort studies

A prospective cohort study (or "current" cohort study) is one in which the outcome (e.g., disease) has not yet occurred at the time the investigation begins. Most prospective studies begin in the present and continue into the future.

2. Retrospective cohort studies

(historical" cohort study, prospective study in retrospect, non-concurrent prospective study, reconstructed cohort study)

A retrospective cohort study (or "historical" cohort study) is one in which the outcomes have all occurred before the start of the investigation. The investigator goes back in time, sometimes 10 to 30 years, to select his study groups (exposed and non exposed) from existing records of past employment, medical or other records and traces them forward through time, from a past date fixed on the records, usually up to the present, to see if the disease has occurred or not. Retrospective cohort studies are generally more economical and produce results more quickly than prospective cohort studies.

3. Combination of retrospective and prospective cohort studies

In this type of study, both the retrospective and prospective elements are combined. The cohort is identified from past records, and is assessed of date for the outcome. The same cohort is followed up prospectively into future for further assessment of outcome.

Elements of a cohort study

1. Selection of study subjects
2. Obtaining data on exposure
3. Selection of comparison groups
4. Follow-up
5. Analysis

1. Selection of study subjects

The subjects of a cohort study are usually assembled in one of two ways- either from general population or select groups of the population that can be readily studied (e.g., persons with different degrees of exposure to the suspected causal factor).

(a) General population: When the exposure or cause of death is fairly frequent in the population, cohorts may be assembled from the general population, residing in well-defined geographical areas. If the population is very large, an appropriate sample is taken, so that the results can be generalized to the population sampled. The exposed and unexposed segments of the population to be studied should be representative of the corresponding segments of the general population..

(b) Special groups: These may be special groups or exposure groups that can readily be studied:

- Select groups: These may be professional groups (e.g., doctors, nurses, lawyers, teachers, civil servants), insured persons, obstetric population, college alumni, government employees, volunteers, etc. These groups are not only homogeneous, but they also offer advantages of accessibility and easy follow up for a protracted period
- Exposure groups: If the exposure is rare a more economical procedure is to select a cohort of persons known to have experienced the exposure. In other words, cohorts may be selected because of special exposure to physical, chemical and other disease agents. A readily accessibly source of these groups is workers in industries and those employed in high-risk situations (e.g., radiologists exposed to X-rays).

When cohorts have been selected because of special exposure, it facilitates classification of cohort members according to the degree or duration of exposure to the suspected factor for subsequent analytical study.

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2. Obtaining data on exposure

Information about exposure may be obtained directly from the

a. Cohort members: Through personal interviews or mailed questionnaires. Since cohort studies involve large numbers of population, mailed questionnaires offer a simple and economic way of obtaining information.
b. Review of records: Certain kinds of information (e.g., dose of radiation, kinds of surgery, or details of medical treatment) can be obtained only from medical records
c. Medical examination or special tests: Some types of information can be obtained only by medical examination or special tests, e.g., blood pressure, serum cholesterol, ECG.
d. Environmental surveys: This is the best source for obtaining information on exposure levels of the suspected factor in the environment where the cohort lived or worked. Information may be needed from more than one or all of the above sources.

Information about exposure (or any other factor related to the development of the disease being investigated) should be collected in a manner that will allow classification of cohort members

a. according to whether or not they have been exposed to the suspected factor, and
b. according to the level or degree of exposure, at least in broad classes, in the case of special exposure groups.

In addition to the above, basic information about demographic variables which might affect the frequency of disease under investigation, should also be collected. Such information will be required for subsequent analysis.

3. Selection of comparison groups

There are many ways of assembling comparison groups

(a) Internal comparisons:

In some cohort studies, no outside comparison group is required. The comparison groups are in-built. That is, a single cohort enters the study, and its members may be classified into several comparison groups according to the degrees or levels of exposure to risk (e.g., smoking, blood pressure, serum cholesterol) before the development of the disease in question. The groups are then compared.

(b) External comparisons:

When information on degree of exposure is not available, it is necessary to put up an external control, to evaluate the experience of the exposed group, e.g., smokers and non smokers, a cohort of radiologists compared with a cohort of ophthalmologists, etc. The study and control cohorts should be similar in demographic and possibly important variables other than those under study.

(c) Comparison with general population rates:

If none is available, the mortality experience of the exposed group is compared with the mortality experience of the general population in the same geographic area as the exposed people, e.g. comparison of frequency of lung cancer among uranium mine workers with lung cancer mortality in the general population where the miners resided.

The limiting factors in using general population rates for comparison are:

(i) non-availability of population rates for the outcome required; and
(ii) the difficulties of selecting the study and comparison groups which are representative of the exposed and non-exposed segments of the general population.

4. Follow-up

One of the problems in cohort studies is the regular follow-up of all the participants.

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Therefore, at the start of the study, methods should be devised depending upon the outcome to be determined (morbidity or death), to obtain data for assessing the outcome. The procedures used are,

(a) periodic medical examination of each member of the cohort
(b) reviewing physician and hospital records
(c) routine surveillance of death records
(d) mailed questionnaires, telephone calls, periodic home visits - preferably all three on an annual basis

Of the above, periodic examination of each member of the cohort yields the greatest amount of information on the individuals examined than would the use of any other procedure.

However, inspite of best efforts, a certain percentage of losses to follow-up are inevitable due to death, change of residence, migration or withdrawal of occupation. These losses may bias the results. It is therefore necessary to build into the study design a system for obtaining basic information on outcome for those who cannot be followed up in detail for the full duration of the study. The safest course recommended is to achieve as close to a 95 per cent follow-up as possible.

5. Analysis

The data are analysed in terms of:

Risk factor (tobacco)	Developed oral cancer	Did not develop	Total
Present (Chewers)	45	9955	10000
Absent (Non chewers)	5	9995	10000

(a) Incidence rates of outcome among exposed and non-exposed:

In a cohort study, we can determine incidence rates directly in those exposed and those not exposed. A hypothetical example shows how incidence rates may be calculated:

Incidence rates:

a. among tobacco chewers = 45/10000 = 4.5 per 1000
b. among non chewers = 5/10000 = 0.5 per 1000

(b) Estimation of risk

Having calculated the incidence rates, the next step is to estimate the risk of outcome (e.g., disease or death) in the exposed and non-exposed cohorts. This is done in terms of two well-known indices:

Relative risk (RR) or "risk ratio"

It is the ratio of the incidence of the disease (or death) among exposed and the incidence among non- exposed.

$$RR = \frac{\text{Incidence of disease (or death) among exposed}}{\text{Incidence of disease (or death) among non-exposed}}$$

$$= \frac{4.5}{0.5} = 9$$

This implies 9 times higher risk of development of oral carcinoma in tobacco chewers compared to non-chewers.

Estimation of relative risk (RR) is important in etiological enquiries. It is a direct measure (or index) of the "strength" of the association between suspected cause and effect. A relative risk of one indicates no association; relative risk greater than one suggests "positive" association between exposure and the disease under study. A relative risk of 2 indicates that the incidence rate of disease is 2 times higher in the exposed group as compared with the unexposed. Equivalently, this represents a 100 per cent increase in risk. A relative risk of 0.25 indicates a 75%

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reduction in the incidence rate in exposed individuals as compared with the unexposed. It is often useful to consider the 95 per cent confidence interval of a relative risk since it provides an indication of the likely and maximum levels of risk. The larger the RR, the greater the "strength" of the association between the suspected factor and disease. It may be noted that risk does not necessarily imply causal association.

Attributable risk (AR) or "risk difference"

It is the difference in incidence rates of disease (or death) between an exposed group and non- exposed group. Attributable risk is often expressed as a per cent. This is given by the formula:

= Incidence of disease rate among exposed - incidence of disease rate among non-exposed

Incidence rate among exposed

$$= \frac{4.5 - 0.5}{4.5} \times 100 = 88.9\%$$

Attributable risk indicates to what extent the disease under study can be attributed to the exposure. Out of the total risk of development of oral cancer in chewers, 88.9% is attributed to tobacco chewing in the hypothetical example. This suggests the amount of disease that might be eliminated if the factor under study could be controlled or eliminated.

Population-attributable risk

It is the incidence of the disease (or death) in the total population minus the incidence of disease (or death) among those who were not exposed to the suspected causal factor.

The concept of population attributable risk is useful in that it provides an estimate of the amount by which the disease could be reduced in that population if the suspected factor was eliminated or modified.

Relative risk versus attributable risk

Relative risk is a better index than attributable risk for assessing the etiological role of a factor in disease. The larger the relative risk, the stronger the association between cause and effect. But relative risk does not reflect the potential public health importance as does the attributable risk. That is, attributable risk gives a better idea of the impact that a successful preventive or public health program might have in reducing the problem.

Bias in cohort studies

a. Selection bias: Selection bias occurs when a group studied does not reflect the same distribution of characteristics like age, sex, occupation, race, etc. as occurring in general population. This may arise because the originally selected members of the cohort may refuse to participate (nonconsent bias) or in a non-concurrent cohort study records on some individuals are missing or incomplete (missing data bias). One of the major problems in cohort study is to accomplish the successful follow-up of all members of the cohort and may lead to follow-up or drop-out bias. If the loss to follow-up occurs equally in the exposed and unexposed groups the internal validity should not be affected assuming, of course, that the rate of disease occurrence is the same among those lost to follow-up within each exposure group. If, however, the rate of disease is different among those lost to follow-up, then internal validity of the study may be affected, that is the relationship between exposure and outcome may be changed.

Selection bias can be reduced by careful selection of individuals for inclusion in the study, and by making every attempt to characterize differences that may exist between respondents and non - respondents. Follow-up bias can be reduced by intensive follow-up of all study

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participants and by establishing criteria for follow-up that will assure that all members of the cohort have an equal opportunity for being diagnosed as having the outcome variable.

b. Information bias:

Information bias occurs when there is an error in the classification of individuals with respect to the outcome variable. This may result from measurement errors, imprecise measurements and misdiagnosis of cases.

Diagnostic suspicion or diagnostic bias: Knowledge of a subject's prior exposure to a possible cause may influence both the intensity and outcome of the diagnostic process.

c. Confounding bias

This is the bias arising due to the "confounding factor". Confounding occurs when other factors that are associated with the outcome and exposure variables do not have the same distribution in the exposed and unexposed groups. The two common confounders in cohort studies are the factors of smoking and age.

d. Post hoc bias

The testing of hypotheses that the study was not designed to test, but that are suggested by the data, has been referred to as 'data dredging'. Finding an association by data dredging and then using the same data to test its significance may lead to unwarranted conclusions; this has been termed 'post hoc bias'.

Advantages of cohort studies

a. Incidence can be calculated
b. Several possible outcomes related to exposure can be studied simultaneously - that is, we can study the association of the suspected factor with many other diseases in addition to the one under study. For example, cohort studies designed to study the association between smoking and lung cancer also showed association of smoking with coronary heart disease, peptic ulcer, cancer esophagus and several others
c. Cohort studies provide a direct estimate of relative risk
d. Dose-response ratios can also be calculated
e. Since comparison groups are formed before disease develops, certain forms of bias can be minimized like misclassification of individuals into exposed and unexposed groups.

Disadvantages of cohort studies

a. Cohort studies involve a large number of people. They are generally unsuitable for investigating uncommon diseases or diseases with low incidence in the population.
b. It takes a long time to complete the study and obtain results (20-30 years or more in cancer studies) by which time the investigators may have died or the participants may have changed their classification. Even in very common chronic diseases like coronary heart disease, cohort studies are difficult to carry out. It is difficult to keep a large number of individuals under medical surveillance indefinitely.
c. Certain administrative problems such as loss of experienced staff, loss of funding and extensive record keeping are inevitable
d. It is not unusual to lose a substantial proportion of the original cohort - they may migrate, lose interest in the study or simply refuse to provide any required information
e. Selection of comparison groups which are representative of the exposed and unexposed segments of the population is a limiting factor. Those who volunteer for the study may not be representative of all

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Individuals with the characteristic of interest

f. There may be changes in the standard methods or diagnostic criteria of the disease over prolonged follow-up. Once we have established the study protocol, it is difficult to introduce new knowledge or new tests later
g. Cohort studies are expensive
h. The study itself may alter people's behavior. If we are examining the role of smoking in lung cancer, an increased concern in the study cohort may be created. This may induce the study subjects to stop or decrease smoking.
i. With any cohort study we are faced with ethical problems of varying importance. As evidence accumulates about the implicating factor in the etiology of disease, we are obliged to intervene and if possible reduce or eliminate this factor.
j. Practical considerations dictate that we must concentrate on a limited number or factors possibly related to disease outcome.

EXPERIMENTAL EPIDEMIOLOGY

Experimental or intervention studies are studies carried out under the direct control of the investigator. These studies involve some action, intervention or manipulation such as the deliberate application or withdrawal of a suspected cause or changing one variable in the causative chain in the experimental group while making no change in the control group and observing and comparing the outcome of the experiment in both the groups.

The aims of experimental studies are:

(a) To provide "scientific proof" of etiological (or risk) factors which may permit the modification or control of those diseases
(b) To provide a method of measuring the effectiveness and efficiency of health services for the prevention, control and treatment of disease and improve the health of the community.

Experimental studies may be conducted in animals or human beings.

Experimental studies are of two types:

1. Randomized controlled trials (those involving a process of random allocation)
2. Non-randomized or "non-experimental" trials (those departing from strict randomization for practical purposes, but in such a manner that non-randomization does not seriously affect the basis of conclusions)

In modern usage, experimental epidemiology is often equated with Randomized Controlled Trials.

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1.	Starts with the disease. Proceeds from effect to cause	Starts with people exposed to the risk factor. Proceeds from cause to effect.
2.	It is the first approach to test a hypothesis	Reserved for testing precisely formulated hypothesis
3.	Involves fewer subjects	Involves larger number of subjects
4.	Yields results quickly	Results are delayed due to long follow up periods
5.	Suitable for studying rare diseases	Unsuitable for study of rare diseases
6.	Generally gives estimate of relative risk only	Yields relative risk and attributable risk
7.	Relatively inexpensive	Expensive
8.	Does not give information about diseases other than that selected for the study	Can give information about more than one disease

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Randomized Controlled Trials (RCT)

The basic steps in conducting a RCT include the following

1. Drawing up a protocol
2. Selecting reference and experimental populations
3. Randomization
4. Manipulation or intervention
5. Follow-up
6. Assessment of outcome

1. Drawing up a protocol:

The protocol specifies the aims and objectives of the study, criteria for the selection of study and control groups, size of the sample, the procedures for allocation of subjects into the study and control groups, treatments to be applied, standardization of working procedures and schedules, up to the stage of evaluation of outcome of the study.

Once a protocol has been evolved, it should be strictly adhered to throughout the study.

2. Selecting reference and experimental populations:

a. Reference or target population: It is the population to which the findings of the trial, if found successful, is expected to be applicable. A reference population may be as broad as mankind or it may be geographically limited or limited to persons in specific age, sex or social groups.
b. Experimental or study population: The study population is derived from the reference population. It is the actual population that participates in the experimental study. Ideally, it should be randomly chosen from the reference population, so that it has the same characteristics as the reference population

When an experimental population has been defined, its members are invited to participate in the study.

The participants or volunteers must fulfill the following three criteria:

A. They must give "informed consent". That is they must agree to participate in the trial after having been fully informed about the purpose, procedures and possible dangers of the trial
B. They should be representative of the population to which they belong
C. They should be qualified or eligible for the trial. In other words, the participants must be fully susceptible to the disease under study.

3. Randomization:

Randomization is a statistical procedure by which the participants are allocated into groups usually called "study" and "control" groups, to receive or not to receive an experimental preventive or therapeutic procedure or intervention. Randomization is an attempt to eliminate "bias" and allows for comparability. By random allocation, every individual gets an equal chance of being allocated into either group. Randomization is best done using a table of random numbers.

4. Manipulation:

Having formed the study and control groups, the next step is to intervene or manipulate the study (experimental) group by deliberate application or withdrawal or reduction of the suspected causal factor as laid down in the protocol.

5. Follow-up:

This involves examination of the experimental and control group subjects at defined intervals of time, in a standard manner under the same given circumstances till final assessment of outcome. Some losses to follow-up are inevitable due to factors such as death, migration and loss of interest. This is known as attrition.

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6. Assessment:

The final step in assessment of the outcome of the trial is in terms of

(a) Positive results: that is, benefits of the experimental measure such as reduced incidence or severity of the disease
(b) Negative results: that is, severity and frequency of side-effects and complications, including death.

Bias may arise from errors of assessment of the outcome due to the human element. These may be from three sources:

(a) Bias on the part of the participants, who may subjectively feel better or report improvement if they knew they were receiving a new form of treatment.
(b) Observer bias, that is the investigator measuring the outcome of a therapeutic trial may be influenced if he knows beforehand the particular procedure or therapy to which the patient has been subjected to.
(c) Bias in evaluation, that is, the investigator may subconsciously give a favorable report of the outcome of the trial.

In order to reduce these problems, a technique known as "blinding" is adopted.

Blinding:

Blinding can be done in three ways

(a) Single blind trial: The trial is so planned that the participant is not aware whether he belongs to the study group or control group
(b) Double blind trial: The trial is so planned that neither the investigator nor the participant is aware of the group allocation and the treatment received
(c) Triple blind trial: The participant, the investigator and the person analyzing the data are all "blind"

Ideally, of course, triple blinding should be used but double blinding is the most frequently used method.

Some study designs:

1. Concurrent parallel study design

In this situation, comparisons are made between two randomly assigned groups, one group exposed to specific treatment and the other group not exposed. Patients remain in the study group or the control group for the duration of the investigation.

2. Cross-over type of study designs

With this type of study design, each patient serves as his own control. As before, the patients are randomly assigned to a study group and control group. The study group receives the treatment under consideration. The control group receives some alternate form of active treatment or placebo. The two groups are observed over time. Then the patients in each group are taken off their medication or placebo to allow for the elimination of the medication from the body and for the possibility of any "carry over" effects. After this period (the length of this interval is determined by the pharmacologic properties of the drug being tested), the two groups are switched. Those who received the treatment under study are changed to the control group therapy or placebo, and vice versa.

Cross-over studies offer a number of advantages. With such a design, all patients can be assured that sometime during the course of investigation, they will receive the new therapy. Such studies generally economize on the total number of patients required at the expense of the time necessary to complete the study. This method of study is not suitable if the drug of interest cures the disease, if the drug is effective only during a certain stage of the disease or if the disease changes radically during the period of time required for the study.

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TYPES OF RANDOMIZED CONTROLLED TRIALS

1. Clinical trials

Clinical trials may be done for various purposes. Some of the common types of clinical trials (according to purpose) are:

a. Prophylactic trials, e.g. Immunization
b. Therapeutic trials, e.g. drug treatment, surgical procedure
c. Safety trials, e.g. side-effects of oral contraceptives and injectables
d. Risk-factor trials, e.g. proving the etiology of a disease by inducing it with the agent in animals, or withdrawing the agent (e.g. smoking) through cessation.

For the most part, "clinical trials" have been concerned with evaluating therapeutic agents.

Unfortunately, not all clinical trials are susceptible to being blinded. For example, there is no way to perform a clinical trial of tooth extraction without its being obvious who received surgery and who did not, a reason why the value of these procedures continues to be uncertain. Many ethical, administrative and technical problems are involved in the conduct of clinical trials. Nevertheless, they are a powerful tool and should be carried out before any new therapy, procedure or service is introduced. The intervention in a clinical trial may include drugs for prevention, treatment or palliation, clinical devices, surgical procedures etc.

Phases of a clinical trial:

a. Phase I clinical trial

This first phase in humans is preceded by considerable research, including pharmacological and toxicological studies in experimental animals to establish that the new agent is effective and may be suitable for human use, and to estimate roughly the dose to be used in man. Phase I trials include studies of volunteers who receive, initially, a fraction of what the anticipated dose is likely to be, and are monitored for effects on body functions, such as hepatic, cardiovascular, renal, gastroinstestinal and endocrinal functions. The metabolism of the drug may also be investigated at this stage. These studies are normally done on volunteers, who are usually institutionalized, and occupy what are called 'research beds'. They require close supervision. This phase, which is of short duration (usually one or two months), requires high technology in biochemistry, pharmacology and endocrinology, and varied medical expertise. It also requires access to highly developed laboratory facilities.

b. Phase II clinical trial

This phase is also carried out on volunteers selected according to strict criteria. The purpose of Phase II is to assess the effectiveness of the drug or device, to determine the appropriate dosage, and to investigate its safety. Further information on the pharmacology, especially the dose-response relationship of the drug, is collected. In the case of a device, its effectiveness is assessed and its configuration is tested and, if needed, improved.

c. Phase III clinical trial

This is the classical phase (the one usually referred to as a 'clinical trial' and reported in health research journals). It is performed on patients, who should consent to being in a clinical trial. Strict criteria for inclusion in and exclusion from the trial are followed. The purpose of this phase is to assess the effectiveness (one could argue that it is still only an efficacy trial, because of the strict conditions under which the study is conducted) and to assess safety in continued use of the drug or device in a larger and more heterogeneous population than in Phase II. It includes more detailed studies and monitoring than those given in a normal service situation. This phase is usually carried out on hospital inpatients, but may be

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performed on outpatients with intensive monitoring and follow-up. It requires superior clinical and epidemiological skills, in addition to the required laboratory technology. It also requires proper planning, organization and strict adherence to preformulated protocols and instructions, especially in multi-centre collaborative trials. Emphasis is also given to proper record keeping, follow-up and supervision.

Results from Phase III trials are used by regulatory agencies to evaluate whether a new product or device should be licensed for general public use. Initial Phase III trials therefore, have strict guidelines on the type and amount of data to be collected, the way the data are analysed and presented, and their dissemination to the users (patients and health care workers).

d. Phase IV trial

Although it has been customary to approve drugs or devices for general use following successful Phase III trials, increasing interest has been shown by governments, and by WHO and other agencies, in subjecting drugs and devices to yet another phase, i.e. a trial in normal field conditions. The purpose of the Phase IV trial is to re-assess the effectiveness, safety, acceptability and continued use of the drugs or devices under these conditions. Note that Phase III trials are often time-limited, and any adverse effects may not become apparent in such a short time. Phase IV trials add to the evidence of safety from this perspective. They also encompass a formulation of the service requirements of the new method, including facilities, training, logistics of supply and transportation, supervision, and other program aspects. Although this phase is carried out under conditions that are as close to normal as possible, Phase IV requires additional epidemiological and biostatistical skills, as well as research requirements, including record-keeping and computer facilities.

2. Preventive trials

In general usage, prevention is synonymous with primary prevention, and the term "preventive trials" implies trials of primary preventive measures. These trials are purported to prevent or eliminate disease on an experimental basis. The most frequently occurring type of preventive trials are the trials of vaccines and chemo -prophylactic drugs. The basic principles of experimental design are also applicable to these trials. It may be necessary to apply the trial to groups of subjects instead of to individual subjects.

Analysis of a preventive trial must result in a clear statement about:

(a) the benefit the community will derive from the measure
(b) the risks involved, and
(c) the costs to the health service in terms of money, men and material resources.

Since preventive trials involve larger number of subjects and sometimes a longer time span to obtain results, there may be a greater number of practical problems in their organization and execution.

3. Risk factor trials

A type of preventive trial is the trial of risk factors in which the investigator intervenes to interrupt the usual sequence in the development of disease for those individuals who have "risk factor" for developing the disease; often this involves risk factor modification. The concept of "risk factor" gave a new dimension to epidemiological research.

For example, the major risk factors of coronary heart disease are elevated blood cholesterol, smoking, hypertension and sedentary habits. Accordingly, the four main possibilities of intervention in coronary heart disease are : reduction of blood cholesterol, the cessation of smoking, control of hypertension and promotion of regular

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physical activity. Risk factor trials can be "single-factor" or "multi -factor" trials. Both the approaches are complementary, and both are needed.

4. Cessation experiments

Another type of preventive trial is the cessation experiment. In this type of study, an attempt is made to evaluate the termination of a habit (or removal of suspected agent), which is considered to be causally related to a disease. If such action is followed by a significant reduction in the disease, the hypothesis of cause is greatly strengthened. The familiar example is cigarette smoking and lung cancer. If in a randomized controlled trial, one group of cigarette smokers continue to smoke and the other group has given up, the demonstration of a decrease in the incidence of lung cancer in the study group greatly strengthens the hypothesis of a causal relationship.

5. Trial of etiological agents

One of the aims of experimental epidemiology is to confirm or refute an etiological hypothesis. Since most diseases are fatal, disabling or unpleasant, human experiments to confirm an etiological hypothesis are rarely possible.

6. Evaluation of health services

Randomized controlled trials have been extended to assess the effectiveness and efficiency of health services. Often, choices have to be made between alternative policies of health care delivery. The necessity of choice arises from the fact that resources are limited, and priorities must be set for the implementation of a large number of activities, which could contribute to the welfare of society. These studies are also labelled as "health services research" studies.

7. Community intervention trials (CITs)

CITs are usually carried out in hospitals or clinics, and are usually directed at a patient group with specific health conditions. However, randomized experiments are also sometimes done in the community. The classic example of a community intervention trial would be that of testing a vaccine. Some communities will be randomly assigned to receive the vaccine, while other communities will either not be vaccinated, or will be vaccinated with a placebo. In these types of studies, the major difference from the RCT is that the randomization is done on communities rather than individuals.

Communities selected for entry to the study have to be similar as much as possible, especially since only a small number of communities will be selected. Very often, blinding is not possible in these types of studies, and contamination and co-interventions become serious problems. Contamination occurs when individuals from one of the experimental groups receive the intervention from the other experimental group. For example, in the study of iron-fortified salt, some of the members of the community receiving non-fortified salt might hear about the fortified salt, and may acquire it from the other community. This is particularly so if the communities are geographically close. Co-intervention occurs when other interventions, either unknown to the investigators of this trial or otherwise, are simultaneously introduced, in which case, comparison of results from the two randomized groups will no longer be a reflection of the intervention under trial. The fact that these trials use randomization by communities also reduces the sample size; the effective sample size is the number of communities, not the number of people in these communities. Special statistical procedures have to be applied to take into account this 'clustering effect'. Most of the community intervention trials involve evaluative strategies to study community health services. Typical examples of such trials include:

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- Community diagnosis: evaluating the need for a service, i.e. assessment or evaluation of needs
- Design evaluation: evaluating the design of a health service
- Efficiency or process evaluation: evaluating the performance or efficiency of the process of delivery of the services
- Effectiveness or impact evaluation: evaluating the effectiveness and impact of the program or procedure
- System evaluation: relating the outcome to the input and constraints of the program including cost-benefit analysis.

NON-RANDOMIZED TRIALS

Although the experimental method is almost always to be preferred, it is not always possible for ethical, administrative and other reasons to resort to a randomized controlled trial in human beings.

- Some conditions have not lent themselves to direct experimentation in human beings. For example, induction of cancer by viruses.
- Some preventive measures can be applied only to groups or on a community-wide basis (e.g., community trials of water fluoridation).
- When disease frequency is low and the natural history long (e.g., cancer cervix) randomized controlled trials require follow-up of thousands of people for a decade or more, the cost and logistics are often prohibitive.
- In such situations, we must depend upon other study designs -these are referred to as non-randomized (or non-experimental) trials.
- The approach in non-randomized trials is rather crude whereas it is sophisticated in randomized controlled trials.
- There is no randomization in non-experimental trials, therefore the degree of comparability will be low and the chances of a spurious result higher than where randomization had taken place.

Nevertheless, vital decisions affecting public health and preventive medicine have been made by non -experimental studies.

A few examples of non-randomized trials are:

1.Uncontrolled trials

Uncontrolled trials may be useful in initially evaluating whether a specific therapy appears to have any value in a particular disease, to determine an appropriate dose, to investigate adverse reactions, etc. However, even in these uncontrolled trials, one is using implied "historical controls", i.e., the experience of earlier untreated patients affected by the same disease.

Since most therapeutic trials deal with drugs which do not produce such remarkably beneficial results, it is becoming increasingly common to employ the procedures of a double-blind controlled clinical trial in which the effects of a new drug are compared to some concurrent experience (either placebo or a currently utilized therapy).

2. Natural experiments

Where experimental studies are not possible to human populations, the epidemiologist seeks to identify "natural circumstances" that mimic an experiment. For example, in respect of cigarette smoking, people have separated themselves "naturally" into two groups, smokers and non-smokers. Epidemiologists have taken advantage of this separation and tested hypothesis regarding lung cancer and cigarette smoking. Other populations involved in natural experiments are migrants, religious or social groups, atomic bombing of Japan, famines, earthquakes, etc.

John Snow's discovery that cholera is a water-borne disease was the outcome of a natural experiment. Snow in his "grand experiment" identified two randomly mixed populations alike in other important respects, except the source of water supply in their households.

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3. Before and after comparison studies

These are community trials, which fall into three distinct groups,

a. Before and after comparison studies without control

These studies centre around comparing the incidence of disease before and after introduction of a preventive measure. The events which took place prior to the use of the new treatment or preventive procedure are used as a standard for comparison. In other words, the experiment serves as its own control; this eliminates virtually all group differences. The classic examples of "before and after comparison studies" were the prevention of scurvy among sailors by James Lind in 1750 by providing fresh fruit; studies on the transmission of cholera by John Snow in 1854; and more recently, prevention of polio by Salk and Sabin vaccines in 1962.

In order to establish evidence in before and after comparison studies, the following are needed,

- data regarding the incidence of disease, before and after introduction of a preventive measure
- there should be introduction or manipulation of only one factor or change relevant to the situation, other factors remaining the same, as for example, addition of fluoride to drinking water to prevent dental caries
- diagnostic criteria of the disease should remain the same
- adoption of preventive measures should be over a wide area
- reduction in the incidence must be large following the introduction of the preventive measure, because there is no control
- several trials may be needed before the evaluation is considered conclusive.

b. After only with control

In this design, two groups or areas (test and control) are selected and treatment is introduced into test area only. The dependent variable is then measured in both the areas at the same time.

c. Before and after comparison studies with control

In the absence of a control group, comparison between observations before and after the use of a new treatment or procedure may be misleading. In such situations, the epidemiologist tries to utilize a "natural" control group i.e., the one provided by nature or natural circumstances. If the preventive program is to be applied to an entire community, he would select another community as similar as possible, particularly with respect to frequency and characteristics of the disease to be prevented. One of them is arbitrarily chosen to provide the study group and the other a control group.

USES OF EPIDEMIOLOGY

Epidemiology concentrates on disease distribution & causation in depth, so as to control the future onslaught by disease & risk factors. Various designs makes one to proceed & try out innovative techniques which helps the public health machinery immensely in the form of,

1. Community diagnosis

One would start with identification and quantification of health problems in a community and identification of their correlates for the purpose of identifying groups or persons at risk and those in need of health care. This consists of collection, description, and analysis of information on the occurrence and distribution of disease in the population in relation to characteristics of the agent, host, and environment. Baseline data thus derived will later serve as a bench mark for evaluating health care services. For community diagnosis, the importance of a disease is usually determined by the extent of

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its incidence, prevalence, and mortality by age, sex, race, nativity, marital status, geographic areas, temporal variations and socioeconomic factors.

2. Rise & fall of disease

Repeated evaluations of community health problems will give insight into the fluctuations in health care related matters over time when some diseases pale out into history and new ones emerge. One epidemic follows a previous one at periodic intervals. Seasonal nature of diseases will be revealed. Patterns of modified disease causing agents will differ over time to recognize changes in their genetic structure.

3. Planning & evaluation

Planning is essential for a rational allocation of the limited resources. Epidemiologic information about the distribution of health problems over time and place provides the basis for planning health services. Evaluation is done to find out whether the measures undertaken to prevent a disease are effective in reducing the frequency of this disease.

4. Evaluation of individuals risk

Modern analytical epidemiology enables us to predict an individual's chances / risks for developing a disease or health related event even in the absence of obvious etiological hypothesis. The purpose of this is to estimate the probable chances that certain types of individuals will, under certain conditions, suffer from specific illnesses, defects, or accidents. It is also an estimate of the probabilities of life and death expectancy. These probabilities can be estimated only by a careful collection and critical analysis of incidence, prevalence, and mortality rates among the affected and the unaffected.

5. Syndrome identification

The classification of clinical syndromes, which include all signs and symptoms that occur together and characterize a disease, can be accomplished by studies of all the aspects of disease and its attendant circumstances to distinguish similar disorders and aid in differential diagnosis.

6. Search for causes / risk factors

Analytical epidemiology succeeds many a times in pointing out the single or multiple etiology of a disease. This paves the way for prevention of the cause or risk factor in the future. Many factors influence the occurrence and distribution of health, disease, disorders, defects, disabilities, and death. The group of factors that are responsible for these conditions may be considered multiple influences of composite etiology or multiple causes. It is essential to search for all agent, host, and environmental elements of the causal mechanism to determine all details of natural history and prevention.

7. Completing the natural history of disease

Although not successful at revealing the cause of disease, longitudinal studies, however, will lay down the complete natural history of the disease in question. All the details of the complete clinical picture of a disease are not usually seen among patients who seek medical attention. For this reason it is important to have a population analysis to complete the clinical picture. Sometimes the silent death caused by the disease may also be revealed by such studies.

ASSOCIATION AND CAUSATION

Defining an association

An association is said to exist between two variables when a change in one variable parallels or coincides with a change in another. This is also called 'covariation' or 'correlation'. An association or covariation may be positive or negative and may be proportionate or disproportionate. An

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association is said to be causal when it can be proved that a change in the independent variable (exposure) produces a change in the dependent variable (disease).

TYPES OF ASSOCIATION

The association between two variables may be causal or non-causal.

1.Causal association

As already stated, a causal association exists when the independent variable (risk factor) causes changes in the dependent variable. Causal associations are of three types,

a. Direct causal association
   A direct causal association is inferred when the risk factor or independent variable changes the dependent variable or condition directly, without intervening variables, e.g. exposure to the tubercle bacillus causes tuberculosis, exposure to lead causes lead poisoning, and iodine deficiency causes goitre.

B. Indirect causal association
   The association is inferred when the risk factor or independent variable causes changes in the dependent variable or condition through the mediation of other intermediate variables or conditions: iodine deficiency - goitre - thyroid adenoma. Thus, thyroid adenoma is caused indirectly by iodine deficiency. Note that the term 'indirect association' may be used in a broader sense. For example, endemic goitre is associated with high altitude simply because water supplies are likely to contain less iodine at high rather than low altitudes. Such usage, however, should be restricted and carefully evaluated.

There may be interactions (positive or negative) between categories of independent variables that produce changes in the dependent variables. One form is synergism (or antagonism) between two variables, whereby each factor has an independent effect on the condition, while the joint effect is greater (or smaller) than each alone.

2. Non-causal, spurious association

In some situations, an association does exist, but, despite its significance and strength, it may be spurious or non-causal as far as the special characteristics under study are concerned. A non-causal association is inferred when the association is

- due to chance,
- due to bias.

Defining the variables in an association

1. Independent and dependent variables

The hypothesis to be tested in a study usually defines which variable is assumed to be causal (i.e. is a risk factor) and which variable is considered to be the effect. The definition of a variable therefore depends on the study hypothesis: a variable may be independent in one hypothesis, a confounder in another, and dependent in a third.

2. Confounding variables

A confounding variable is an independent variable (other than the hypothesized causal variable) that has or can have an effect on the dependent variable, but the distribution of which is systematically correlated with that of the hypothesized causal variable.

3. Control variables

Control variables are independent variables (other than the causal variable), which are potential confounders, and hence should be controlled or neutralized in the design or analysis. These are only the 'known' or controllable variables. In most studies, it is impossible to control for all variables other than the suspected causal variables. By the process of randomization, it is hoped that

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many of these 'uncontrolled' variables will be equally distributed between the exposure and control groups.

4. Intermediate or intervening variables

3289

When the effect of a causal variable on the dependent variable or study condition is mediated through a third set of variables, the latter are called intermediate variables. They are in fact dependent variables in relation to the causal variable, and independent in relation to the subsequent condition.

5. Effect modification

Some independent variables may modify (positively or negatively) the effect of the hypothesized causal variables. For example, hypertension is more frequent among black than among white Americans, while coronary heart disease is more frequent in whites than in blacks. It is possible, therefore, that something related to the constitution or way of life of blacks modifies the effect of hypertension on coronary heart disease among them. Some confounding variables are also effect modifiers.

Measuring an association

When the incidence (or prevalence) of a condition (e.g. lung cancer) in a group with certain characteristic (e.g. smoking) differs from the incidence (or prevalence) in a group without the characteristic (e.g. non-smokers), an association is inferred that may or may not be causal. The strength of the association is commonly measured by the relative risk or odds ratio (OR), in addition to attributable risk and population attributable risk per cent. Another measure of association is the correlation between two variables. This can be expressed graphically in a correlation or scatter diagram, when the dependent variable (e.g. lung cancer incidence or mortality) is plotted on the vertical or Y-axis and the independent variable or characteristic (e.g. number of cigarettes smoked) on the horizontal or X-axis. If an association exists, changes in Y will coincide with changes in X. The relationship can also be expressed in terms of a correlation coefficient, or r, which is a measure of the degree to which a dependent variable varies with an independent variable. The correlation coefficient varies between +1 and -1.

The common correlation coefficients in use include:

- the Pearson product-moment correlation coefficient,
- the Spearman rank-order correlation coefficient, and
- the Kendall tau correlation coefficient.

Regression coefficients can also be used in measuring association. They are a measure of the mean changes to be expected in the dependent variable for a unit change in the value of the independent variable. When more than one independent variable is associated with the dependent variable, multiple regression analysis will indicate how much of the variation observed in the dependent variable can be accounted for, by one or a combination of independent variables.

Problems in establishing causality

1. The existence of a correlation or association does not necessarily imply causation.
2. The concept of a single cause (the agent), once held in relation to communicable disease, has been replaced by the concept of multiple causation in diseases such as cancer and heart disease. Even in communicable diseases, factors in the agent, the host and the environment cooperate to cause the disease.
3. The criteria used in establishing causality in infectious disease, namely, Koch's postulates, are not applicable to non-infectious diseases. Koch's postulates are:

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- The organism is always found with the disease in accord with the lesions and clinical stage.
- The organism is not found in any other disease.
- The organism is isolated from one who has the disease, and cultured through several generations.
- The organism from culture is capable of producing disease in susceptible animals.

Even in some infectious diseases, these postulates are not totally applicable.

4. The period between exposure to a factor or cause, and the appearance of clinical disease, is relatively long in non-infectious diseases. During this latent period, exposure to other factors complicates the research.
5. Specificity, easily established in infectious disease, does not apply to most other diseases. Lung cancer, for example, can result from smoking or exposure to radiation, asbestos or nickel dust. At the same time, each of these risk factors can cause diseases other than lung cancer. Smoking, for example, is involved in the causation of heart disease and emphysema.
6. Certain confounders that are associated with the cause of a disease tend to distort or confound the relationship with the suspected factors. These require special handling during design or analysis to control or neutralize their effect.
7. Several systematic errors or bias in research design or data collection can produce false or spurious associations.
8. No statistical method can differentiate between causal and non-causal associations.

Because of these many uncertainties, the terms 'causal inference', 'causal possibility' or 'likelihood' are preferred to 'causal conclusion'. Such inferences would be enough in many situations to formulate policy rather than waiting for the unequivocal proof, which may be unattainable in several disease conditions.

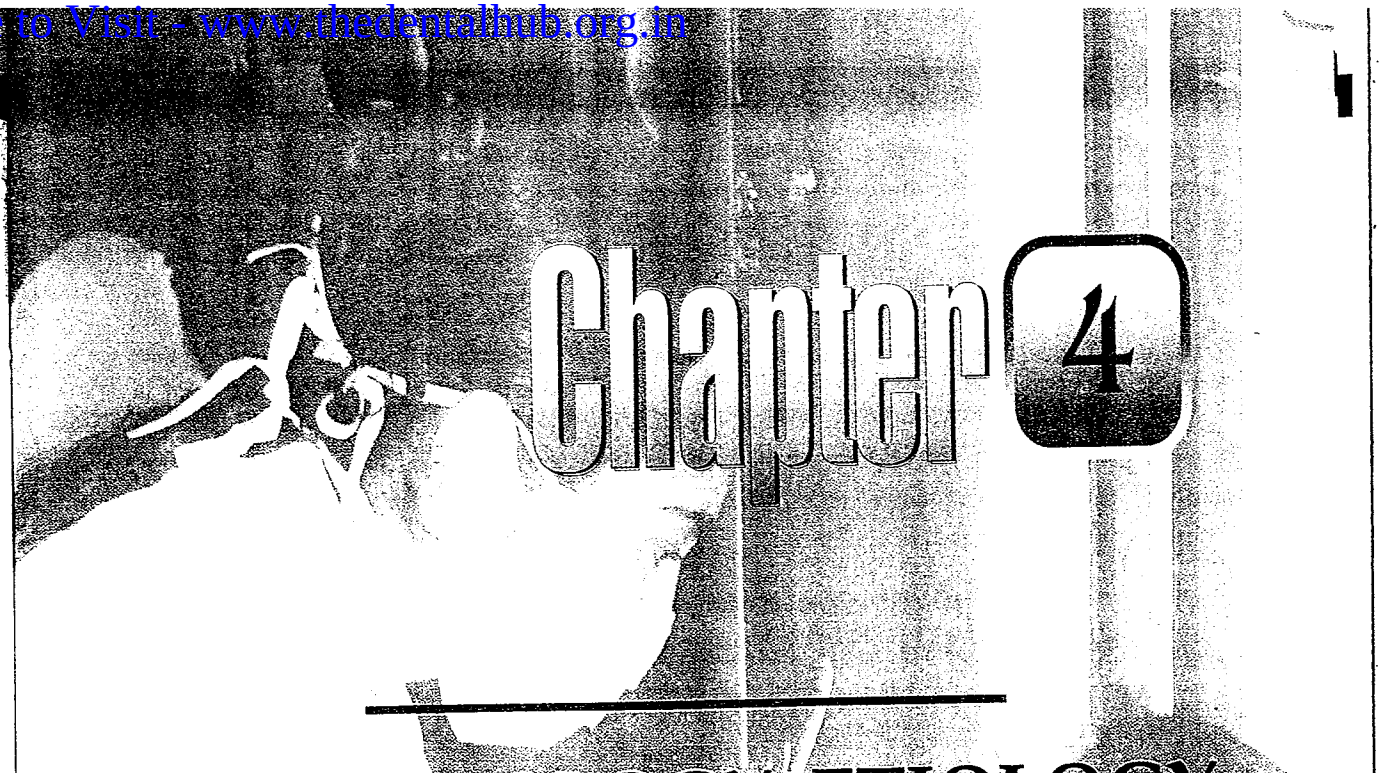
CONCLUSION

The most outstanding contribution of epidemiology is the study of association and causation in health and disease. Ironically, this is also the most difficult field in epidemiology, since it is often not easy to tell whether an observed association between a condition and a risk factor represents a cause-and-effect relationship.

The reasons for interest in establishing or excluding causality are:

- to understand the determinants of disease occurrence, distribution and outcome
- to identify the links in the chain of causality that are amenable to intervention through general or specific intervention programs
- to relate the output and impact of intervention programs to their input, i.e. a causal evaluation.

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Chapter 4

EPIDEMIOLOGY, ETIOLOGY AND PREVENTION OF DENTAL CARIES

INTRODUCTION

EPIDEMIOLOGY

THEORIES OF CARIES ETIOLOGY

ETIOLOGIC FACTORS

PREVENTION

CARIES VACCINE

CARIES RISK ASSESSMENT

CARIOGRAM

CONCLUSION

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INTRODUCTION

Dental caries is defined as an infectious microbiologic disease of the teeth that results in localized dissolution and destruction of the calcified tissues.

The word caries is derived from Latin, meaning 'rot' or decay. It is similar to the Greek word 'Ker' meaning death.

There is presently an alarming rate of increase in the prevalence of dental caries in developing countries. The introduction of sucrose into the modern diet has been associated with increased caries prevalence.

The relationship between diet and dental caries is characterized by the equation,

Bacterial Enzyme + Fermentable Carbohydrate = Acid
Acid + Enamel = Dental Caries

Allowing caries to proceed untreated results in the progressive destruction of the tooth and eventual infection of the dental pulp.

EPIDEMIOLOGY

Dental caries may be considered a disease of modern civilization, since prehistoric man rarely suffered from this form of tooth destruction. Anthropologic studies of Von Lenhossek revealed that the Dolicocephalic skulls of men from Pre - Neolithic periods (12,000 BC) did not exhibit dental caries, but skulls from Brachycephalic man of the Neolithic periods (12,000 to 3000 BC) contained carious teeth. The cervical areas of teeth in older persons were frequently affected.

Caries rates in contemporary isolated populations:

Isolated populations that had not acquired the dietary habits of modern, industrialized man, retained a relative freedom from dental caries.

In East Greenland native food prevailed everywhere except at trading ports where imported food was available, Pederson (1938) reported that 4.3% males living in isolated settlements of Angmagssalik had caries, as compared to 43.2% of a comparable Eskimo population living at a trading post. On the West part of Greenland, where contact with European technology was greatest, the percentage of male Eskimos with caries was 31.8% for those living in the proximity of trading posts.

Current trends in caries prevalence:

The WHO records a Global DMFT of 1.61 for 12-year-olds in 2004, a reduction of 0.13 as compared to a DMFT of 1.74 in the year 2001. Per cent of countries having 3 DMFT or less is 74% (139 countries)

WHO reported a DMFT score of 3.94 for India in 2003

In India, data from the National Oral Health Survey (2002-2003) states that in children aged 12 years, the caries prevalence was 53.8% and the mean DMFT was 1.8 whereas it was 80.2% and 5.4 in the 35-44 year age group. In the 65-74 year age group, the prevalence was 85% and the mean DMFT was 14.9.

WHO Regions	DMFT (2004)
AFRO	1.15
AMRO	2.76
EMRO	1.58
EURO	2.57
SEARO	1.12
WPRO	1.48
Global average (among 188 countries)	1.61

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Indian studies:

AUTHORS	YEAR	POPULATION	FINDINGS
Day & Tandon	1940	756 subjects aged 5-18 yrs in Lahore	Point prevalence = 94.04 The mean deft = 0.23.
Bhat & Shetty	1946	3-8 yrs 8-16 yrs.	Percentage incidence = 74.03% Percentage incidence = 75.77%
Shourie	1947	387 children aged 6-18 yrs, in Ajmer	Caries prevalence = 33.7%.
Kokila	1951	3-15 yrs old Gujarati children in Bombay	Percentage DMFT / dft = 12.60
Chaudhury & Chawla	1957	2991, 5-16 years old children in Lucknow	deft = 11.1 and the DMFT = 1.9
Miglani & Sharma	1963	1125 subjects aged 15-25 yrs in Madras	DMFT percentage = 5.0
Dutta	1965	1424 children aged 6-12 yrs in Calcutta	DMFT / deft = 1.17
Mehta	1977	1160 children, 5-16 yrs old in Behrampur, Orissa	Point prevalence = 60.4
Rao Nagaraj	1980	511 school children aged 5-15 yrs in Udupi, South Karnataka	5-10 year group DMFT = 5.01 11-15 year group DMFT = 4.54
Ashwini Rao, Sequeira SP, Peter S et al	1999	2902 school children aged between 5 and 12 years in Moodbidri, Karnataka	Caries prevalence = 76.9%. The mean DMFT was 0.78 and the mean deft was 3.48.
Goel P, Sequeira P, Peter S	2000	5-6 and 12-13 year old school children in Puttur, Karnataka	Prevalence of dental caries = 81.25% in 5-6 years age group Prevalence of dental caries = 59.6 in 12-13 years age group
Das JK, Sahoo PK, Bhuyan SK, Sahoo SK.	2002	1257 school children aged 5, 8, 11 & 15 years in Cuttack, Orissa.	Point prevalence = 64.3% , Average DMFT = 2.38.
Saravanan S, Anuradha KP, Bhaskar DJ.	2003	2022 school children aged 5 and 12 years in Pondicherry	Prevalence of dental caries = 44.4% in 5 years age group Prevalence of dental caries = 22.3 in 12 years age group
Dhar V, Jain A, Van Dyke TE, Kohli A.	2007	1587 school children aged 5-14 years in Udaipur	Caries prevalence= 46.75%

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Caries susceptibility of jaw quadrants:

Dental caries experience was found to be higher in the maxillary arch. The reason for the difference between the arches in caries susceptibility is not well documented. It may relate to gravity and the fact that saliva, with its buffering action, would tend to drain from the upper teeth and collect around the lower teeth.

THEORIES OF CARIES ETIOLOGY

The etiology of dental caries is a complex problem complicated by many indirect factors that obscure the direct cause or causes. There is no universally accepted opinion of the etiology of dental caries.

A. EARLY THEORIES OF CARIES FORMATION

- The legend of the worm:

The earliest reference to tooth decay and toothache came from the ancient Sumerian text known as 'The legend of the worm'. It was discovered on a clay tablet, excavated from an ancient city within the Euphrates Valley of the Lower Mesopotamian area, which dates from about 5000 BC.

The early history of India, Egypt and the writings of Homer also makes reference to the worm as the cause of toothache. Fumigation devices consisting of burning of leeks and hyocyamus (an alkaloid) were used by the Chinese and Egyptians.

B. ENDOGENOUS THEORIES

- Humoral theory:

The four elemental humors of the body were blood, phlegm, black bile and yellow bile. According to Galen, the ancient Greek physician and philosopher, " dental caries is produced by the internal action of acrid, corroding humors".

Hippocrates, the father of Medicine, while favoring the concept of humoral pathology, also referred to the accumulated debris around teeth and to their corroding action. He also stated that stagnation of juices in the teeth was the cause of toothache.

- Vital theory:

A Vital theory of tooth decay was advanced towards the end of the 18th century which postulated that tooth decay originated like bone gangrene, from within the tooth itself.

C. EXOGENOUS THEORIES

- Chemical (acid) theory :

In the 17th and 18th century, there emerged the concept that teeth were destroyed by acids formed in the oral cavity. The acids implicated were inorganic.

Robertson (1835) proposed that dental decay was caused by acid formed by fermentation of food particles around teeth. However the possibility that microorganisms were involved was not yet recognized.

- Parasitic (septic) theory :

Early microscopic observation of scrapings from teeth and of the carious lesions by Antoni Van Leeuwenhock (1632-1723) indicated that microorganisms were associated with the carious process.

In 1843, Erdl described filamentous parasites in the membrane removed from the teeth. Ficinus in 1847, a physician, also observed filamentous organisms in the enamel cuticle and in carious lesions.

Dubos (1954) postulated that micro organisms ('animal culae') can have toxic effects on tissue.

- Miller's chemicoparasitic theory (acidogenic theory):

This theory was proposed originally by W.D.Miller in 1890. He made the significant observation that many organisms can produce acid from the fermentation of sugar

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and showed that several oral microorganisms have this property and lactic acid is one of the major acids formed. He also showed that extracted human teeth could be demineralized by incubation in mixtures of bread or sugar with human saliva.

Stephan curve:

Stephan showed that within 2-4 minutes of rinsing with a solution of glucose or sucrose, plaque pH is reduced from about 6.5-5 and gradually returns to the original value within approximately 40 minutes. This is graphically plotted as the 'Stephan's curve'.

- Proteolytic theory:

In 1947, Gottlieb, suggested that the initial attack on enamel might be the destruction of organic material rather than demineralization by acid. Thus, according to this theory, the organic matrix would be attacked before the mineral phase of the enamel. The proteolytic enzymes liberated by oral bacteria destroy the organic matrix of enamel, loosening the apatite crystals, so that they are eventually lost and the tissue collapses.

However, areas of enamel with a relatively high organic content (e.g.; tufts and lamellae) do not show a greater susceptibility to caries. It has also not been possible to simulate caries in vitro with proteolytic agents. The part played by proteolysis in the initiation of dental caries is likely to be of no significance, but its role in the progression of the more advanced carious lesion cannot be ruled out.

- Proteolysis chelation theory:

This theory was originated by Schatz & Martin in 1955. It proposes that some of the products of bacterial action on enamel, dentin and food and salivary constituents can form chelates with calcium. A chelate is a complex between an ion (Ca) & two or more groups of the complexing compound. Since chelates can be formed at neutral or alkaline pH, the theory suggested that demineralization of the enamel could arise without acid formation.

Jenkins & Dawes carried out studies to discover whether chelation plays a role in the etiology of caries. They concluded that saliva and plaque do not contain substances in sufficient concentrations to chelate calcium in detectable amounts from enamel. However, although chelation is unlikely to be involved in the initiation of the lesion, it may play a minor role in the established lesion.

D.OTHER THEORIES OF CARIES ETIOLOGY

- Auto immune theory :

Burch & Jackson (1966) analyzed caries epidemiologic data and suggested that genes, partly inherited and partly mutational, determine whether a site on a tooth is at risk.

In discussing this hypothesis, Jenkins points out that most of the data on which the theory is based are epidemiologic. It is doubtful whether these data, collected during routine clinical examinations are sufficiently accurate for mathematical analysis.

ETIOLOGIC FACTORS IN DENTAL CARIES

Dental caries is a multifactorial disease in which there is an interaction between three principle factors,

a. A susceptible host tissue
b. Microflora with a cariogenic potential
c. A suitable local substrate

In addition, a fourth factor, time, must be considered. This concept is shown in the 'Keyes diagram'. All the factors must be present and must interact with each other for dental caries to develop.

A. A SUSCEPTIBLE HOST TISSUE

- Tooth
- Saliva

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Tooth:

The morphologic characteristics of tooth have been suggested as influencing the initiation of dental caries. The morphologic feature, which conceivably might predispose to the development of caries is the presence of deep, narrow, occlusal fissures or buccal and lingual pits. Such fissures tend to trap food, bacteria and debris and since defects are common in the base of fissures, caries may develop rapidly in these areas. Conversely, as attrition advances, the inclined planes become flattened, providing less opportunity for entrapment of food in the fissures and caries predisposition diminishes.

Evidence indicates that alteration of tooth structure by disturbance in formation or in calcification is of only secondary importance in dental caries. The rate of caries progression may be influenced, but initiation of caries is affected very little.

Tooth position may play a role in dental caries under certain circumstances. Teeth which are malaligned, out of position, rotated or otherwise not normally situated may be difficult to cleanse and tends to favor the accumulation of food and debris. This, in susceptible persons, would be sufficient to cause caries in a tooth, which under normal circumstances of proper alignment, would conceivably not develop caries.

Saliva :

The fact that the teeth are in constant contact with and bathed in saliva would suggest that this environmental agent could profoundly influence the state of oral health of a person, including the carious process.

One of the most important functions of saliva with respect to caries is its role in the removal of bacteria and food debris from the mouth. When saliva is swallowed, any bacteria contained therein are removed from the oral cavity. The average unstimulated flow rate of saliva is about 0.3 ml per minute and the amount of saliva present in the mouth prior to swallowing is of the order of 3 or 4 times that volume.

The composition of saliva varies between persons and the concentrations of inorganic calcium and phosphorous show considerable variation, depending upon the rate of flow.

A number of different enzymes have been isolated from saliva. They are derived from extrinsic and intrinsic sources. Urease is an enzyme derived from oral microorganisms. Ptyalin or Amylase is an enzyme responsible for the degradation of starches.

pH:

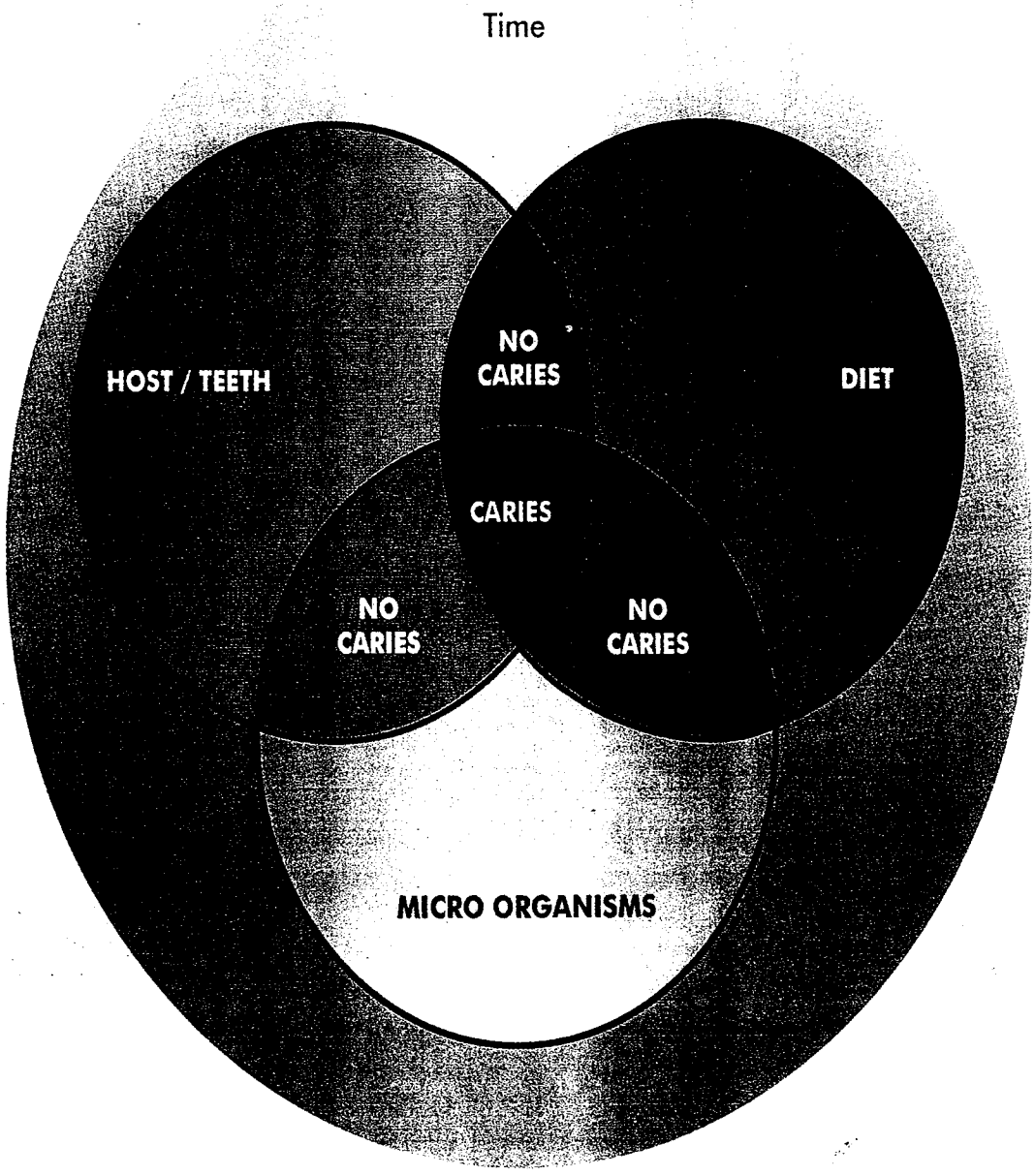
The pH of saliva is determined mainly by the bicarbonate concentration. So, the pH will vary according to the bicarbonate content. The saliva pH increases with flow rate. Saliva may be slightly acidic as it is secreted at unstimulated flow rates but it may reach a pH of 7.8 at high flow rates. As it is exposed to the atmosphere, carbon dioxide will diffuse out and pH will rise, often to 9 or more in saliva present as a thin film. Other salivary components contributing to the ability of saliva to neutralize acid are, salivary phosphate, salivary proteins, ammonia, urea and statherin.

Sialin is an arginine peptide which is a pH rise factor present in saliva which rapidly clears glucose from plaque, increases base formation and elevates pH in the plaque.

The acid production, significant in the caries process, occurs at a localized site on the tooth. This site, in the early stages of caries, is protected by the dental plaque, which appears to act as an osmotic membrane preventing a completely free exchange of ions. Thus, even though buffer ions are present in saliva, these may not be available at those specific sites where they are needed on the tooth surface.

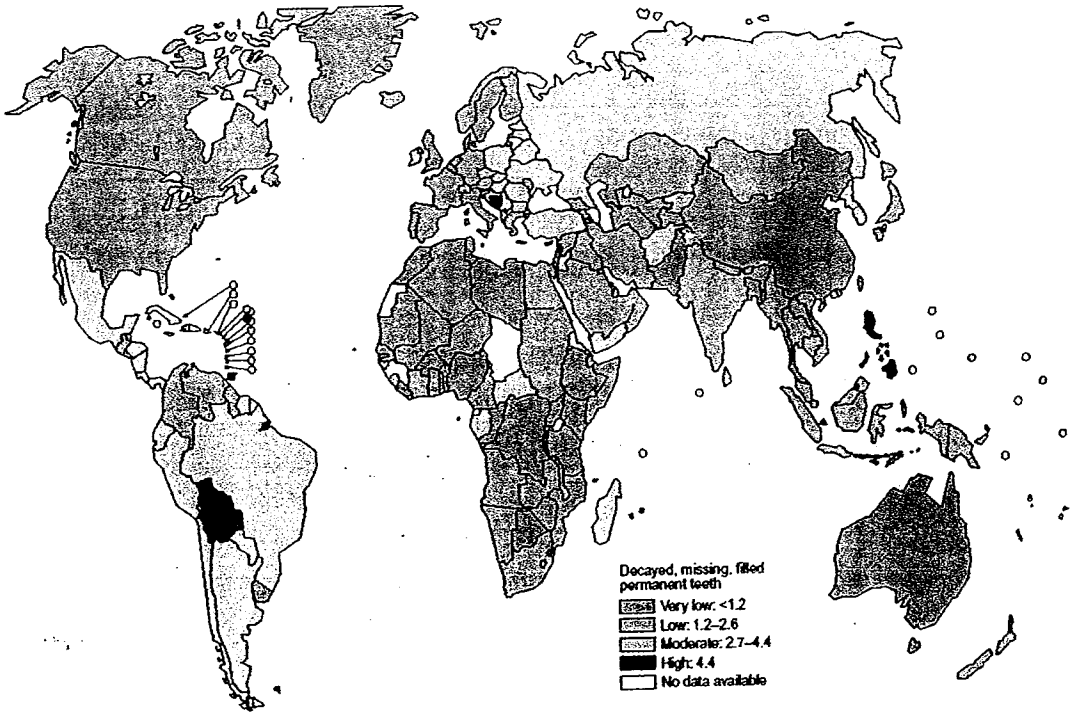
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ETIOLOGIC FACTORS IN DENTAL CARIES

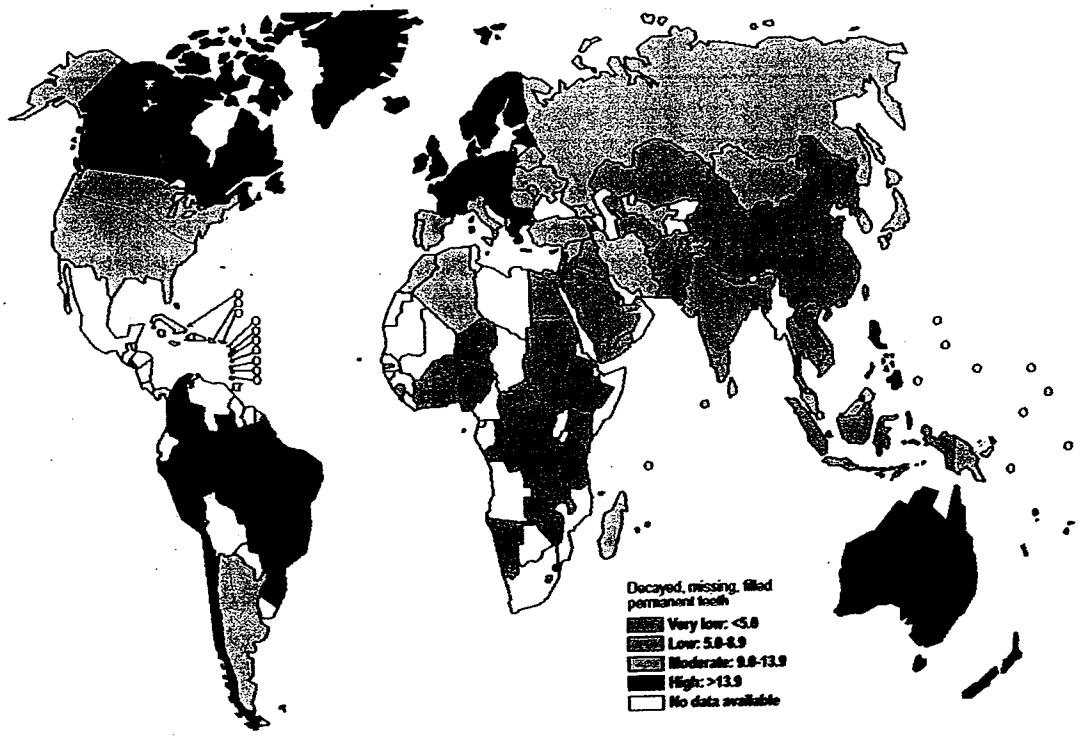


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DENTAL CARIES AMONG 12 YEARS, WHO 2003



DENTAL CARIES AMONG 35 - 44 YEARS, WHO 2003



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Quantity:

The quantity of saliva secreted normally is 700 - 800 ml / day. The quantity of saliva may influence caries incidence as is especially evident in cases of salivary gland aplasia and xerostomia in which salivary flow may be entirely lacking, with rampant dental caries the typical result. However, mild increase or decrease in flow is of little significance in the development of caries.

Viscosity:

It has been suggested to be of some significance in accounting for differences in caries activity between different persons. Miller reported that salivary viscosity was not of great importance in the caries process, since numerous cases would be found in which saliva was extremely viscid and the patients were free of caries. Occasional workers have, however, reported that a high caries incidence is associated with a thick, mucinous saliva. The viscosity of saliva is due largely to the mucin content.

ANTIBACTERIAL PROPERTIES:

Salivary antibacterial substances or enzymes are,

a) Lactoperoxidase, b) Lysozyme, c) Lactoferrin, d) IgA

1.Lactoperoxidase :

These enzymes participate in killing micro organisms by catalyzing the hydrogen peroxide mediated oxidation of a variety of substances in the microbes. Utilizing thiocyanate ions in saliva or halide ions in the phagocyte system, peroxidases generate highly reactive chemical compounds that bind and inactivate several intracellular microbial enzyme systems, as well as microbial surface components.

Lactoperoxidase has a high affinity for the enamel surface and it forms an important defense mechanism, limiting early microbial colonization of tooth surfaces.

2. Lysozyme :

It is a small, highly positive enzyme that catalyzes the degradation of the negatively charged peptidoglycan matrix of microbial cell walls. There is strong evidence that lysozyme, which is highly positively charged, binds to hydroxyapatite and maintains its activity after binding. Also, because of its positive charge, lysozyme tends to have strong ionic interactions with bacterial cell walls and with the mucins in saliva. In areas of large plaque deposits, a low local pH may interfere with optimal lysozyme binding and function.

Central Library,
A.C.P.M. Dental College,
DHULE.

3.Lactoferrin :

It is an iron binding basic protein, found in saliva with molecular weight near 80,000. In the oral cavity, it tends to bind and limit the amount of free iron. Since iron is essential for microbial growth, this salivary protein is an active host defense mechanism.

4.IgA:

3289

It is the predominant immunoglobulin present in saliva. It's concentration averages about 6 mg%.

Secretory IgA is an effective agglutinin because each molecule possesses four antigen binding sites. It inhibits adherence and thereby prevents colonization of mucosal surfaces and teeth by organisms, facilitating their disposal by swallowing.

Other host factors:

Age, illness and socioeconomic conditions also influence caries development. Caries of enamel is comparatively less as the individual ages. However root caries is common in the elderly because of the exposure of cementum due to improper tooth brushing.

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Systemic penicillin given prophylactically on a long term basis to patients with rheumatic heart disease reduced the caries activity. It was also found that patients of high socio economic status have less caries risk than those of lower socioeconomic status.

B. MICROFLORA WITH A CARIOGENIC POTENTIAL

A variety of microbial factors have been associated with caries activity. Various observations indicate a causal relationship between Streptococcus Mutans and the development of the early carious lesion of enamel. Lactobacilli, however seem to be associated with dentinal caries and Actinomyces strains with root surface caries.

The fact that S. Mutans is closely associated with caries does not mean that it is the only microorganism causing caries, nor does it imply that S. Mutans is always cariogenic. When groups of highly caries active and caries inactive persons were compared, statistically, significant correlations have been found between caries activity and the proportions of both S. Mutans and Lactobacilli in plaque or saliva. However, in studies of persons unselected with regard to caries activity, no definite correlations have been observed.

Role of microorganisms in caries:

- Micro organisms are a prerequisite for caries initiation.
- A single type of micro organism is capable of inducing caries.
- The ability to produce acid is a prerequisite for caries induction, but not all acidogenic organisms are cariogenic.
- Streptococcus strains that are capable of inducing caries are also able to synthesize extracellular dextrans or levans. Not all strains that produce extracellular polysaccharides are capable of carious induction.
- Organisms vary greatly in their capacity to induce caries.

Role of dental plaque :

Dental plaque is a complex, metabolically interconnected, highly organized, bacterial ecosystem. It is a structure of vital significance as a contributing factor to the initiation of the carious lesion.

An important component of dental plaque is acquired pellicle, which forms just prior to or concomitantly with bacterial colonization and may facilitate plaque formation. However, the presence of plaque does not necessarily mean that a carious lesion will develop at that point.

The microbiology of dental plaque includes three groups of microorganisms namely,

1. Streptococci
2. Actinomyces
3. Veillonellae

Of all these, S. Mutans is considered to be the chief etiologic agent in dental caries. It is now generally and universally agreed that the accumulation of dental plaque, even on a clean tooth surface can result in dental caries in an individual susceptible to the disease and consuming a diet conducive to the disease

Dental plaque contain in the order of 10^8 organisms per mg wet weight, i.e., 10^9 organisms are present in 10 mg of plaque, which is typically the accumulation on a tooth in one day without brushing. In young plaques, streptococci usually predominate. When a plaque is undisturbed, it will become thicker after a few days. The flora of the plaque then changes from its predominantly coccal form to a mixed filamentous form.

Properties of cariogenic plaque:

If acid production from readily fermentable substrates by certain plaque bacteria is the mechanism involved in enamel destruction during the formation of a carious lesion, the metabolism and microbial composition of plaque should reflect these properties.

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1. The rate of sucrose consumption is noticeably higher in cariogenic plaques.
2. Bacteria in cariogenic plaques synthesize more intracellular glycogen-amylopectin-type polysaccharides.
3. Upto 20% of the sucrose consumed within 15 minutes, is converted into intracellular polysaccharides by cariogenic plaque.
4. Cariogenic plaque forms more lactic acid from stored intracellular polysaccharides.
5. Cariogenic plaque forms approximately twice as much extracellular polysaccharide from sucrose as do non - cariogenic plaque.
6. Cariogenic plaque contains higher levels of S. Mutans than non - cariogenic plaques.
7. Non - cariogenic plaque harbor higher levels of S. Sanguis and Actinomyces than cariogenic plaque.
8. Non - cariogenic plaque have significantly higher proportions of dextranase producing organisms.
9. Non - cariogenic plaque have higher levels of Veillonella and slightly lower concentration of lactic acid.

It is apparent that clear differences exist in the metabolic patterns of plaque associated with carious areas as compared to plaque associated with non - carious surfaces.

C. A SUITABLE LOCAL SUBSTRATE - DIET

The role of diet and nutritional factors deserves special consideration because of the often observed differences in caries incidence of various populations who subsist on dissimilar diets.

DIET is defined as the types and amounts of food eaten daily by an individual (FDI, 1994)

NUTRITION is defined as the sum of the processes by which an individual takes in and utilizes food (FDI, 1994)

Physical properties of food and cariogenicity:

The physical properties of food may be significant by affecting food retention, food clearance, solubility and oral hygiene. Physical properties of food, particularly those that improve the cleansing action and reduce the retention of food within the oral cavity and increase saliva flow are caries preventive.

Physical nature of diet:

It has been suggested as one factor, responsible for the difference in caries experience between primitive man and modern man. The diet of primitive man consisted generally of a great deal of roughage, which cleanses the teeth of adherent debris during mastication. In the modern diet, soft refined foods tend to cling tenaciously to the teeth and are not removed because of the general lack of roughage. It has been demonstrated that mastication of food dramatically reduces the number of culturable oral microorganisms. Therefore, mechanical cleansing by detergent foods may have some value in caries control.

Carbohydrate content of diet:

It has been almost universally accepted as one of the most important factor in the dental caries process and one of the few factors, which may be voluntarily altered as a preventive dentistry measure.

Vitamin content of diet:

Vitamin A: It's deficiency has definite effects on developing teeth in animals, although there are no human studies relating excess or deficiency of Vitamin A to dental caries experience.

Vitamin D : There is general agreement on the necessity of Vitamin D for the normal development of the teeth. In spite of the fact that children who have suffered from rickets may exhibit a slightly higher caries

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experience, other local factors appear to be of greater importance. Evidence indicates that Vitamin D supplements may reduce the dental caries increment, particularly in children, who may not be receiving adequate Vitamin D. However, ingestion of Vitamin D in excess of adequate metabolic requirements has only a questionable effect on caries experience.

Vitamin K : It has been tested as a possible anticaries agent by virtue of its enzyme inhibiting activity in the carbohydrate degradation cycle. There are no known effects of Vitamin K deficiency on dental caries incidence.

Vitamin B complex: Vitamin B6 (Pyridoxine) has been proposed as an anticaries agent on the hypothetical ground that it selectively alters the oral flora by promoting the growth of non - cariogenic organisms which suppress the cariogenic forms.

Calcium and phosphorous dietary intake: Disturbance in calcium and phosphorous metabolism during the period of tooth formation may result in severe enamel hypoplasia and defects of the dentin. Available evidence indicates that there is no relation between dietary calcium and phosphorous and dental caries experience.

Fluoride content of diet: Varying amounts of fluoride are found in many plant substances. In general, the leaves contain more fluoride than the stems and the skin of fruit contains more than the pulp. Some researchers believe that topical fluorides are more important compared to systemic fluorides.

DIETARY STUDIES ON CONTROLLED HUMAN POPULATIONS

1.VIPEHOLM STUDY

(Described by Gustaffson et al in 1954, summarized by Davies in 1955)

It was a five year investigation of 436 adult inmates of Vipeholm hospital in Lund, Sweden, an institution for the mentally challenged.

Purpose of the study

To find out

1. Does an increase in carbohydrate (mostly sugar) intake cause an increase in dental caries?

   If so, is caries activity influenced by

- The ingestion at meals of refined sugar in a non sticky form
- The ingestion at meals of sugar in a sticky form
- The ingestion between meals of sugar in a sticky form

2. Does a decrease in carbohydrate (sugar) intake produce a decrease in dental caries?

Method

The institutional diet was nutritious, but contained little sugar, with no provision for between meal snacks. Four meals were eaten daily. The dental caries rate in the inmates was relatively low. The experimental design divided the inmates into 1 control and 6 experimental groups;

1. A control group

It consisted of 60 males with an average age of 34.9 years who for 2 years received a low carbohydrate, high fat diet practically free from refined sugar. Caries activity was completely suppressed.
After 2 years this diet was replaced by an ordinary diet to which was added 110 gms of sugar a day at meal times which was accompanied by a small but significant rise in caries.

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2. A sucrose group

It consisted of 57 males who received 300 gms of sucrose given in solution, at meal times but was reduced to 75gms during the last 2 years. No significant increase in caries increment was found.

3. A bread group

Were subdivided into 41 males and 42 females and received once daily with their afternoon coffee, 345 gms of sweet bread containing 50 gms of sugar daily during the first 2 years, which did not produce a demonstrable increase in caries. During the second 2 years, 4 portions of sweet bread were given daily with all meals resulting in a significant increase in caries, more in males than in females.

4. A chocolate group

It consisted of 47 males who received 300 gms of sucrose given in solution, at meal times during the first 2 years which was reduced to 110 gms supplemented by 65gms of milk chocolate daily between meals during the second 2 years. Caries increment was low in the initial period but increased significantly in the second period.

5. A caramel group

After 2 control years, this group of 62 males, received 22 caramels daily in 2 portions between meals during the third year, changed in the fourth year to 22 caramels in 4 portions between meals. In the fifth year, the caramels were withdrawn and replaced by an isocaloric quantity of fat with meals. There was a significant increase in caries increment which resulted in withdrawal of caramels resulting in a fall in the caries increment.

6. An 8 toffee group

It consisted of 40 males who got a low carbohydrate, high fat diet in the first year. They then received 8 toffees a day in the second year during breakfast and lunch which was later changed to in between meals.

7. A 24 toffee group

The group consisted of 48 males who received 24 toffees between meals during the third and fourth year followed by the withdrawal of the toffees in the fifth year. This group showed the greatest increase in caries during the 3rd and 4th year followed by a sharp drop in the fifth year.

The main conclusions of the Vipeholm study were;

1. An increase in carbohydrate (mainly sugar) definitely increases the caries activity.
2. The risk of caries is greater if the sugar is consumed in a form that will be retained on the surfaces of the teeth.
3. The risk of sugar increasing caries activity is greatest, if the sugar is consumed between meals.
4. Upon withdrawal of the sugar rich foods, the increased caries activity rapidly disappears.
5. Caries lesions may continue to appear despite the avoidance of refined sugar and maximum restrictions of natural sugars and dietary carbohydrates.
6. The increase in the clearance time of the sugar increases the caries activity.

This study showed that the physical form of carbohydrates is much more important in cariogenicity than the total amount of sugar ingested.

Drawbacks of the study:

1. The groups were made up from the patients in individual wards with no possibility of matching the age or initial caries status.
2. The patients were mentally challenged and did not always understand or follow the instructions correctly.

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3. The dietary regimes of the various groups were not changed in a consistent pattern, some groups having longer periods of sugar with meals compared to others.
4. It is considered unethical to alter diets experimentally in directions likely to increase disease.

2. HOPEWOOD HOUSE STUDY

(Sullivan and Harris-1958, Harris-1963)

The dental status of children between 7 to 14 years of age residing at Hopewood House, Bowral, New South Wales, was studied longitudinally for 10 years. Almost all these children had lived from early infancy at Hopewood House.

All lived on a strictly natural diet, that, with the exception of an occasional serving of egg yolk, was entirely vegetable in nature and largely raw. The absence of meat and a rigid restriction of refined carbohydrate were the two principal features of the Hopewood House diet.

The meals were supplemented by vitamin concentrates and an occasional serving of nuts and a sweetening agent such as honey. The fluoride content of water and food was insignificant and no tea was consumed.

At the end of a ten year period, the 13 year old children had a mean DMFT per child of 1.6. The corresponding figure for the general child population was 10.7 .

53 % of the children at the Hopewood House were caries free whereas only 0.4% of the 13 years old state school children were free from caries.

The children's oral hygiene was poor, calculus uncommon, but gingivitis was prevalent in 75% of children. This work showed that, in institutionalized children at least, dental caries can be reduced by a spartan diet, without the beneficial effects of fluoride and in the presence of unfavorable oral hygiene.

3. TURKU SUGAR STUDY

(Scheinin and Makinen in 1975)

The study was carried out in Turku, Finland.

Aim of the study

- To compare the cariogenicity of Sucrose, Fructose and Xylitol.

Basis of the study

- Xylitol is a sweet substance not metabolized by plaque micro organisms

Method

In a 2 year feeding study, 125 young adults with an average age of 27.6 years were divided into three groups based on their own preference.

They consumed the entire dietary intake using these sugars exclusively,

Sucrose group - 35 people

- Fructose group - 38 people
- Xylitol group - 52 people

About 100 items including pastries, candies, chewing gum, pickles, mustard and even cough mixture were made with the two alternative sugars.

Findings of the study

After one year,

- Sucrose and fructose had equal cariogenicity whereas xylitol produced almost no caries.

By the second year,

- Caries had continued to increase in the sucrose group but remained unchanged in the fructose group whereas xylitol produced almost no caries.

Therefore,

- Fructose was less cariogenic than sucrose

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- Xylitol was non cariogenic or even anticariogenic (because of the number of reversals of the early white spot lesions)

4. HEREDITARY FRUCTOSE INTOLERENCE (HFI)

It is caused by the remarkably reduced levels of hepatic fructose-1-phosphate aldolase which splits fructose-1-phosphate into two three - carbon fragments to be further metabolized.

Persons affected with this rare metabolic disorder tend to avoid any food that contains fructose or sucrose, because the ingestion of these foods causes symptoms of nausea, vomiting, malaise, tremor, excessive sweating, and even coma due to fructosemia.

Newbrun in 1969 tabulated the caries prevalence of 31 persons with HFI and found that the dental caries prevalence was extremely low.

ANIMAL STUDIES

Animal studies have greatly increased the knowledge of the relationship between carbohydrates and dental caries. Some general conclusions that can be drawn from the studies are,

1. Rats fed by stomach tube do not develop caries despite the prevalence of a cariogenic microflora.
2. Sugar in solution produces significantly less caries than does solid sugar.
3. Coarse particles of sugar are less cariogenic than finely ground powdered sugar.
4. Litters born of animals fed a high cariogenic diet during pregnancy develop much more caries than those who were fed a non cariogenic diet.
5. Post eruptive maturation of teeth is greatly reduced in a high sugar environment.
6. When caries resistant animals are subjected to appropriate dietobacterial challenge, they develop highly active infections with extensive multi-surface lesions.
7. Raw starch usually has a low ability to produce caries. Partially cooked starch when combined with other sugars, has high caries producing potential.
8. Caries conducive streptococci do not colonize smooth surfaces of teeth and do not induce severe caries in the absence of carbohydrate in the diet, particularly sucrose.
9. Frequent intake of sucrose for at least 60-100 minutes / day is associated with the formation of rampant caries.
10. Dental plaques developed in primates fed by gastric intubation contain less carbohydrate and do not lower plaque pH following exposure to sugar solutions.
11. Phosphate additions to diets of experimental animals result in a major reduction in dental caries.
12. Addition of fluoride to the diet or drinking water results in a major reduction of dental caries.
13. The sugar alcohols, xylitol, sorbitol and mannitol have no ability to initiate or support caries in laboratory animals.
14. The relative cariogenicity of sucrose, maltose, glucose and lactose cannot always be consistently demonstrated in animal experiments.
15. Sugars, naturally present in foods like bananas, grapes, raisins, honey and figs cause as much caries as do refined carbohydrates and added sucrose.

In spite of these findings, animal data must be interpreted with caution due to the entirely different ecologic system in the human mouth compared to experimental animal mouths.

PREVENTION

The approach to preventing the development

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of dental caries is to establish and maintain good oral hygiene, optimize systemic and topical fluoride exposure and eliminate prolonged exposure to simple sugars in the diet.

Prevention of caries is based on breaking the chain of events that promote the formation of caries:

- By modifying the cariogenic bacterial flora
- By altering the substrate on which these bacteria survive
- By rendering the tooth less susceptible

Primary preventive measures are aimed at reducing the occurrence of new cases of caries in a population. This is accomplished by introduction of fluoride in communal water supplies or the avoidance of sucrose containing in between meal snacks.

Secondary prevention aims at reducing the prevalence of caries. The use of radiographs to detect initial carious lesions leads to prevention at the secondary level.

Tertiary prevention involves a treatment phase aimed at maximum limitation of disability and maximum rehabilitation.

Levels of Prevention	PRIMARY		SECONDARY	TERTIARY	
Preventive Services	Health Promotion	Specific Protection	Early diagnosis and prompt treatment	Disability limitation	Rehabilitation
Services provided by the individual	-Diet planning -Demand for preventive services -Periodic visits to the dental office	-Appropriate use of fluoride -Ingestion of fluoridated water -Use of fluoride dentifrice -Oral hygiene practices	Self examination and referral Utilization of dental services	Utilization of dental services	Utilization of dental services.
Services provided by the community	-Dental health education programs -Promotion of research efforts -Lobby efforts	-Community school water fluoridation -School fluoride mouth rinse program -School fluoride tablet program -School sealant program	screening and referral Provision of dental services	Provision of dental services	-Provision of dental services
Services provided by the dental professional	-Patient education -Plaque control program -Diet counseling -Recall reinforcement	-Topical application of fluoride -Fluoride supplement / rinse -Pit and fissure sealants -Caries activity tests	-Complete exam -Prompt treatment of incipient lesions -Preventive resin restorations -Simple restorative dentistry -Pulp capping	-Complex restorative dentistry -Pulpotomy -RCT -Extraction	-Removable and fixed prosthodontics -Minor tooth movement -Implants.

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DENTAL CARIES VACCINE

The term 'Vaccine' is a Latin word which means a suspension of attenuated or killed micro-organisms (bacteria, viruses or ricketsiae) administered for the prevention, amelioration or treatment of infectious diseases.

'Vaccine' is an immuno-biological substance designed to produce specific protection against a given disease. It stimulates the production of protective antibody and other immune mechanisms.

The concept of vaccination against dental caries was strengthened because of,

- The transmissible and infectious nature of dental caries
- The discovery and understanding of the secretory immune system

IMMUNIZATION

Immunization is the process by which an individual's immune system becomes fortified against an agent (known as the immunogen).

Immunisation can be achieved in an active or passive fashion. vaccination is an active form of immunization.

Active immunization

Active immunization entails the introduction of a foreign molecule into the body, which causes the body itself to generate immunity against the target. This immunity comes from the T cells and the B cells with their antibodies.

Active immunization can occur naturally when a person comes in contact with, for example, a microbe. The immune system will create antibodies against the microbe. The next time the immune response against this microbe can be very efficient.

Artificial active immunization is a process where the microbe, or parts of it, are injected into the person so that they develop antibodies and become immune. If whole microbes are used, they are pre-treated, so that they will not harm the injected person. Depending on the type of disease, this technique also works with dead microbes, parts of the microbe, or treated toxins from the microbe.

Passive immunization

Passive immunization is a process whereby pre-made elements of the immune system, such as antibodies, are transferred to a person, and the body doesn't have to create these elements itself. This method of immunization begins to work very quickly, but it is short lasting, because the antibodies are naturally broken down, and if there are no B cells to produce more antibodies, they will disappear.

Passive immunization can also be naturally acquired when antibodies are being transferred from mother to fetus during pregnancy, to help protect the fetus before and shortly after birth.

Artificial passive immunization is normally given by injection and is used if there has been a recent outbreak of a particular disease or as an emergency treatment to poisons (for example, for tetanus). The antibodies can be produced in animals or in vitro.

Streptococcus Mutans

S. mutans is the bacterium most intimately associated with initiation and development of carious lesion. It is a facultative anaerobic, non-haemolytic, acidogenic organism, producing extra cellular and intracellular polysaccharides. The minimum infective dose in man is 10^4 to 10^5 S. mutans per ml of saliva. The organism fulfills Koch's postulates as a cause of dental caries.

1. S. mutans is found in the plaque of carious teeth and cannot usually be isolated in the absence of caries.
2. The organism can be grown in pure culture.

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3. Infection of germ-free rats or normal hamsters with S. mutans has induced caries
4. The organism can then be recovered from the carious lesion and grown in pure culture.
5. Antibodies to this organism are increased in patients with caries.

Cariogenicity of S.mutans has been related to Its ability to

- Colonize on the teeth.
- Produce extra and intra cellular polysaccharides.
- Produce large amount of acids even at low pH values.
- Utilize salivary glycoproteins.

S. mutans has been separated into seven serotypes (a to g) by means of precipitating and immunofluorescence techniques. The ones important in promoting caries in humans are S. mutans containing strains of serotypes c, e & f. Serotype c contains only polymers of glucose and rhamnose, whereas serotype d has in addition galactose. S. mutans consists of a cell wall and protoplast membrane which encloses the protoplast of the organism. The surface antigens of the cell wall are involved in the immunogenicity of the organism. A large number of antigens have been identified, of which the most important are proteins, including the enzyme glucosyl transferase and wall-associated proteins.

Glucosyltransferases (GTF)

They are a group of extra cellular enzymes involved in the synthesis of polymers (glucans) from sucrose. In rodent studies, the use of GTF as an immunizing antigen has resulted concomitantly in an inhibition of S. mutans accumulation in dental plaques and in caries reduction. The application of novel techniques, including gene cloning, is also bringing to light previously uncharacterized forms of GTF which have yet to be tested as vaccines.

Wall-associated proteins

Two purified proteins from the surface of S. mutans serotype c have been suggested for use as dental caries vaccines.

Antigen B has the advantage of being found in all serotypes of streptococci and could therefore give wide-ranging protection. It has, however, been suggested to be heart cross-reactive, and therefore regarded as unacceptable at present.

The other wall-associated protein of interest is Antigen A, which is a small molecular weight cell wall protein (29,000 daltons). It has been purified and has been shown to be effective in gnotobiotic rats and monkeys. Antigen A is quite distinct from the known Heart Cross-Reactive Antigens (HCRA) of S. mutans and has been put through the extensive toxicological tests required of new therapeutic agents. The vaccine using Antigen A has been produced on a large scale and initial trial using volunteers is pending.

Source of antibodies in saliva

Protection against dental caries by immunization would be achieved by

- IgG antibodies from serum,
- IgA antibodies in salivary secretions or
- A combined effect of serum and salivary components.

The major immunoglobulin in saliva is secretory IgA, whereas IgG, which comprises about 80% of the total immunoglobulin in serum, is found only in low level in salivary secretions. The molecular configuration renders the secretory IgA antibody exceptionally resistant to digestion by proteolytic enzymes. Consequently, it can function highly effectively in an oral environment which contains microbial proteases. Salivary IgA plays an important role in the defense of the host against colonization of streptococci by agglutination of the organisms.

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The concentration of IgA is 19.4 mg ± 5.37 mg / 100 ml of unstimulated mixed saliva and assuming a salivary flow of about 1lt /day, about 190mg of IgA are secreted daily into the oral cavity. The concentration of IgG is 1.44 mg ± 0.9 mg / 100 ml of unstimulated mixed saliva

Types of caries vaccine

Vaccines may be prepared from

- Live modified organisms
- Inactivated or killed organisms
- Extracted cellular fractions, toxoids or combination of these.

In the past, the most popular type of vaccine was prepared from whole cells of S. mutans killed by heat or by treatment with formalin. This resulted in cross-reactivity with other tissues. When animals are injected with whole S. mutans bacteria, they form antibodies which react not only with the bacteria but also with heart tissue. There was a chance that antibodies induced by the heart cross-reactive antigens (HCRA) would cause damage to the heart. However recent advances promise to provide safer, more effective vaccines.

Periglandular salivary immunization

In this method, repeated subcutaneous injections of formalin killed S. mutans in Freunds adjuvant were administered adjacent to the salivary glands. This resulted in protection but inoculation with similar antigens in sites remote from the salivary glands were less consistently successful.

Salivary gland immunization by combined periglandular injection and installation of S. mutans into the parotid duct

Combined immunization of monkeys by multiple periglandular injections, followed by retrograde ductal installation of S. mutans resulted in both salivary IgA and serum IgG antibodies. There was a reduction in the number of S. mutans on the teeth and although this could be ascribed to salivary antibodies, the serum antibody titres were much higher than those in saliva. This regime also lead to some functional impairment of the salivary gland.

Parenteral immunization

Killed S. mutans were administered to germ-free rats in the drinking water for 45 days, before implantation of live S. mutans, throughout the experimental period. A significant reduction in caries was related to an increased level of salivary IgA antibodies to S. mutans, as the serum antibody titre was minimal. That, IgA can be involved in the protection against caries has been established by passive transfer of secretory IgA antibodies in the milk of lactating rats to their litter. Unlike IgG antibodies which are absorbed by the gastrointestinal tract of the offspring to enter the blood and are found in both serum and saliva, IgA antibodies do not demonstrate these features. It is therefore not certain whether passive transfer of IgA in the milk has a protective value by directly preventing adherence of S. mutans to the tooth or indirectly by being absorbed into the blood circulation and then affecting the tooth via crevicular fluid or saliva.

Oral sub mucous immunization

Cells or cell walls mixed with an adjuvant are injected under the mucosa of the buccal sulci of the four quadrants of the mouth. Although the serum antibody response was comparable to that elicited by subcutaneous immunization, the salivary antibody titres were only marginally higher. This method of immunization resulted in a significant

3289

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reduction in caries, which is similar to that found with subcutaneous immunization. As the immunological advantages of oral submucous immunization are questionable and this is an untried route which might lead to some discomfort and possibly complications it has not been pursued energetically.

Ingestion of whole S. mutans

Several studies have been conducted in humans to determine the antibody response following the ingestion of whole S. mutans. This approach is attractive because most people who are moderately infected by S. mutans may swallow several million of these microorganisms per day, apparently without any untoward effects . It has been postulated that if the equivalent of several years of dosage of S. mutans could be given over a short period of time, it might be possible to induce the type of protection which is believed to be observed in adults. It has been studied that in subjects who swallowed S. mutans, encapsulated in such a manner that the content is not released until the capsules reach the lower bowel where Peyer's patches are located, it could stimulate an antibody response which is reactive with the homologous microorganisms.

Murine monoclonal antibody

It is a method of passive immunization. Applying murine monoclonal IgG antibody (to streptococcal antigen) to monkey gingiva, resulted in decreased colonization of implanted S. mutans, reduced caries and it also did not show tissue reactive properties associated with active immunization with this agent.

Immune bovine milk

It is a method of passive immunization wherein ingestion of food supplemented with immune bovine milk resulted in diminished S. mutans, less plaque and reduced caries in rodents.

Egg yolk antibody

It is a method of passive immunization involving immunization of hens with GTF, followed by purification of the antibody-enriched IgG from egg yolks and the experimental use of this enriched antibody as a dietary additive in rodents. Dental caries was reduced by 50%.

Replacement therapy

Dr. Jeffrey D. Hillman has developed a genetically-modified strain of Streptococcus mutans. The new strain, called BCS3-L1, is incapable of producing lactic acid, which dissolves tooth enamel, and aggressively replaces native flora. In laboratory tests, rats who were given BCS3-L1 were conferred with a lifetime of protection against S. mutans. BCS3-L1 colonizes the mouth and produces a small amount of a lantibiotic, called MU1140, which allows it to out-compete S. mutans.

Lantibiotics are produced by a large number of Gram positive bacteria such as Streptococcus and Streptomyces to attack other gram positive bacteria.

Hillman suggests that treatment with BCS3-L1 in humans could also provide a lifetime of protection, or, at worst, require occasional re-applications. The product is being developed at Oragenics under license from the University of Florida.

However, the prospect of introducing genetically modified organisms into the human body's flora has raised muted concerns including the prospect that BCS3-L1 might be more harmful than native S. mutans as a causative agent of inflammatory heart disease.

Conclusion

The salivary IgA concentrations at birth is very low but increases dramatically during the first

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year of life. The colonization of the oral cavity with Streptococci requires the presence of teeth. S. sanguis can be found in children by the end of the first year of life whereas S. mutans are not found in the oral cavity until the 3rd year of life. The period of 2 years of age after primary teeth begin to erupt is called 'window of infectivity'. Theoretically, immunization at approximately 12 months of age would build up a competent immune system to interfere with subsequent colonization and accumulation of S. mutans.

An effective caries vaccine might be advantageous in some groups such as in patients undergoing head and neck radiation and those with severe xerostomia, chronically sick children on continuous medication presented in high sucrose syrups and the mentally or physically handicapped unable to practice adequate oral hygiene.

In the developing countries where the dental caries prevalence has increased, the use of a caries vaccine could be beneficial. The low dentist to population ratio and lack of organized dental healthcare limits the possibilities of utilizing conventional caries preventive methods. Hence, the use of a caries vaccine could be of a great value as a preventive adjunct in some societies and a major public health measure in others.

CARIES RISK ASSESSMENT

"Risk" is defined as "the probability that some harmful event will occur". To predict if new carious lesions (a "harmful event") will develop, or if early lesions will continue to grow, is to assess the caries risk. The importance of properly predicting the occurrence of lesions is obvious as targeted preventive actions can be directed to those persons having a high risk for caries and scarce resources can be properly utilized.

Indications for caries risk assessment:

- Assessment is highly indicated in populations where a large portion is caries-free, but some individuals are still highly caries-active.

In a population where majority of people are caries-active, there is little use of risk assessment, as a population strategy is more effective (= general preventive measures given to everyone). Likewise, in a population where practically no persons develop caries, risk assessment would be of little use

- Where resources are available to take care of these targeted persons.

How to select risk groups or risk individuals?

There are several factors and characteristics that accompany the development of an increased number of carious lesions, which are helpful in caries risk assessment.

In considering them, it is important to differentiate between

a) Factors or circumstances that are indirectly related to such events, referred to as "risk indicators".
B) Factors that are directly involved in the biochemical events resulting in the carious lesions, biochemical factors.

Risk indicators

1. They are circumstances, which may indicate increased caries risk,

Examples:

- Socially deprived, no work, bad economy
- Low knowledge, low education of parents
- No regular dental check-up

These conditions can result in more cariogenic food, in less good oral hygiene, saliva problems, reduced fluoride support. It should be observed that 'bad economy' under certain circumstances may promote caries,

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for example if carbohydrate products in the area are cheaper than proteins. In another society, 'bad economy' may work in the opposite direction, as there will be no money to buy sweets.

2. Factors related to general health which may indicate increased caries risk,

Examples:

- General diseases
- Various handicaps

Several diseases or their treatments, affect saliva secretion. Also, the conditions can result in more cariogenic food and in less good oral hygiene.

Handicaps can interfere with the maintenance of oral hygiene, which might increase the caries risk.

3. Epidemiological factors or circumstances which may indicate increased caries risk,

Examples:

- Living in high DMF country
- Living in high DMF area
- Member of high DMF family
- High past caries experience
- Intra-oral distribution of earlier lesions/fillings

Country/area/family can be characterized by frequent intakes of cariogenic food, high S. Mutans load, less good oral hygiene and low fluoride in drinking waters. High past caries experience indicates that the individual is susceptible and/or might have been under cariogenic challenge - the same factors that caused the past disease may still be in operation. The distribution of earlier lesions / fillings reflect to some extent the cariogenic pressure that has been in operation. Fillings/cavities in front teeth in the lower jaw, for example, indicates a serious situation, as these teeth normally are the last ones to be affected by caries.

4. Clinical findings which may indicate increased caries risk,

Examples:

- Early signs of disease (for example white spot lesions)
- Newly erupted teeth

FACTOR	HIGH RISK	LOW RISK
Amount of plaque	Large amount of plaque on the teeth, meaning many bacteria that can produce acids (low pH, demineralization)	Few bacteria = "good" oral hygiene
Type of bacteria	Large proportion of "cariogenic" types of bacteria, resulting in lower pH and sticky plaque and also prolonged acid production	Low proportion of "cariogenic" types
Type of diet	High in carbohydrates, in particular sucrose; "sticky" diet leading to low pH, longer time	Low sugar content; non- "sticky" type of diet
Frequency of carbohydrates	High sugar frequency resulting in longer time per day with low pH	Low sugar frequency
Saliva secretion	Reduced saliva flow leading to prolonged sugar clearance time and to a reduced amount of other saliva protective systems	Optimal, helps to wash out sugars and acids
Saliva buffer capacity	Low buffer capacity resulting in prolonged time with low pH	Optimal, shorter time with low pH
Fluorides	Absent: reduced remineralization	Available: increased remineralization

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- Exposed root surfaces
- Crowded teeth
- Deep fissures or other "natural" retentive sites
- Retentive sites caused by dental treatment

Early signs of disease can reflect an ongoing caries process and is therefore not a real risk indicator, as the "risk" stage has already passed. However, it is a risk factor in the sense that the caries process may continue even in the future. Newly erupted teeth and exposed root surfaces are less resistant. Crowded teeth and various retentive sites, including orthodontic appliances, indicate risk for increased plaque accumulation and reduced saliva flow over the tooth surfaces concerned.

Biochemical factors

Factors to which the tooth surface is directly exposed to and which contributes to the development of the lesion. These factors may, depending on the "dose" and "duration", indicate higher or lower risk for caries. For example, a large amount of plaque ("high dose") indicates high risk only if present for a longer period of time ("long duration").

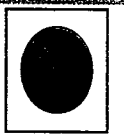
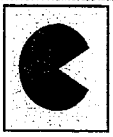
CARIOGRAM

It is a model proposed by Bratthall D (1996), WHO Collaborating Centre, Malmö University, Sweden, to illustrate the interactions between bacteria, diet and host response. The process of making the evaluation is termed 'Cariography'.

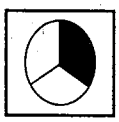
Principles of Caries Risk Estimation - Based on the "Cariogram" Concept

"Caries Risk" is a term used to indicate what will happen in the future - will there be

Cariogram principles

Caries - Cavities will occur	No new cavities
 Full circle	 Broken circle
Illustrates the unfavorable situation where caries will develop. There are enough bacteria, a cariogenic diet, and a susceptible host	Illustrates a situation where "something is missing" for cavity formation. - It is a positive situation.

What do the colors indicate?

Bacteria	Sugars	Susceptibility
		

Large sectors	Small sectors
 Large sector (any color) indicates an unfavorable situation.The risk for caries is increased	 Small sector indicates a favorable situation. The risk for caries is lower

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demineralization and will new cavities occur? The evaluation is made for a certain period of time, for example for the coming year.

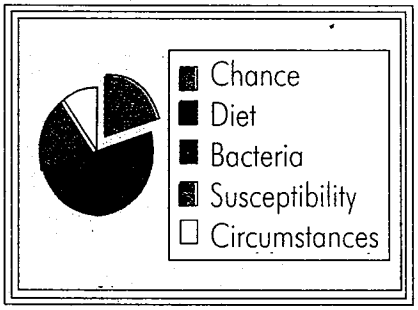
The "Cariogram" model can be used to illustrate the caries risk. The risk is expressed as "Per Cent Chance to Avoid Cavities". A low percentage, for example 5%, indicates a high caries risk. In contrast, 90% chance to avoid cavities indicates a very low caries risk.

Points to consider when using the "Cariogram" for risk evaluation:

- The "Chance to Avoid Cavities" must be between 0 and 100 %, it cannot be "negative" or more than 100%.
- In addition to Diet, Bacteria and Susceptibility, a fourth factor "Circumstances" is also included.

The interactive Cariogram computer program calculates the percent chance to avoid cavities, by entering values ranging from 0-3 for different parameters. The score "0" is the most favorable value and the maximum score "3" indicates a high, unfavorable risk value.

Using the Cariogram for Evaluation of Caries Risk



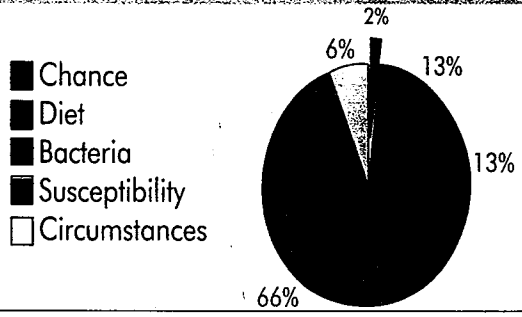
Chance - The Chance to avoid new cavities in the near future
Diet - Frequency of eating as well as contents of diet
Bacteria - Plaque amount as well as types of bacteria
Susceptibility - Tooth resistance (fluorides) and saliva characteristics
Circumstances - Past caries experience and general diseases and conditions

The size of the "Chance" sector is determined by the four other factors - it is "what is left" when the others have taken their shares



The "Chance" is similar in the three Cariograms, but the reasons are different.
Left: All factors add to the high risk. Middle: Bacteria (Red) in particular unfavorable. Right: Susceptibility (Light-blue) in particular unfavorable.

Example: Very High caries risk - only a 2% chance to avoid cavities



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The case illustrated above has a normal caries experience (given score 2) for his age group and a disease (handicap), which is considered being of some relevance (score 1) for the caries activity.

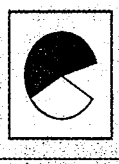
Diet content of sugars is fairly high (score 2) with a frequency of 7 intakes per day, including between meal snacks (score 2).

Oral hygiene (plaque amount) is fairly good (score 1) but the level of Mutans Streptococci is very high (score 3). Fluoride exposure consists of fluoride from toothpaste only (score 2) with no extra supplements. Saliva secretion is very low (xerostomia, score 3) and saliva buffer capacity is somewhat reduced (score 1).

The combination of factors is evaluated as that the risk for new cavities in the coming year is very high. The low saliva secretion rate in combination with the cariogenic diet and the high level of Mutans Streptococci makes it urgent to introduce preventive measures. The low saliva secretion has a heavy impact - that's why the light-blue sector in this case is so large.

How to control dental caries? How to avoid cavities?

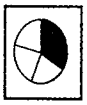
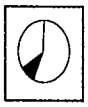
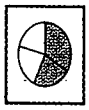
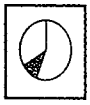
Open the Circle!

	The dark blue sector is reduced indicating that the frequency of sugar containing snacks have been reduced. Result: Less frequent acid attacks.
	The red sector is reduced indicating that the number of cariogenic bacteria has been reduced. Proper oral hygiene, reduction of S. Mutans and Lactobacilli are examples of this action. Result: Less acids formed, slower demineralization.
	The light blue sector is reduced indicating that the susceptibility to disease has been reduced. Proper use of fluoride is one example to increase resistance to caries. Result: Slower demineralization, more efficient remineralization.

Measures to Reduce Caries Activity and Caries Risk

Sector	Patient measures	Dental personnel measures
	To reduce the red sector - the plaque factor - a proper oral hygiene is needed. Tooth brushing twice a day can be seen as a minimum and where indicated, further measures should be installed after instructions from oral health personnel.	Dental personnel can analyze the situation by identifying sites often covered with dental plaque, and instruct how to improve the situation there. Further on, it is possible to analyze the microbial flora to estimate the proportions of cariogenic microorganisms such as Mutans Streptococci and Lactobacilli. Advice can be given on how to avoid high proportions of such microorganisms.

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	Parents can be observant so that their children will have a chance to adopt a low-cariogenic plaque covering their teeth	Dental plaque situation can be improved by repeated professional mechanical tooth cleaning. Where indicated, various antimicrobial solutions can be applied professionally to reduce numbers of cariogenic microorganisms. Patients can be instructed to follow up the treatment by proper home care
 	To reduce the blue sector - the diet/sugar factor - a "sugar discipline" is needed. That means to avoid "unnecessary" frequent intakes of sugar containing snacks. Use of sugar substitutes in sweets can be recommended. Parents can be observant so that their children will have a chance to adopt a proper diet both from a general health as well as a dental health aspect.	Dental personnel can analyze the situation by discussing the dietary patterns and by identifying products that should be avoided or reduced. Further on, it is possible, by analyzing the microbial flora for lactobacilli, to get an idea about the cariogenicity of the food with respect to sugar content. Advice can be given on how to reduce the blue sector by proper diet. Information regarding sugar substitutes can be given.
 	To reduce the susceptibility and increase the resistance to caries, the patient should have a proper fluoride exposure, for example from tooth pastes. In addition, various fluoride supplements can be used after advice from dental personnel. Diet which promotes normal saliva secretion rate by proper chewing is recommended.	Dental personnel can analyze the situation by checking the properties of saliva, like the quantity and its buffering capacity. Dental personnel can then identify the reasons (for example drugs) and if possible try to improve the situation. Saliva substitutes can be recommended in extreme situations. For fluoride, dental personnel can recommend proper supplements. The fluoride concentration at tooth surfaces can be strongly increased by applications from professionally administered products such as fluoride varnishes, gels or solutions. Patients can be instructed to supplement these treatments by proper home care.

In many cases, the measures performed by the patient should be enough to keep dental caries under control after having received proper instructions. In more severe cases, professional measures are needed and the degree of risk factors and disease outcome will decide the intensity of the actions.

When the disease comes under control, the professional measures can step by step be reduced. Saliva samples can often help in deciding when the situation has significantly improved.

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CONCLUSION

Since dental caries is a highly prevalent disease, control of dental caries is a concern of all the people. The ideal control measure for dental caries must have immediate, high and lasting effectiveness, be innocuous and reach all of the people at a cost in money and facilities well within the economic capabilities of the community.

For a developing country like India, the focus should be on assessing the caries risk and identifying those individuals at high risk to develop caries. Preventive measures can then be targeted at this group thereby not only reducing the economic burden of the restorative care but also eliminating pain and improving the overall quality of life

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Chapter 5

EPIDEMIOLOGY, ETIOLOGY AND PREVENTION OF PERIODONTAL DISEASE

INTRODUCTION

EPIDEMIOLOGY

PLAQUE HYPOTHESES

CLASSIFICATION

ETIOLOGY

PREVENTION

CONCLUSION

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INTRODUCTION

The periodontium, defined as those tissues supporting and investing the tooth, comprises of cementum, periodontal ligament, bone lining the tooth-socket (alveolar bone), and that part of the gingiva facing the tooth (dentogingival junction).

Dentogingival junction

The dentogingival junction (gingiva facing the tooth) is an adaptation of the oral mucosa that comprises epithelial and connective tissue components. The epithelium is divided into three functional compartments - gingival, sulcular, and junctional epithelium and the connective tissue into superficial and deep compartments. The junctional epithelium plays a crucial role since it essentially seals off periodontal tissues from the oral environment. Its integrity is thus essential for maintaining a healthy periodontium. Periodontal disease sets in when the structure of the junctional epithelium starts to fail.

The junctional epithelium

The junctional epithelium arises from the reduced enamel epithelium as the tooth erupts into the oral cavity. It forms a collar around the cervical portion of the tooth that follows the cementoenamel junction. The free surface of this collar constitutes the floor of the gingival sulcus. Basically, the junctional epithelium is a nondifferentiated, stratified squamous epithelium with a very high rate of cell turnover. It is thickest near the bottom of the gingival sulcus and tapers to a thickness of a few cells as it descends apically along the tooth surface. This epithelium is made up of flattened cells oriented parallel to the tooth. The cell layer facing the tooth provides the actual attachment of the gingiva to the tooth surface by means of a structural complex called the epithelial attachment.

The connective tissue supporting the junctional epithelium is structurally different from that supporting the oral gingival epithelium. Even in clinically normal circumstances, it shows an inflammatory cell infiltrate. The gingival connective tissue adjacent to the junctional epithelium contains an extensive vascular plexus.

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Cementum

Cementum is the hard, avascular connective tissue that coats the roots of teeth and that serves primarily to invest and attach the principal periodontal ligament fibers. There are basically two varieties of cementum distinguished on the basis of the presence or absence of cells within it and the origin of the collagen fibers of the matrix.

3289

Acellular extrinsic fiber cementum (primary cementum or acellular cementum) which is found on the cervical half to two thirds of the root.

Cellular intrinsic fiber cementum (secondary cementum, cellular cementum) which is distributed along the apical third or half of the root and in furcation areas.

Periodontal ligament

The bulk of the periodontal ligament is the soft, specialized connective tissue situated between the cementum covering the root of the tooth and the bone forming the socket wall (alveolo-dental ligament). It ranges in width from 0.15 to 0.38 mm, with its thinnest portion around the middle third of the root, showing a progressive decrease in thickness with age. It is a connective tissue particularly well adapted to its principal function, supporting the teeth in their sockets and at the same time permitting them to withstand the

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considerable forces of mastication. In addition, the periodontal ligament has the capacity to act as a sensory receptor necessary for the proper positioning of the jaws during mastication and, very importantly, it is a cell reservoir for tissue homeostasis and repair/regeneration.

The periodontal ligament has also the capacity to adapt to functional changes. When the functional demand increases, the width of the periodontal ligament can increase by as much as 50%, and the fiber bundles also increase markedly in thickness. Conversely, a reduction in function leads to narrowing of the ligament and a decrease in number and thickness of the fiber bundles. These functional modifications of the periodontal ligament also implicate corresponding adaptive changes in the bordering cementum and alveolar bone.

Alveolar bone

The alveolar process is that bone of the jaws containing the sockets (alveoli) for the teeth. It consists of outer cortical plates (buccal, lingual, and palatal) of compact bone, a central spongiosa, and bone lining the alveolus (alveolar bone). The cortical plate and bone lining the alveolus meet at the alveolar crest. The bone lining the socket is specifically referred to as bundle bone because it provides attachment for the periodontal ligament fiber bundles.

EPIDEMIOLOGY

Epidemiology is the study of health and disease in populations and the effect of various biologic, demographic, environmental and lifestyle factors on these states. Epidemiologic studies are conducted to

- Describe the health status of populations
- Elucidate the etiology of diseases
- Identify risk factors
- Forecast disease occurrence
- Assist in disease prevention and control

Global data from WHO global oral health data bank

	Country	Year	Age	% of persons with highest score of				
				0	1	2	3	4
1.	Australia	1988	18	0	2	58	38	2
2.	Bangladesh	1990	18	5	5	66	22	1
3.	France	1993	15-19	45	3	51	1	0
4.	Germany	1992	15-19	7	7	11	62	9
5.	India	1990	15-19	6	11	79	5	0
6.	Japan	1988	15	11	4	76	9	0
7.	Nepal	1987	16-19	0	3	93	0	0
8.	Pakistan	1991	15-19	26	20	52	2	0
9.	Singapore	1994	15-18	26	14	59	1	0
10.	United Kingdom	1991	15-19	12	36	49	3	0
11.	USA	1986	15-19	17	13	33	32	5

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Indian Studies

	AUTHORS	YEAR	POPULATION	FINDINGS
1.	Mehta and Sanjana	1956	1640 school children of Bombay city in the age group of 11-17 years	Prevalence of gingivitis was 93.7% and it increased with age
2.	Gupta	1962	800 people, aged 11-50 years in Trivandrum	Periodontal disease was 100% after the age of 30 years and 90% between 11-30 years.
3.	Ramachandra et al	1973	6,647 rural and 1,536 urban population of Tamilnadu state	Periodontal disease in both the population were high (95.3% & 95.5% respectively).
4.	Nagaraj Rao et al	1980	500 school children of 5-10 years of age in Udupi	28% had marginal gingivitis and 7.2% had chronic generalized gingivitis
5.	Anil S, Hari S and Vijaykumar T	1990	2756 subjects aged 15-44 years in Trivandrum	Calculus and bleeding was more frequent (86%) in 15 - 19 years; Shallow pocketing in 80% of subjects in 25 - 29 years; Deep pockets more than 6 mm were in 33% of 35-44 years.
6.	Mathew Kurian et al	1996	1513 subjects aged 15 years and above in Hebri, in Udupi district	0.4% had healthy periodontium. Shallow pockets were observed in 26.6% and deep pockets in 24.1%
7.	Ashwini Rao, Sequeira P, Peter S, Rajeev A.	1999	287 institutionalized elderly aged 60 years and above residing in Mangalore	Shallow pockets were seen in 32.29% of the dentate subjects and none of the subjects had a completely healthy periodontium
8.	Srikanth G et al	2000	300 subjects aged 15 years and above of a fishermen community at coastal Malpe village in Udupi district.	Prevalence of periodontal disease was 91% and there was dominance of calculus (66.6%) as the most frequently recorded score
9.	Christensen LB, Petersen PE, Bhambal A.	2003	11-13-year-olds in Bhopal, India	Fifteen per cent of the children had healthy gingiva and 91% of rural children had maximum CPI score 2. Mean number of sextants with CPI score 0 was 3.5 among children in urban areas and 0.6 for children in slum areas.

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In India, data from the National Oral Health Survey (2002-2003) states that in children aged 12 years, the prevalence of periodontal disease was 57% and in the 15 year age group, it was 67.7%. The prevalence was 89.6% and 79.9% in the 35-44 year and the 65-74 year age group respectively.

PLAQUE HYPOTHESES

Non-Specific Plaque Hypothesis

According to this theory, periodontal disease results from the elaboration of noxious products by the entire plaque flora. When only small amounts of plaque are present, the noxious products are neutralized by the host but when large amounts of plaque are present periodontal disease results. According to this theory, the control of periodontal disease depends on control of the amount of plaque accumulation. This theory was discarded in favor of the specific plaque hypothesis because

- Some individuals with considerable amounts of plaque, calculus and gingivitis never developed destructive periodontitis
- Individuals with periodontitis showed site specificity, with some areas being unaffected and some sites showing advanced disease.

Specific Plaque Hypothesis (Loesche,1976)

This theory states that only certain plaque is pathogenic and its pathogenicity depends upon the presence of or increase in specific microorganisms.

The "ecological plaque hypothesis" (Marsh, 1991)

In this hypothesis, it is proposed that a change in a key environmental factor (or factors) will trigger a shift in the balance of the resident plaque microflora, and this might predispose a site to disease. The occurrence of potentially pathogenic species as minor members of the resident plaque microflora would be consistent with this proposal. Under the conditions that prevail in health, these organisms would be only weakly competitive and may also be suppressed by inter-microbial antagonism, so that they would comprise only a small percentage of the plaque microflora and would not be significant clinically. Microbial specificity in disease would be due to the fact that only certain species are competitive under the new (changed) environmental conditions.

Disease could be prevented not only by inhibiting the periodontopathogens directly but also by interfering with the factors driving the transition.

CLASSIFICATION

1. Gingival diseases
- Plaque-induced gingival diseases
- Non-plaque-induced gingival lesions

2. Periodontal diseases
- Chronic periodontitis
- Aggressive periodontitis
- Periodontitis as a manifestation of systemic disease

ETIOLOGY OF PERIODONTAL DISEASES

Gingivitis is a disease characterized by inflammation restricted to the gingival soft tissues, with no loss of alveolar bone or apical migration of the periodontal ligament along the root surface.

Periodontal disease is defined as "an inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms or groups of specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone with pocket formation, recession or both."

Periodontitis is a multifactorial disease in

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which microorganisms and microbial products in dental plaque are the main etiologic factors. The other factors are the host factors and the environmental factors.

AGENT FACTORS IN PERIODONTAL DISEASES

Materia Alba refers to the soft accumulations of bacteria, desquamated epithelial cells, leukocytes and salivary proteins and lipids. It lacks the organized structure of dental plaque and can be removed by rinsing.

Dental plaque is defined as a structured, resilient, yellow-grayish substance that adheres tenaciously to the intraoral hard surfaces, including removable and fixed restorations. Plaque is composed of bacteria in a matrix of salivary glycoproteins and extracellular polysaccharides and extracellular polysaccharides. It is because of this matrix that plaque cannot be removed by rinsing

1 gram of plaque (wet weight)	Approximately 10^{11} bacteria
Healthy gingival crevice	From 10^{3} bacteria
Deep periodontal pocket	More than 10^{8} bacteria

Dental plaque is classified as

1. Supragingival plaque (Marginal plaque)- found at or coronal to the gingival margin
2. Subgingival plaque - found apical to the gingival margin

Formation of plaque

The three phases in the formation of plaque are

- The formation of pellicle
- Initial adhesion and attachment of bacteria
- Colonization and plaque maturation

The pellicle is a thin, saliva derived layer which forms on the tooth surface immediately on exposure to saliva. It consists of glycoproteins, proline-rich proteins, phosphoproteins, histidine rich proteins and enzymes.

The bacteria are transported to the tooth surface resulting in an initial, reversible adhesion. This is followed by a firm anchorage between the bacteria and the tooth surface.

The firmly attached microorganisms start growing and the newly formed bacterial clusters remain attached to form a biofilm.

Plaque Biofilm

A biofilm is a well organized, cooperating community of microorganisms. They are composed of microcolonies of bacterial cells non - randomly distributed in a matrix. The plaque biofilm has open fluid filled channels (primitive communication systems) running through the plaque which permits the passage of nutrients and other agents. The intercellular matrix consists of organic and inorganic materials derived from saliva, gingival crevicular fluid and bacterial products. The matrix functions as a barrier to retain and concentrate the substances produced by bacteria.

Basic Biofilm Properties

- Cooperating community of various types of microorganisms
- Microorganisms are arranged in microcolonies
- Microcolonies are surrounded by protective matrix
- Within the microcolonies there are differing environments
- Microorganisms have primitive communication systems
- Microorganisms in biofilm are resistant to antibiotics, antimicrobials and host response

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During the first 24 hours, starting from a clean tooth surface, the plaque growth is negligible. During the following 3 days, plaque growth increases at a rapid rate and then slows down. After 4 days, about 30% of the tooth crown will be covered with plaque. In the initial phases, plaque is characterized by gram positive facultative microorganisms which get replaced by gram negative anerobic microorganisms in the later phases.

Key microorganisms in periodontal diseases

Actinobacillus actenomycetemcomitans

Tannerella forsythia

Porphyromonas gingivalis

CALCULUS

Dental calculus is a hard deposit that forms by mineralization of dental plaque and is usually covered by a layer of unmineralized plaque.

Calculus can be classified as

- Supragingival calulus
- It is located coronal to the gingival margin, is white or whitish yellow in color and has a hard, clay-like consistency which can be easily detached from the tooth.
- Subgingival calculus
  It is located below the crest of the marginal gingiva, is dark brown or greenish black in color and is hard and dense which is firmly attached to the tooth surface.

Mineralization of dental plaque results in calculus. Precipitation of mineral salts into plaque starts between the first and the fourteenth day of plaque formation. Microorganisms are not always essential for calculus formation. Calcification begins along the inner surface of supragingival plaque and in the attached component of subgingival plaque and is formed in layers. Calculus formation continues until it reaches a maximum(10 weeks to 6 months) after which it reduces in amount due to mechanical wear from food and from cheeks, lips and tongue (Reversal phenomenon).

HOST FACTORS IN PERIODONTAL DISEASE

1. Age:

The prevalence of periodontal disease has been found to increase with increasing age. However, the greater prevalence and severity of periodontal disease in older individuals is because of the cumulative progression of the lesions over time and not because of the increased susceptibility in older individuals

2. Gender :

In general, epidemiologic studies have shown that males have a higher prevalence and severity of periodontal disease than females. However, the current knowledge of the pathogenesis of periodontal disease indicates no inherent differences between men and women in susceptibility to periodontitis.

3. Socioeconomic status :

Periodontal diseases have been related to lower socioeconomic status. Generally, those who are better educated, wealthier and live in better circumstances have better health status, with a greater frequency of dental visits, than those who are less educated and who live in poorer circumstances.

Lower socio- economic status results in a poor diet, poor oral hygiene, and a general lack of dental awareness. They cannot afford the high cost of dental services and even simple oral hygiene measures involving tooth paste and tooth brushes are considered as luxury items in India. Studies have shown that less than 1/3rd of the Indian population use a tooth brush and tooth paste to clean their teeth.

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Other oral hygiene aids like dental floss, interdental cleaning aids and mouth washes are not widely available and are rarely used. The use of powdered charcoal in cleaning teeth is practiced widely even now, in both urban and rural areas.

4. Diet and nutrition:

Sticky food adheres to the teeth and is difficult to remove, thus, interfering with the natural self-cleansing process of the oral cavity. Foods such as cakes, candies, bread, jam, peanut butter, chocolates and soft breads might aggravate or emphasize an already existing periodontal problem.

The nutrients that have been specifically associated with periodontal tissues are vitamin A, B complex, C and D, calcium and phosphorus. Studies have shown that there is a trend towards a higher prevalence and severity of periodontal disease in areas where protein calorie malnutrition and vitamin A deficiency are common.

Studies have also demonstrated a possible relation of fluoride in the drinking water to periodontal disease. The prevalence of periodontal diseases have been found to decrease in the presence of fluoride.

5. Anatomy:

The preservation of gingival and periodontal health depends largely on the correct form and position of the teeth in the dental arch. The normal contour of the tooth protects the underlying tissues.

Tooth:

Poor cusp anatomy, uneven marginal ridges, lack of contact between teeth and crowding can cause food impaction and accumulation causing the underlying gingival tissue to become irritated and inflamed resulting in periodontal disease.

Soft tissue:

When a frenum is inserted close to the marginal gingiva, the pull of this attachment may cause recession of the inter-proximal papilla. The proximity of the frenum to the marginal gingiva interferes with the proper use of the toothbrush in the area.

Gingivitis is often seen at the time of tooth eruption. Incompletely erupted third molars, partially covered by gingival flaps are often sites of pericoronal infections.

6. Habits:

Unilateral Mastication:

One often finds that one side of the mouth is affected by periodontal disease to a greater degree than the other because of a large cavity, a recent extraction or discomfort on one side of the mouth, as the patient forms a habit of chewing on the unhealthy side only, thus giving little function and stimulation to the affected side. As a result, one side of the mouth is in normal function, the teeth are clean, the gingiva are stimulated and in good health, where as on the neglected side there is loss of tissue tone, accumulation of food debris and calculus and the effects of traumatic occlusion can be seen. A disuse atrophy usually ensues, that results in loss of teeth on the unused or non-functioning side.

Abnormal habits:

Abnormal habits usually involves putting foreign bodies into the oral cavity such as biting a pencil, finger nail, toothpick, etc., opening of bobby pins, lip biting, cheek biting, occupational habits like thread biting, holding nails between teeth, using a reed during playing a wind instrument, pipe smoking, incorrect methods of tooth brushing.

These habits cause traumatic injury of the periodontium. In individuals with the habit of bruxism, the clenching and grinding causes excessive pressure resulting in necrosis of the

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periodontal membrane as tremendous forces are transferred to the attachment apparatus.

7. Local irritants:

Mechanical Irritants:

Faulty toothbrushing can cause abrasion or recession of the gingival tissues and irritate already inflamed tissues. Cross brushing or the scrubbing method, accompanied by an abrasive dentifrice is usually responsible for recession of the gingival tissues along with abrasion of tooth surfaces.

Faulty dentistry such as overhanging margins of any restoration or open-cavity margins impinge on the gingiva or irritate them and these areas provide an ideal location for the accumulation of food debris and the growth of bacteria, which give rise to toxic metabolic products that result in periodontal diseases with resultant bone resorption.

Faulty orthodontic treatment also results in root resorption as well as alveolar bone loss and mobility.

For eg.

- Too rapid movement
- Too vigorous pressure
- Not allowing sufficient resting time between applications of pressure
- Moving tooth against occlusal opposition or into traumatic occlusion
- Unusual tissue responses

Chemical Irritants:

Alcohol, tobacco and condiments directly lowers tissue resistance and increases gingival susceptibility to gingivitis and periodontal diseases.

The deleterious effects of smoking on the gingiva are due to the liberated heat and the products of tobacco such as nicotine.

Atmospheric irritants:

Because of obstructions in the nasal passages, habit, malocclusion, systemic disturbances and psychosomatic factors, some patients breathe through the mouth. The dehydration of the mucous membrane of the mouth leads to a lowered tissue resistance. The tissues enlarge and become fibrotic. resultingin gingiva enlargement/ inflammation.

8. Systemic factors:

The relationship between periodontal disease and systemic health is two way, with systemic factors acting locally to reduce the resistance to periodontal destruction and the local periodontal pathogens acting systemically to produce an impact on the general health.

Many systemic diseases and disorders have been implicated as risk factors in periodontal disease. Studies have shown that although there are specific bacteria associated with destructive periodontal disease, these bacteria do not cause disease simply by their presence alone. The individual host immune response to these pathogens is important. Certain systemic disorders and conditions alters the host tissue, reducing the host defense to periodontal infection, resulting in more destructive disease.

Eg: Anemia, puberty and pregnancy gingivitis, diabetes mellitus, leukemia, hyperparathyroidism, HIV/AIDS, radiation, drugs such as dilantin sodium.

ENVIRONMENTAL FACTORS

1. Geographic variation:

Earlier studies showed considerable differences in susceptibility to periodontal disease between nations. However, the WHO Global Oral Health Data Bank does not suggest any difference between nations and therefore race and ethnicity cannot be considered as risk factors for periodontal disease.

2. Degree of urbanization:

Degree of urbanization appears to be

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Related to periodontal disease. Studies have shown that people living in rural areas had a significantly higher prevalence of periodontal disease than did urban people. This could however be because of other related factors like oral hygiene practices, diet, socioeconomic status or inaccessibility to dental care.

3. Psychological and cultural factors:

India being a country with diverse social and cultural background, the role of these factors in the prevalence of periodontal disease is very significant. Anxiety, fear of the dentist, lack of knowledge about diseases and their treatment are some of the relevant psychological factors. Also certain cultures view dental problems and loss of teeth solely as an extension of the ageing process. Lack of transport as in villages or the belief that periodontal disease is not a life-threatening situation are other factors.

PREVENTION OF PERIODONTAL DISEASE

Periodontal disease is primarily due to bacterial products causing breakdown of the periodontal tissues. Methods of prevention are directed at preventing plaque formation thereby eliminating or controlling the bacteria which produce the disease and / or at increasing the tissue resistance to disease.

PLAQUE CONTROL

Dental plaque is defined as a highly specific variable structural entity formed by sequential colonization of microorganism on the tooth surface, epithelium and restorations. The natural physiologic forces that clean the oral cavity are inefficient in removing dental plaque.

"Plaque Control" is the removal of microbial plaque and the prevention of its accumulation on the teeth and adjacent gingival tissues. Besides, it also deals with the prevention of calculus formation.

Plaque control includes the usage of mechanical procedures as well as chemical agents, which retards plaque formation. As of now, mechanical plaque control seems to be the most dependable form of plaque control method. Chemical plaque control has been used only as an adjunct to mechanical means and not as a substitute.

	Primary		Secondary	Tertiary	
Levels of prevention	Health Promotion	Specific Protection	Early Diagnosis and Prompt Treatment	Disability Limitation	Rehabilitation
Services provided by the Individual	Periodic visits to dental office Demand for preventive services	Oral hygiene practices	Self examination and referral Utilization of dental services	Utilization of dental services	Utilization of dental services
Services provided by the community	Dental health education programs Promotion of research	Provision of oral hygiene aids, Supervised school brushing programs	Periodic Screening and referral Provision of dental services	Provision of dental services	Provision of dental services
Services provided by the dental professional	Patient education Recall reinforcement	Plaque control program Correction of mal-aligned teeth, Prophylaxis	Complete examination, Scaling and curettage, Corrective restorative and occlusal services	Deep curettage Root planing and splinting Periodontal surgery, Selective extractions	Removable or fixed partial dentures Minor tooth movement

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DISCLOSING AGENTS

A disclosing agent is a preparation in liquid, tablet or lozenge from which contains a dye or other coloring agent, which is used for the identification of bacterial plaque, which might otherwise be invisible to the naked eye.

When applied to the teeth, the agent imparts its color to soft deposits but can be rinsed easily from clean tooth surfaces. After staining, the deposits can be distinctly seen providing a valuable visual aid in patient instruction. Thereby such a procedure can demonstrate dramatically to the patients the presence of deposits and the areas that need special attention during personal oral care.

Uses of disclosing agents

- Personalized patient instruction & motivation.
- Self-evaluation by the patient.
- To evaluate the effectiveness of oral hygiene maintenance.
- In research studies with regard to effectiveness of plaque control devices like toothbrushes and dentifrices etc.

Properties of an acceptable disclosing agent

A. Intensity of color: A distinct staining of deposits should be evident. The color should contrast with normal colors of the oral cavity.

B. Duration of intensity: The color should not rinse off with ordinary rinsing methods, or be removable by the saliva for the period of time required to complete the instruction or clinical service. It is desirable for the color to be removed from the gingival tissue and lips by the completion of the appointment as the patient might react to color retained for a long period of time.

C. Taste: The patients should not be made Uncomfortable by an unpleasant or highly flavored substance. The use of the agent should be pleasant and encourage cooperation.

D. Irritation to the mucous membrane: The agent should not cause irritation of the oral mucosa.

E. Diffusibility: The solution should be thin enough so that it can be applied readily to the exposed surfaces of the teeth, yet thick enough to impart an intensive color to bacterial plaque.

F. Astringent and antiseptic properties: It is frequently recommended that an antiseptic be applied prior to scaling and if an antiseptic disclosing agent is used, one solution serves a dual purpose.

Agents used for disclosing plaque

a) Iodine preparations
   - Skinner's iodine solution
   - Diluted tincture of iodine

b) Mercurochrome preparations
   - Mercurochrome solution 5%
   - Flavored mercurochrome disclosing Solution

c) Bismark Brown

d) Merbromin

e) Erythrosine:
   FD & C (Federal Food Drug & Cosmetic Act) Red No.3 / No.28

f) Fast green:
   FD & C green No.3

g) Fluorescein:
   FD & C yellow No.8 (used with special ultraviolet source to make the agent visible)

h) Two tone solutions:
   FD & C blue No.1
   FD & C red No.3
   It mainly stains thicker (older) plaque blue & thinner (newer) plaque red.

i) Basic Fuchsin

Application of disclosing agents

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The disclosing solution may be directly applied on to the tooth surface using cotton pellets or it may be rinsed after proper dilution. The tablets & wafers may be chewed or swished around the mouth for 30 to 60 seconds and rinsed.

MECHANICAL PLAQUE CONTROL AIDS:

The various aids used for mechanical plaque control are,

1. Toothbrushes and dentifrices
2. Interdental aids
   a) Dental floss
   b) Interdental brushes
   c) Wooden tips
3. Aids for gingival stimulation
   a) Gingival massage
   b) Water irrigation devices
4. Tongue scrapers

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TOOTHBRUSHES

Toothbrushes are the most widely used oral hygiene aids. It is the principal instrument in general use for accomplishing the goals of plaque control.

According to ADA's Council on Dental Therapeutics "The tooth brush is designed primarily to promote cleanliness of teeth and oral cavity".

History of tooth brushes:

They were first introduced in China as early as 1600 B.C. and was introduced into the western world in 1640. By the early nineteenth century craftsmen in various European countries constructed handles of gold, ivory or ebony in which replaceable brush heads could be fitted. Nylon came into use in toothbrush construction in 1938. Powered toothbrushes were actively promoted after 1960.

Objectives of tooth brushing

1. To clean teeth and interdental spaces of food remnants, debris and stain etc
2. To prevent plaque formation
3. To disturb and remove plaque
4. To stimulate and massage gingival tissue
5 To clean the tongue

Toothbrushes vary in size and design as well as in length, hardness and arrangement of bristles.

Types of toothbrushes:

- Manual toothbrushes
- Powered toothbrushes
- Sonic & ultrasonic toothbrushes
- Ionic toothbrushes

There is no clear cut evidence that one particular type of toothbrush is superior to others. However many authors recommend that soft filament brushes are better in view of the damage the hard filaments may cause.

MANUAL TOOTHBRUSHES

The ideal characteristics of a toothbrush are,

- It should confirm to individual patient requirement in size, shape and texture.
- It should be easily and effectively manipulated.
- It should be readily cleaned and aerated and should be impervious to moisture.
- It should be durable and inexpensive.

It should be designed for utility, efficiency and cleanliness

Parts of a toothbrush

Handle	The part grasped in the hand during tooth brushing
Head	The working end of a tooth brush that holds the bristles or filaments
Tufts	Clusters of bristles or filaments secured into the head
Brushing plane	The surface formed by the free ends of the bristles or filaments.
Shank	The section that connects head and handle.

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A toothbrush consists of a handle and a head connected by a neck. The bristles with or without rounded ends are arranged in rows and follows a particular pattern according to brush design. The size of the head, should be small enough for maximum maneuverability in the oral cavity. The handle of a toothbrush should be long enough to fit the palm of the hand. Straight handles are more common. Contra angled handles may provide the brushes with a better sense of touch.

Toothbrush bristles

They can be hard or soft, natural or synthetic, multi-tufted or space tufted

Natural bristles are obtained from hair of hog or wild boar. The bristles are tubular in form and are more susceptible to fraying, breaking, contamination with microbial debris, softening and loss of elasticity.

Synthetic bristles are made of nylon and are uniform in size and elasticity, resistant to fracture and do not get contaminated.

The stiffness of bristles vary based on the following factors:

- Diameter of bristles: Bristles wider in diameter are stiffer as compared to bristles with a lesser diameter. They vary in size from .0035 to .0190 inch.
- Length of bristles: Stiffness of the bristle is inversely proportional to its length. Shorter bristles are stiffer as compared to longer bristles.
- Number of filaments in a tuft: Each filament gives support to adjacent filaments and each tuft gives support to adjacent tufts.
- Curvature of filaments: Curved filaments may be more flexible and less stiff than straight filaments of equal length and diameter.

Though both of these remove plaque, nylon filaments are superior in terms of homogenicity, uniformity of bristle size, elasticity, resistance to fracture and repulsion of water and debris. Though the most desirable bristle design is questionable, multi-tufted brushes show better cleaning ability and rounded ends produce fewer lacerations.

ADA specifications of a toothbrush

Brushing surface:

- 1-1.25 inches in length
- 5/16 to 3/8 inches in width
- 2 to 4 rows of bristles
- 5-12 tufts/ row

Manual toothbrushes are designed to reach and efficiently clean most areas of the oral cavity. Whatever be the design of the toothbrush, the fact is that the user is the only one responsible for using any toothbrush most efficiently.

Conventional toothbrushes may be modified in order to achieve enhanced plaque removal. Eg: modifications to the configuration of the handle grip, the head and the bristles

Toothbrush modifications
Long & contoured handle
Double angulation of the handle & neck
Concave surface of the brushing plane
Special indicator bands

POWERED TOOTHBRUSHES

In 1885, Fredrick Tornberg, a Swedish watchmaker designed the first mechanical toothbrush which was followed by the first powered toothbrush in 1939. The actual marketing of the brush was done in the 1960's. They are also known as automatic, mechanical or electric toothbrushes. These brushes mimic the action of manual toothbrushes and also make tooth brushing faster and efficient.

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The heads of these toothbrushes oscillate in a side-to-side motion or in a rotary motion. The frequency of the oscillations is around 40 Hz in an ordinary powered toothbrush.

Indications of powered toothbrushes

- Young children
- Handicapped patients
- Individuals lacking manual dexterity
- Patients with prosthodontic or endosseous implants
- Orthodontic patients
- Institutionalized patients including the elderly who are dependent on care providers
- Patients on supportive periodontal therapy.

Advantages of powered toothbrushes:

- It increases patient motivation resulting in better patient compliance.
- Increased accessibility in interproximal and lingual tooth surfaces.
- No specific brushing technique required.
- Uses less brushing force than manual toothbrushes.
- Brushing timer is incorporated in some brushes to help the patient in brushing for the required duration.

SONIC AND ULTRASONIC TOOTHBRUSHES

These types of toothbrushes produce high frequency vibrations (1.6 MHz), which lead to the phenomenon of cavitation and accoustic micro streaming. This phenomenon aids in stain removal as well as disruption of the bacterial cell wall (bactericidal)

IONIC TOOTHBRUSHES

Ionic toothbrushes change the surface charge of a tooth by an influx of positively charged ions. The plaque with a similar charge is thus repelled from the tooth surface and is attracted by the negatively charged bristles of the toothbrush. However, further studies are required to prove the efficacy of these type of toothbrushes.

DENTIFRICES

According to the American Dental Associations Council on Dental therapeutics "A dentifrice is a substance used with a toothbrush for the purpose of cleaning the accessible surfaces of the teeth".

Webster described the term dentifrice as derived from dens [tooth] and fricare [to rub].

The functions of toothpaste in conjunction with tooth brushing are:

- Minimizing plaque build up
- Anticaries action
- Removal of stains
- Mouth freshener

They are available in the form of pastes, tooth powders and gels.

Application of dentifrices

The amount of toothpaste or gel needed for effective cleaning is a pea sized dab on the top half of the toothbrush. The dentifrice should preferably be dispersed in between the bristles rather than on the tips. Children under 6 years of age should only be given half the amount of dentifrice as compared to that of an adult.

Recent development in dentifrices

- Toothpaste for children
- Natural toothpastes (Herbal toothpastes)
- Whitening toothpastes (As it contains highly abrasive silica particles, not recommended for regular use)

TOOTH BRUSHING TECHNIQUES

A number of toothbrushing techniques have achieved acceptance by the dental profession. Each technique has been designed to achieve a definite goal. Hence, no one procedure can be described as the

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COMPOSITION OF DENTIFRICES

Agents	Material used	Functions
Polishing/abrasive agents	Calcium carbonate Dicalcium phosphate dihydrate Alumina Silicas	These agents have a mild abrasive action, which aids in eliminating plaque and removing stains from the tooth surface
Binding/thickening agents	**Water soluble agents:** Alginates Sodium carboxymethyl cellulose **Water insoluble:** Magnesium aluminum silicate Colloidal silica Sodium magnesium silicate	Agents which controls stability and consistency of a tooth paste
Detergents/ surfactants	Sodium lauryl sulfate	Produces the foam which aids in the removal of food debris and also dispersion of the product within the mouth
Humectants	Sorbitol Glycerin Polyethylene glycol	Aids in reducing the loss of moisture from the toothpaste
Flavoring agents	Peppermint oil Spearmint oil Oil of wintergreen	They render the product pleasant to use and leaves a fresh taste in the mouth after use.
Sweeteners and coloring agents	Saccharin	Sweetener
Antibacterial agents	Triclosan ,Delmopinol Metallic ions, Zinc citrate trihydrate	
Anticaries agents	Sodium monofluorophosphate Sodium fluoride Stannous fluoride	
Anticalculus agents	Pyrophosphates Zinc citrate Zinc chloride Gantrez acid (a copolymer of methyl vinyl ether and maleic anhydride)	Anticalculus agents are mostly designed to inhibit the mineralization of plaque. They are also known as crystal growth inhibitors
Desensitizing agents	Sodium fluoride Potassium nitrate Strontium chloride	

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best. Depending on the individual cases, the techniques of toothbrushing may have to be altered to achieve the maximum beneficial effect.

THE BASS METHOD OR SULCUS CLEANING METHOD

It is the most widely accepted and most effective method for the removal of dental plaque present adjacent to and directly underneath the gingival margin.

Indications:

- Particularly adaptable for open interproximal areas, cervical areas beneath the height of contour of the enamel and exposed root surfaces
- Recommended for routine patients with or without periodontal involvement

Technique

The bristles are placed at a 45° angle to the gingiva and moved in small circular motions. Strokes are repeated around 20 times, 3 teeth at a time. On the lingual aspect of the anterior teeth, the brush is inserted vertically and the heel of the brush is pressed into the gingival sulci and proximal surfaces at a 45° angle. The bristles are then activated. Occlusal surfaces are cleansed by pressing the bristles firmly against the pits & fissures and then activating the bristles.

Advantages

- Effective method for removing plaque
- Provides good gingival stimulation
- Easy to learn

Disadvantages

- Overzealous brushing may convert the "very short strokes" into a scrub brush technique and cause injury to the gingival margin
- Time consuming
- Dexterity requirement is too high for certain patients

MODIFIED BASS TECHNIQUE

Indications

- As a routine oral hygiene measure
- Intrasulcular cleansing

Technique

This technique combines the vibratory & circular movements of the Bass technique with the sweeping motion of the Roll technique. The toothbrush is held in such a way that the bristles are at 45° to the gingiva. Bristles are gently vibrated by moving the brush handle in a back & forth motion. The bristles are then swept over the sides of the teeth towards their occlusal surfaces in a single motion.

Advantages

- Excellent sulcus cleaning
- Good interproximal and gingival cleaning
- Good gingival stimulation
- Disadvantages
- Dexterity of wrist is required

MODIFIED STILLMAN'S TECHNIQUE

Indications

- Dental plaque removal form cervical areas below the height of contour of the enamel and from exposed proximal surfaces.
- General application for cleaning tooth surfaces and massage of the gingiva.
- Recommended for cleaning in areas with progressing gingival recession and root exposure to prevent abrasive tissue destruction.

Technique

The bristles are pointed apically with an

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oblique angle to the long axis of the tooth. The bristles are positioned partly on the cervical aspect of teeth and partly on the adjacent gingiva. The bristles are activated by short back and forth motions and simultaneously moved in a coronal direction. Following 20 strokes, the procedure is repeated systematically on adjacent teeth. A soft toothbrush is indicated for this technique.

Disadvantages

- Time consuming
- Improper brushing can damage the epithelial attachment.

FONES METHOD OR CIRCULAR / SCRUB METHOD

Indication

- Young children
- Physically or emotionally handicapped individuals
- Patients who lack dexterity

Technique

The child is asked to stretch his/her arms such that they are parallel to the floor. The child is then asked to make big circles using the whole arm to draw circles in the air. The circles are reduced in diameter until very small circles are made in front of the mouth. The child is now ready to make circles on the teeth with the toothbrush, making sure that the teeth and gums are covered.

Advantages

- It is easy to learn
- Shorter time is required

Disadvantages

- Possible trauma to gingiva
- Interdental areas are not properly cleaned
- Detrimental for adults especially who use the brush vigorously

VERTICAL METHOD - LEONARDS METHOD

Leonard advocated a vertical stroke in which maxillary and mandibular teeth are brushed separately

Technique

The bristles of the toothbrush are placed at 90° angle to the facial surface of the teeth. With the teeth edge to edge, place the brush with the filaments against the teeth at right angles to the long axes of the teeth. Brush vigorously, without great pressure with a stroke that is mostly up and down on the tooth surfaces with just a slight rotation or circular movement after striking the gingival margin with force. Enough pressure is used. It is not intended that the upper and lower teeth shall be brushed in the same series of strokes. The teeth are placed edge to edge to keep the brush slipping over the occlusal or incisal surface.

Advantage

Most convenient and effective for small children with deciduous teeth

Disadvantage

Interdental spaces of the permanent teeth of adults are not properly cleaned

CHARTER'S METHOD

Indications

- Individuals having open inter dental spaces with missing papilla and exposed root surfaces.
- Those wearing fixed partial dentures or orthodontic appliances.
- For patients who have had periodontal surgery.
- Patients with moderate interproximal gingival recession.

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Technique

A soft/medium multi-tufted tooth brush is indicated for this technique. Bristles are placed at an angle of 45° to the gingiva with the bristles directed coronally. The bristles are activated by mild vibratory strokes with the bristle ends lying interproximally.

Advantage

- Massage and stimulation for marginal and interdental gingiva.

Disadvantages

- Brush ends do not engage the gingival sulcus to remove subgingival bacterial accumulations
- In some areas the correct brush placement is limited or impossible, therefore modifications become necessary which add to the complexity of the procedure
- Requirements in digital dexterity are high

SCRUB BRUSH METHOD

This method of brushing requires vigorous horizontal, vertical and circular motions. It is the virtual free style of the brushing scene.

Disadvantages

- Not very effective at plaque removal
- Tooth abrasion and gingival recession

THE ROLL TECHNIQUE

This method of brushing is also known as the Rolling Stroke method or ADA method or the Sweep method. It works fairly well for patients with anatomically normal gingival tissues.

Indications

- Children
- Adult patients with limited dexterity
- Useful for preparatory instruction (first lesson) for modified Stillman's technique since the initial brush placement is the same

Technique

In this method, the bristles are placed at a 45° angle and lightly rolled across the tooth surface towards the occlusal surfaces. This technique requires some flexibility around the wrist.

Advantage

- Provides gingival massage and stimulation

Disadvantages

- Brushing too high during initial placement can lacerate the alveolar mucosa.
- Tendency to use quick, sweeping strokes resulting in no brushing for the cervical third of the tooth, since the brush tips pass over rather than into the area and likewise for the interproximal area.
- Replacing the brush with filament tips directed into the gingiva may produce punctuate lesions.

PHYSIOLOGIC METHOD-SMITH METHOD

The physiologic method was described by Smith and advocated later by Bell. It was based on the principle that the toothbrush should follow the physiologic pathway that is followed by food when it traverses over the tissues during mastication.

Technique

- Bristles are pointed incisally or occlusally and then moved along and over the tooth surfaces and gingiva
- The motion is gentle sweeping from incisal or occlusal surfaces over to facial surfaces and progressing towards and over the gingiva. It is almost an attempt to duplicate nature's self cleansing and gingival stimulation mechanism during mastication of food

Advantages

- Natural self cleansing mechanism

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- Supragingival cleaning is good

Disadvantages

Interdental spaces and sulcular areas of teeth are not properly cleaned.

Maintenance of tooth brushes

The toothbrush may act as a vehicle in breeding and transmitting various organisms in the oral cavity. Storing toothbrushes in dry areas is a necessity since wet surfaces may allow bacterial proliferation.

Toothbrushes should be kept in open air with the head in an upright position with no contact with other brushes.

INTERDENTAL CLEANING AIDS

Interdental cleaning aids are adjunctive devices, which are used to remove plaque from the interproximal tooth surfaces.

Factors in selection of an interdental cleaning aid

- Type of gingival embrasure
- Alignment of teeth
- Fixed prosthesis / orthodontic appliances
- Open furcation areas
- Contact areas

DENTAL FLOSS

This type of interdental cleaning aid is indicated to remove plaque from interproximal tooth surfaces.

Dental floss may be available in various forms:

- Multifilament - twisted / non twisted
- Bonded / non bonded
- Thick / thin
- Waxed / non waxed

The degree of plaque control achieved by any type of floss is similar. Therefore the choice of the type of floss is based on individual preference. Bonding prevents the fibers from spreading apart when used on a tooth surface. The fibers may or may not have a waxed coating.

The unwaxed dental floss is better than the waxed for the following reasons:

1. It is smaller in diameter and passes more easily through tight interproximal contacts.
2. Under tension it flattens out on the tooth surface with each component thread adding separately as a cutting edge to dislodge debris.
3. Unwaxed floss makes a squeaking noise when used on a clean tooth surface, and this noise can be used to monitor performance.

Functions of dental floss

1. Removal of adherent plaque and food debris from the interproximal embrasure and under the pontics of the fixed partial denture.
2. Polishing of the tooth surface during removal of the plaque and debris.
3. Stimulating and massaging the interdental papillae.
4. Helping in locating the following
   a. Subgingival calculus deposits.
   b. Overhanging margins of the restorations.
   c. Proximal carious lesions.
5. Vehicle for application of polishing or therapeutic agents to interproximal and subgingival area.

Disadvantages

- It is time consuming
- Requires skill
- Carries the risk of tissue damage if not used properly.

Technique of using dental floss

The two methods for holding the floss are,

1. The spool method
2. The circle or loop method

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Spool method:

About 12 -18 inches long floss is taken and about 4 inches from each end is wound around the middle finger of each hand. In both the hands the last three fingers are folded and closed and both the hands are moved apart. In this way about 1-2 inches of floss is held tightly between the index fingers of both the hands.

Circle or loop method:

In this method, a loop or circle of the floss is made from about 12 -18 inches long piece and both ends are tied securely with the three knots. All the fingers except the thumbs of both the hands are placed within the loop and the floss is held tightly by both the hands having about 1-2 inches of floss between fingers of both the hands.

Floss holders may also be used for holding the floss, especially in patients lacking manual dexterity. Powered flossing devices are also available which moves the prestrung floss in short motions.

The floss is then passed gently through each contact area with a firm back and forth motion. Once the floss is apical to the contact area, it is wrapped around the proximal surface of one tooth and slipped gently under the marginal gingiva. The floss is then moved firmly along the tooth up to the contact area and gently down into the sulcus again, repeating this stroke for 2 -3 times. Then move the floss across the interdental gingiva and repeat the procedure on the adjacent tooth until the whole dentition is covered.

INTERPROXIMAL/INTERDENTAL BRUSHES

They are cone shaped or cylindrical brushes made of bristles mounted on a handle. They are particularly suitable for cleaning large, irregular or concave tooth surfaces adjacent to wide interdental spaces. They are inserted through interproximal spaces and moved back and forth between the teeth with short strokes. Powered interdental brushes are also available.

WOODEN TIPS

These devices are manufactured from orange wood and are triangular in cross section. They are inserted into the gingival embrasures with the base of the triangle oriented towards the gingiva. This design also aids in the proper fit of the wooden tip within the interdental space. The wooden tip then may be repeatedly moved in and out of the embrasure, thereby removing soft deposits from the teeth and also mechanically stimulating the gingiva. Their use is restricted to the facial aspects of anterior teeth. However, specific handles have been designed, attached to which the wooden tips may be used throughout the oral cavity.

GINGIVAL MASSAGE

The mechanical stimulation of the gingiva either by toothbrushing or interdental cleansing with various aids or simple finger massage leads to,

1. Increased keratinization.
2. Increased blood flow.
3. Increased flow of gingival crevicular fluid within the gingival sulcus.

This results in an overall improvement in the gingival health. However, studies have shown that this improved gingival health is more likely due to the removal of plaque rather than due to gingival massage.

WATER IRRIGATION DEVICES (Water pik)

Water irrigation devices have been proven to be a valuable supplement for mechanical plaque control measures. It is mainly

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beneficial in the removal of unattached plaque and debris. Irrigation devices are mainly composed of a built in pump and a reservoir. These devices may also be used to deliver antimicrobial agents e.g. chlorhexidine, subgingivally. When used as an adjunct to tooth brushing these devices have a beneficial affect on periodontal health by retarding plaque and calculus formation. However, transient bacteremia has been reported following the use of sub gingival irrigation devices, especially in the presence of inflammation.

TONGUE SCRAPERS

Tongue scraping is defined as "the process of removing debris from the surface of the tongue with some form of scraper designed for this purpose". Most tongue scrapers are made of a soft flexible plastic. Metal scrapers are also available. However, a soft toothbrush may also be used for this purpose.

Techniques

1. Brushing
   a. Place the brush on the dorsum of the tongue with the tip directed towards the throat
   b. Apply light pressure and move the brush forward and out, repeat to cover the entire surface
2. Tongue cleaning devices
   a. The device is placed towards the back of the tongue on the dorsal surface, then pulled forward with light pressure
   b. They can be recommended for patients who have elongated papillae, deep fissures or surface coating

CHEMICAL PLAQUE CONTROL

Chemical plaque control agents have proven to be an ideal adjunct to mechanical plaque control procedures. The ADA has accepted two agents as plaque control agents

- Prescription chlorhexidine rinse
- Nonprescription essential oil rinse

These agents have been evaluated in placebo-controlled clinical trials of 6 months or longer and have demonstrated significantly improved gingival health compared to controls.

IDEAL REQUISITES OF AN ANTIPLAQUE AGENT

- Should significantly reduce plaque and gingivitis
- Should prevent growth of pathogenic bacteria.
- Should prevent development of resistant bacteria.
- Should be compatible with the oral tissues.
- Should not stain teeth / alter taste
- Should exhibit good retentive properties (substantivity)
- Should be inexpensive and easy to use.

CHLORHEXIDINE GLUCONATE (0.2%)

Chlorhexidine gluconate is a cationic bisbiguanide which is effective against an array of microorganisms, including gram positive and gram negative organisms, fungi, yeasts and viruses. Chlorhexidine exhibits both anti plaque and anti bacterial properties.

Mechanism of action:

The superior antiplaque activity of Chlorhexidine is due to its property of sustained availability - "Substantivity". This involves a reservoir of Chlorhexidine, slowly dissolving from all oral surfaces, resulting in the "Bacteriostatic mileu" in the oral cavity. Chlorhexidine shows different effects at different concentrations.

It is bacteriostatic at low concentrations and bactericidal at high concentrations. These concentrations vary between bacterial species. After a single rinse with Chlorhexidine, saliva itself exhibits antibacterial activity for about 5 hours and

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suppresses salivary bacterial counts for over 12 hours. Following several rinses of Chlorhexidine, the number of aerobic and anaerobic species in saliva can be reduced by 80-90%. Chlorhexidine has also been found to be a potent antifungal agent in the oral cavity.

Chlorhexidine inhibits plaque by,

- Preventing pellicle formation by blocking acidic groups on salivary glycoproteins thereby reducing glycoprotein adsorption on to the tooth surface.
- Preventing adsorption of bacterial cell wall onto the tooth surface by binding to the bacteria.
- Preventing binding of mature plaque by precipitating agglutination factors in the saliva and displacing calcium from the plaque matrix.

Chlorhexidine should not be used before/immediately after using a tooth paste as interaction with anionic surfactants found within the formulations, will reduce effective delivery of Chlorhexidine in an active form. Toothpaste should be used prior to using Chlorhexidine and excess tooth paste rinsed away with water.

Adverse effects of Chlorhexidine

a) Brownish staining of teeth on restorations. The staining however is reversible.
b) Loss of taste sensation
c) Rarely hypersensitivity to Chlorhexidine has been reported
d) Stenosis of the parotid duct has also been reported

NON PRESCRIPTION ESSENTIAL OIL RINSES

These products have a long history of use and safety and have also demonstrated plaque reductions in long term clinical studies. Eg. Thymol, Eucalyptol, Menthol, Methyl salicylate

Other plaque control agents

Central Library, A.C.P.M. Dental College 3289 DHULE.

TRICLOSAN

It is a phenol derivative which has been recently included in mouth rinses and toothpastes. It is synthetic, non-ionic and is used as a topical antimicrobial agent. Triclosan has a broad spectrum of activity against both gram positive and gram-negative bacteria. Its spectrum of activity also includes mycobacterium spores, and candida species.

Triclosan acts on the microbial cytoplasmic membrane, inducing leakage of cellular constituents and thereby causing bacteriolysis. Triclosan has recently been introduced into toothpastes and mouth rinses in order to reduce plaque formation along with Zinc citrate or the co-polymer Gantrez (methoxyethylene and maleic acid) to enhance its retention within the oral cavity. It was observed that Triclosan can delay plaque maturation and also inhibit formation of prostaglandin's and leukotrienes, which are key mediators of inflammation via inhibition of both the cyclo-oxygenase and lipo-oxygenase pathways.

DELMOPINOL

It is a morpholino ethanol derivative. It has shown to inhibit plaque growth and reduce gingivitis. It interferes with plaque matrix formation and also reduces bacterial adherence. It causes weak binding of plaque to the tooth surface, thus aiding in easy removal of plaque by mechanical procedures. It is therefore indicated as a pre-brushing mouthrinse.

However, transient numbness of tongue, tooth and tongue staining, taste disturbance and sometimes mucosal soreness and erosion are the adverse effects.

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METALLIC IONS

Some metal ions have a plaque inhibitory capacity. Salts of zinc and copper are the ones most commonly used. Metallic salts act by reducing the glycolytic activity in microorganisms and delay bacterial growth.

QUATERNARY AMMONIUM COMPOUNDS

They are cationic antiseptics and surface-active agents. They tend to be more active against gram positive than gram negative organisms. They are therefore effective against developing plaque, which consists of predominantly gram positive organisms. The positively charged molecule reacts with the negatively charged cell membrane phosphates and thereby disrupts the cell wall structure of microorganisms. Eg: Benzathonium chloride

Sanguinarine:

It is a benzophenanthridine alkaloid, which is derived from the plant Sanguinaria Canadensis. They are effective against a wide variety of gram negative organisms. Sanguinarine exhibits good retentive properties with dental plaque when used as a mouth rinse.

ENZYMES

Enzymes have been used as active agents in antiplaque preparations, due to the basic fact that they would be able to breakdown already formed matrix of plaque and calculus. Besides, certain proteolytic enzymes are bactericidal to microorganisms and would therefore be effective when applied topically in the mouth.

Eg: Mucinase

ANTIBIOTICS

Antibiotics such as Vancomycin, Erythromycin, Niddamycin and Kanamycin have been used as agents for plaque control. However, due to potential problems of bacterial resistance and hypersensitivity reactions, the use of these agents have reduced considerably.

CONCLUSION

Periodontal disease accounts for a majority of missing teeth in adults and results in tremendous economic and social burdens both to the individual and society. Periodontal disease is so prevalent that the only possible solution to the problem is "prevention". Available data suggests that faithful adherence to proper oral hygiene practices should be at least as effective, in controlling periodontal disease as fluoride has been in controlling dental caries.

To be effective, prevention requires responsible action on the part of the individuals themselves, government and society in general. Consumers and providers of health services have to become involved and there must be improved access to comprehensive care.

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Chapter 6

EPIDEMIOLOGY, ETIOLOGY AND PREVENTION OF ORAL CANCER

INTRODUCTION

EPIDEMIOLOGY

ETIOLOGY AND RISK FACTORS

GLOBAL INITIATIVES IN THE PREVENTION OF ORAL CANCER

- THE CRETE DECLARATION ON ORAL CANCER PREVENTION 2005
- WHO FRAMEWORK CONVENTION ON TOBACCO CONTROL (WHO FCTC)
- BLOOMBERG INITIATIVE TO REDUCE TOBACCO USE

PREVENTION AND CONTROL

CONCLUSION

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INTRODUCTION

Cancer is one of the major threats to public health in the developed world and increasingly in the developing world. In developed countries cancer is the second most common cause of death. According to the World Health Report 2004, cancer accounted for 7.1 million deaths in 2003 and it is estimated that the overall number of new cases will rise by 50% in the next 20 years.

The disease cancer is best defined by four characteristics which describe how cancer cells act differently from their normal counterparts.

- Clonality : Cancer originates from genetic changes in a single cell, which proliferates to form a clone of malignant cells.

Autonomy : Growth is not properly regulated by the normal biochemical and physical influences in the environment.

Anaplasia : There is a lack of normal, co-ordinated cell differentiation.

Metastasis : Cancer cells develop the capacity for discontinuous growth and dissemination to other parts of the body.

In the International Classification of Diseases (WHO - 9th version), oral cancer is classified under the rubrics 140 (lip), 141 (tongue),143 (gingiva), 144 (floor of the mouth) and 145 (other parts of the mouth).

Oral precancer is an intermediate clinical state with increased cancer risk, which can be recognized and treated, obviously with a much better prognosis than a full blown malignancy.

EPIDEMIOLOGY

Oropharyngeal cancer is more common in developing than developed countries. Being the eighth most common cancer worldwide, the prevalence of oral cancer is particularly high among men. Incidence rates for oral cancer vary in men from 1 to 10 cases per 1,00,000 population in many countries. In south-central Asia, cancer of the oral cavity ranks among the three most common types of cancer. The age standardized incidence rate per 100,000 population ranges from 0.7 in China to 4.6 in Thailand and 12.6 in India. It is noteworthy that sharp increases in the incidence rates of oral/pharyngeal cancers have been reported for several countries and regions such as Denmark, France, Germany, Scotland, central and eastern Europe and to a lesser extent Australia, Japan, New Zealand and the USA. The high incidence rates relate directly to risk behaviors such as smoking, use of smokeless tobacco (e.g. tobacco chewing) and alcohol consumption. It is estimated that over 47% of Indians aged 15 years or more use tobacco in one form or another.

A wide variety of oral mucosal changes attributable to the usage of tobacco have been observed in more than 50% of tobacco users. A dose-response relationship has been shown between the chewing habit and oral cancer. The risk among those who chewed less than 2 times a day was 8.4, among those who chewed more than 6 times a day was 17.6 and those who retained the quid overnight had a risk of equal to or less than 63.

An increased risk of oral cancer is seen in those who only chew as compared to those who only smoke. A greater risk is seen in those who have the dual habit.

Oral cancer is predominantly seen in the older age group, in the 5th and 6th decade of life. The increase observed in the older age group could be due to the prolonged duration of exposure to the initiators and promoters of cancer, cellular aging and the decreased immunological surveillance.

Cancer registration in India

Until 1964, no information on cancer occurrence in India was available from surveys.

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CANCER REGISTRIES	
Population based	**Hospital based**
Bombay	Chandigarh
Chennai	Dibrugarh
Bhopal	Trivandrum
New Delhi	Bangalore
Bangalore	Chennai
Barshi	Mumbai

However, the boost for cancer registration in India was in 1982, through initiation of National Cancer Registry Program (NCRP) by Indian Council of Medical Research.

The coordinating unit of NCRP provides guidelines and quality control checks to the current network of population based and hospital based cancer registries of NCRP. The data from cancer registries helped in highlighting the magnitude and common sites of cancer in India, and was useful in planning the National Cancer Control Program.

Based on currently available data, males in Bhopal have the highest age adjusted incidence rates of cancer of the tongue (8.8 per 100,000). Similarly the rates of cancer of the oral cavity in both males and females in all the urban registries are among the highest in the world.

Bangalore	3.5	-	-	8.0
Barshi	2.2	2.4	0.6	0.9
Bhopal	8.8	7.3	-	5.1
Chennai	5.1	6.4	-	6.0
Delhi	6.0	4.1	-	-
Mumbai	5.7	5.7	-	4.2

ETIOLOGY AND RISK FACTORS

Tobacco and alcohol are acknowledged risk factors for oral and oropharyngeal cancers.

Tobacco

WHO estimates that there are about 1100 million regular smokers in the world today. About 300 million (200 million males and 100 million females) are in the developed countries, and nearly three times as many (800 million: 700 million males and 100 million females), in developing countries. Global consumption of cigarettes has been rising steadily since manufactured cigarettes were introduced at the beginning of the 20th century. The consumption of tobacco has reached the proportions of a global epidemic. Tobacco companies are producing cigarettes at the rate of five and a half trillion a year - nearly 1,000 cigarettes for every man, woman, and child on the planet. Asia, Australia and the Far East are by far the largest consumers (2,715 billion cigarettes), followed by the Americas (745 billion), Eastern Europe and Former Soviet Economies (631 billion) and Western Europe (606 billion)

Historical background of tobacco

Christopher Columbus reported a gift of strange dry leaves from a native of San Salvador. It was seen that these leaves were being traded and used for ceremonial and medicinal purposes. Also, these powdered leaves were inhaled by the Indians in a Y shaped piece of cone or pipe, called tobago or tobacca, the forked ends of which were placed in each nostril. The leaves subsequently came to be known as tobacco. The word tobacco is also said to have come from other sources, perhaps after the island of "Tobago" in the West Indies. Friar Roman Paine, a monk who had accompanied Columbus in his 2nd voyage (1493) is reported to have carried a supply of tobacco back to Portugal and the practice of sniffing

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started to spread. In the medieval era, in Europe, it was believed that tobacco protected and cured a long list of disorders including toothache. Hence it gained social acceptance and respectability. The first commercial plantation of tobacco was in Virginia (USA) in 1612. Pierre Lorillard established the first snuff mill in America in 1789 and his sons published the first known printed American advertisement. In the 19th and 20th century America, dental snuff was said to relieve toothache, bleeding gums, preserve and whiten teeth and prevent decay.

In India, tobacco was introduced in the late 16th and early 17th century by the Portuguese traders. Here, tobacco smoking became a symbol of aristocracy with the introduction of "hookah" during the Moghul rule. In 1776, the British East India Company began growing tobacco in India as a cash crop. In the late 19th century, the beedi industry began to grow in India. Recently, the consumption of Gutka has overtaken that of smoking forms of tobacco.

The National Household Survey of Drug and Alcohol Abuse conducted in 25 states in India in 2002 reported that 55.8% of males aged 12- 60 years currently use tobacco.

According to the National Epidemiological Oral Health Survey & Fluoride Mapping of the Dental Council of India (1994), about 23-24 percent, more males, across age groups reported smoking tobacco in the country. About 50 percent of states and union territories had more percent of smokers than the national level.

40-45 percent, of smokers, more males, across age groups were smoking Bidi followed by more males and more in urban areas across age groups had the habit of smoking cigarettes.

About 76-86 percent of smokers, more females, across places of residence and age groups in the country as well as in states and union territories, reported smoking less than 10 times in a day.

About 9 percent, more males and more in rural areas, across age groups, reported chewing pan or pan masala with tobacco in the country. A higher percentage reported chewing pan or pan masala in Orissa than in other states and union territories.

About 42-52 percent of those chewing pan or pan masala, reported chewing the same for the last 5-10 years.

About 11-13 percent, more males and more in rural areas, across age groups, reported the habit of consuming alcohol: 50 percent or more of these were consuming alcohol occasionally.

Tobacco preparations

Tobacco is derived from the species of the plant of genus Nicotiana of the potato family. Carl Linnaeus in 1753 had named the genus of the tobacco plant 'Nicotiana' after the French ambassador to Portugal, Jean Nicot. The major varieties include Nicotiana Rustica and Nicotiana Tabacum. The tobacco leaves are subjected to different types of curing, for example,

- piped warm air (flue-curing),
- directly over an open slow-burning fire (fire-curing)
- left in the sun (sun-curing). This process involves partial drying. It can be subjected to further drying followed by controlled fermentation or 'sweetening' varying from a few months to 2 years. During this time, moisture loss reduces the weight of the tobacco. Some sun-dried tobacco are not allowed to ferment and are sold for chewing.

Tobacco may be chewed, smoked, sucked or sniffed. The carcinogenic role of tobacco is related to the type of tobacco product, the way in which it is used and its use in combination with other substances. In the western countries, chewing tobacco is

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available in various forms which include,

- loose leaf chewing tobacco (pouches),
- chewing tobacco pressed into cakes and sweetened, for example, with molasses (plugs, block),
- fine cut tobacco (snuff)
- twisted or folded leaves from which the stems are removed (twist).

In the Soviet, Nass, (a mixture of tobacco, ash and oil) and in Afghanistan and Pakistan, Naswar (a mixture of powdered tobacco, slaked lime, oil or water) are used.

In India, tobacco is used in various ways, which include,

Smoked tobacco

Bidi is the most popular form of tobacco in India. Out of the total production of tobacco in India, about 34% is used for the manufacture of Bidi. Bidi produces a smaller volume of smoke than cigarette, as they contain a small amount of coarsely ground tobacco (about 0.15 gms to 0.25 gms) compared to 1 gram of finely cut tobacco in cigarettes. About 31% of the tobacco grown in India is used for the manufacture of cigarettes and cigarette smoking is more common in urban areas than in the rural areas.

Reverse smoking :

Tobacco is smoked with the lighted end inside the mouth. Air is supplied to the burning zone through the unlighted end of the cigarette and the smoke is expelled through the cigarette or through the mouth. In India, reverse smoking is found particularly among females in Vishakapatnam and Srikakulam district of Andhra Pradesh. In Telugu, this habit is known as "adda poga". In Andhra Pradesh, a person smokes 1 or 2 chuttas (crude cigars) per day. A typical reverse smoker lights the chutta and draws a few puffs conventionally to ensure that it is properly lit. Once lighted, it is rarely taken out. The temperature of the palatal mucosa has been estimated to be 58° C . In Goa dhumti is smoked. The word "dhumti" might have originated from the konkani word dhumvor (smoke). This leaf tobacco is prepared by the individual and reported to be not available from vendors. Normally, 1 to 2 dhumtis are smoked per day. Reverse smoking produces palatal patches reported to exhibit a malignant change of 12 per 1000

The various smoking habits prevailing in India are the following:

1. **Bidi** : About 0.2 to 0.3 grams of sundried tobacco flakes are hand rolled in a rectangular piece of temburni (Diospyros ebenum) or tendu (Diospyros melanoxylon) leaf and tied with a thread. About 60% of the weight of a bidi is made up of the leaf wrapper. It is available in lengths of about 60mm (regular) and 80mm (long). The nicotine content has been estimated to be 1.7 to 3 mg and tar as much as 45-50 mg
2. **Chillum** : is a straight, 10-14 cm long conical clay pipe used for smoking tobacco. The chillum is held vertically and to prevent tobacco from entering the mouth, a pebble or a stopper is introduced into the chillum. It is filled with coarsely cut tobacco pieces and a glowing charcoal is kept on top of the tobacco.
3. **Chutta** : A somewhat cylindrical coarsely prepared cheroot. Cured tobacco is wrapped in a dried tobacco leaf. The name is reported to be derived from a Tamil word ' shruttu' which means 'to roll' tobacco. It is also called as "cigar" or "cheroor" and is a popular form of tobacco in parts of India. About 9% of the total tobacco production in India is used for the preparation of 300 million pieces of these forms of tobacco annually. Cigars are made of air cured, fermented tobacco usually in modern factories. Cheroors are small cigars made of heavily bodied

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Tobacco. These forms usually does not have a wrapper and contain a single bind.

4. **Cigarettes :** About 1 gram of tobacco cured in the sun or artificial heat is covered with paper. The tobacco is generally treated with a variety of sugars, flavoring and aromatic ingredients. They are estimated to contain 1-1.4 mg of nicotine and 19-27 mg of tar. Only about 51% are filter tipped and filter length averages 12 mm. The filters of Indian made cigarettes comparatively trap less nicotine.
5. **Dhumti :** They are somewhat conical cheroots. Rolled leaf tobacco is used inside a leaf of jack fruit tree. Sometimes dried leaf of the banana plant is used. This form of tobacco is occasionally used for reverse smoking especially among women.
6. **Gudakhu :** is a paste of powdered tobacco, molasses (brown sugar) and other ingredients primarily used to clean the tooth. It is used predominantly by women in Bihar.
7. **Hookah :** It is also called water pipe or hubble-bubble. It is used in places with a strong Moghul cultural influence. Hookah is purely of Indian origin which corresponds with the introduction of tobacco in India. The tobacco smoke is drawn through the water in the base of the hookah which cools and filters the smoke.
8. **Hookli :** It is a clay pipe of rather short stem varying from about 7 to 10 cms with a mouth piece and a bowl. It is commonly used in Bhavnagar district of Gujarat.

Smokeless tobacco

Paan chewing is the most common habit of smokeless tobacco usage in India, which has its origins dating back to more than 2000 years. Betel quid use is a part of Hindu culture and religious heritage. Paan is used in temples as religious offerings and in marriages. It is a symbol of auspiciousness. The betel leaf is offered to guests to show respect and regard. Other reasons, which have been given for paan usage, are that it aids digestion, increases appetite, satisfies hunger, strengthens the gums, sweetens the breath, colors the oral structure, counters boredom, habit, increases alertness, induces euphoria, for concentration and is said to have anti-helminthic properties.

One of the first published medical reports on the effects of tobacco appeared in 1859. It was based on a study of 68 patients with cancer of lip, tongue and other parts of mouth. The association of betel quid and oral cancer was observed in India as early as 1895 by Balram, Trivandrum. Niblock a British doctor at the General Hospital in Madras, in 1902 attributed the oral cancer in Madras to the habit of chewing arecanut, betel leaf, often with lime and tobacco.

Paan is alkaline. Hence, there is a chronic alteration to the oral mucosa in habitual paan chewers because of the pH alteration, due to slaked lime, many times a day. The buccal mucosa loses its smoothness and the rough areas retain the quid for sometime. Gradually the rough areas show discolouration.

The use of Snuff had gained respectability a few centuries ago in England. The site of placement of the snuff is primarily a matter of customs and social habits. In the earlier years in England, some snuffers preferred to 'dip', that is, moistening a stick or twig, dipping it in the snuff and chewing it. A few placed snuff in the mouth. Presently, in Sweden, it has been reported that the most common area for placing snuff is in the region of the maxillary labial mucosa whereas in other regions it is in the mandibular groove.

The various forms of smokeless tobacco used in India are the following:

1.Khaini :

It is powdered sun-dried tobacco, slaked

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Lime (calcium hydroxide)- paste mixture occasionally used with arecanut. It is simply placed in the mouth or chewed. This form of smokeless tobacco is widespread in use in Maharastra and several states in North India. The ingredients are vigorously mixed with the thumb to make the mixture alkaline and is placed in the premolar region of the mandibular groove.

2.Mainpuri tobacco :

Ingredients are tobacco, slaked lime, finely cut arecanut, camphor and cloves. About 7% of the villages in parts of Uttar Pradesh use this product. A high prevalence of oral cancer and leukoplakia among persons who used mainpuri tobacco have been found.

3.Mawa :

It is a preparation containing thin shavings of arecanut with the addition of some tobacco and slaked lime. It is usually wrapped in cellophane paper and tied in the shape of a small ball. Before consumption the packet is rubbed vigorously to mix the contents and the mixture is chewed until it becomes softer after which is transferred to the mandibular groove.

4.Mishri/Masheri :

It is prepared by roasting tobacco on a hot metal plate until it is uniformly black. It is then powdered. It is used with or without catechu. Catechu is a residual extract obtained by soaking the heartwood of the tree Acacia Catechu or Acacia Suma in boiling water. It is used primarily to clean teeth.

5.Paan :

Paan refers to the betel leaf (from piper betel wine) itself and often to the quid. The quid (also called beeda, tambula) Contains arecanut (which may be used raw, baked or boiled), lime obtained from limestone or seashells and according to local customs may also include aniseed, catechu (kattha gambir), cardamom, cinnamon, coconut, cloves, sugar and tobacco (thambakoo) wrapped in betel leaf.

6.Snuff :

Contains finely powdered air-cured and fire-cured tobacco leaves. It may be dry or moist, used plain or with other ingredients and may be used orally or nasally. Bajjar is a dry snuff used by about 14% of the women in Gujarat. It is carried in a metal container. A twig is dipped into it and applied over the tooth and gingiva.

7.Zarda :

Tobacco leaf is boiled in water along with lime and spices until evaporation. The residual tobacco is then dried and colored with dyes. It is chewed.

8.Gutka:

It is a preparation of crushed betel nut, tobacco, and sweet or savory flavorings.

9.Pan Masala:

It is a mixture of betel leaf with lime, areca nut, clove, cardamom, mint, tobacco, essence in the form of granules.

Constituents in tobacco

Tobacco smoke is estimated to contain over four thousand compounds, many of which are pharmacologically active, toxic, mutagenic and carcinogenic. There are 43 known carcinogens in tobacco smoke. NNN (N-nitrosonornicotine), a volatile N-nitroso compound, was the first organic carcinogen isolated from smokeless tobacco. Increased amounts of the carcinogen have been shown in snuff and chewing tobacco. It is partly

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derived from bacterial or enzyme action on nicotine during curing.

The following are the constituents of tobacco and the adverse effects caused by each one of them:

1. Nicotine:

Nicotine is among the most toxic of all poisons and acts with great speed. The average lethal dose for an adult human is estimated to be between 30 - 60 milligrams (mg). Nicotine is the pharmacological agent in the tobacco smoke that causes addiction among smokers. The addictive effect of nicotine is linked to its capacity to trigger the release of dopamine - a chemical in the brain that is associated with the feelings of pleasure. Its immediate physiological effects include increased heart rate and blood pressure, constriction of cutaneous blood vessels, and muscular, hormonal and metabolic effects. With prolonged exposure to nicotine, it may contribute (in combination with carbon monoxide) to increased platelet stickiness and aggregation and damage to the lining of the blood vessels, suggesting a potential role in causing coronary disease. Although nicotine does not appear to possess direct carcinogenic activity itself, it enables the formation of tobacco-specific nitrosamines, which are potent carcinogens.

2. Tar:

It describes the particulate matter inhaled when the smoker draws on a lighted cigarette. Each particle is composed of a large variety of organic and inorganic chemicals consisting primarily of nitrogen, oxygen, hydrogen, carbon dioxide, carbon monoxide, and a wide range of volatile and semivolatile organic chemicals. In its condensate form, tar is a sticky brown substance which can stain smokers' fingers and teeth yellow brown. It also stains the lung tissue. Among the carcinogens or tumor initiators present in cigarette smoke are the two major classes of tumor initiators: polycyclic aromatic hydrocarbons and tobacco-specific nitrosamines. Benzopyrene as a carcinogen, is a prominent polycyclic aromatic hydrocarbon found in tar.

3. Carbon monoxide:

Carbon monoxide (CO) is an odourless, tasteless gas, giving no warning of its presence in most circumstances. In large amounts it is rapidly fatal. It interferes with the uptake of oxygen in the lungs and its release from the blood to the tissues that need it. As carbon monoxide has a chemical affinity for haemoglobin over 200 times greater than that of oxygen, it binds preferentially with haemoglobin, thereby reducing the amount of oxygenated blood circulated to body organs and tissues. Thus, the oxygen transportation in the body is impaired. The amount of oxygen carried by the blood may be severely deprived in heavy smokers due to the effects of carbon monoxide. Oxygen levels may be reduced by as much as 15%. Carbon monoxide is strongly linked with the development of coronary heart diseases. It might occur through interference with myocardial oxygenation, increasing platelet stickiness, or promotion or atherosclerosis. Carbon monoxide also restricts the oxygen available to the foetus, contributing to the low weight of babies born to women who smoke. The baby in the womb cannot grow normally if deprived of oxygen.

4. Nitrogen oxides:

Cigarette smoke contains oxides of nitrogen in relatively high levels. This gas is known to cause lung damage in experimental animals similar to that noted in smokers, and may be responsible for initiating lung damage leading to emphysema.

5. Hydrogen cyanide and other ciliatoxic agents:

Hydrogen cyanide has a direct, deleterious

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effect on the cilia, part of the natural lung clearance mechanism in humans. Interference with this cleaning system can result in an accumulation of toxic agents in the lungs, thereby increasing the likelihood of developing disease.

6. Metals:

Thirty metals have been detected in tobacco smoke, including nickel, arsenic, cadmium, chromium and lead. Arsenic and arsenic compounds and chromium and some chromium compounds are causally associated with cancer in humans, while nickel and cadmium and their compounds are probably carcinogenic to humans.

7. Radioactive compounds:

The radioactive compounds found in highest concentration in cigarette smoke are polonium-210 and potassium-40. Other radioactive compounds present include radium-226, radium-228 and thorium-228. Radioactive compounds are well established as carcinogens.

Health consequences of tobacco use

- Tobacco is a major contributor to oral disease. Tobacco use slows wound healing after dental surgery, promotes periodontal disease, halitosis and oral infections. When tobacco use is combined with the intake of areca nut or alcohol, health risks due to tobacco increase.
- Smoking causes cancer of the oral cavity and tongue, larynx and pharynx, oesophagus, stomach, uterine cervix and lung. Many cases of lung cancer in India are due to smoking.
- Smokeless tobacco is known to cause oral cancer. There is some evidence that it causes some other cancers as well. Chewing of paan (with supari) with or without tobacco is a major cause of oral and oesophageal cancers in India.
- Smoking is a known cause of cardiovascular disease. Emerging evidence points to smokeless tobacco use also as a cause of cardiovascular disease.
- Smoking causes most cases of chronic obstructive lung disease emphysema and chronic bronchitis.
- Exposure of non-smokers to second-hand smoke is an important cause of respiratory infections, worsening of asthma and poor lung function. Many of the sufferers are women and children.
- Newer research findings indicate that smoking is a major risk factor for tuberculosis in India. Tuberculosis is about 3 times more common among ever-smokers than among never-smokers and mortality due to this disease is 34 times greater among smokers than non-smokers.
- Pregnant women exposed to passive smoke may deliver lower weight babies. Evidence is accumulating that pregnant women who use smokeless tobacco are more likely to have low birth weight or stillborn babies. The birth of an infant with congenital cleft lip or palate can be a consequence of cigarette smoking.
- Additionally, there are often long-term effects on surviving children born of mothers who smoke or are passively exposed to smoke.
- Men who smoke or use smokeless tobacco may develop reduced fertility and sexual impotence.

Alcohol :

Alcohol is an independent risk factor for oral cancer. A synergistic effect of tobacco and alcohol has been observed. They account for 75% of all oral and pharyngeal cancers and have been implicated in the formation of multiple primary cancer sites found in oropharyngeal cancer patients. Heavy drinkers who smoked over 20 cigarettes per day were observed to be 24 times more likely to have oral cancer. The mechanisms by which alcohol and tobacco act synergistically

3289

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may include dehydrating effects of alcohol on the mucosa, increasing mucosal permeability and the effects of potential carcinogens in alcohol or tobacco.

Diet and nutrition:

Several components of diet are seen as tumor promoters or anti-promoters. They may enhance or impede the delivery of carcinogen or alter the susceptibility of the target tissue to the carcinogen. An example of oral carcinogenesis attributed to dietary imbalances in humans is the Plummer-Vinson syndrome. It is a manifestation of iron deficiency anemia. A decrease in copper, zinc and manganese is reported to deplete the level of antioxidant nutrients in tissues and increase the production of tumor-enhancing free radicals. Decreased levels of serum retinol have been reported in advanced cases of oral cancer. Ascorbic acid has been shown to prevent conversion of amines to nitrosamines. It has been observed that Vitamin E has a similar action to Vitamin C. One of the most studied antioxidants in vegetables and fruits thought to protect against cancer is beta-carotene, concentrated in deep green, yellow or orange vegetables such as carrots, spinach and lettuce.

Besides the protective effect of some food items, certain other items like the consumption of red chilli powder has emerged as a risk factor. The effect was seen to be dose-dependent i.e:, as the amount consumed increased from less than 75 gms/consumption unit/month to over 150 g/cu/month, the risk increased from 1 - 4-fold.

Ultraviolet radiation:

This is a risk factor for skin cancer of the face and other exposed areas particularly in fair-skinned individuals. It is also important in the etiology of squamous cell carcinoma of the vermillion border of the lip especially in those who work outdoors.

Fungal infections:

Hyphae of candida albicans are frequently seen invading the outer epithelial layer in oral red and white lesions and in oral cancer. Although opinions are divided as to whether they are secondary opportunistic invaders or play an etiological role, dysplastic lesions with candidal infection have shown a greater risk of malignant transformation.

Viruses:

Infection with human (alpha) herpes virus 1 may also increase the risk of oral cancer, but the available data are not conclusive. Herpes Simplex Virus type I and the Human Immuno deficiency Virus have been associated with squamous cell carcinoma. In practical terms, the importance of these factors as a cause of oral cancer is very much overshadowed by tobacco.

Trauma and dental irritation:

Continued dental irritation from jagged teeth and dentures, poor oral hygiene have been incriminated as a risk factor for oral cancer.

Genetic factors:

Many gene alterations have been implicated in the development and progression of oral squamous cell carcinomas and the stages of carcinogenesis have been clearly defined. Expression of genes involved in DNA repair and the stability of the genome is frequently altered.

Genetic changes commonly observed in oral cancers include loss of heterozygosity at the site of known or suspected tumor suppressor genes, in particular 3p (FHIT), 9p (CDKN2A) and 17p (TP53).

PRE - CANCEROUS LESION

"is defined as morphologically altered tissue in which cancer is more likely to develop than in its apparently normal counterpart."

Eg: Leukoplakia, erythroplakia, and smoker's palate.

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LEUKOPLAKIA

Leukoplakia is defined as " a raised white part of the oral mucosa measuring 5mm or more which cannot be scraped off and which cannot be attributed to any other diagnosable disease". This definition does not carry any histologic connotation.

Leukoplakia is the most important precancerous lesion in terms of being the most common as well as being the point of origin for most oral cancers. The global prevalence of leukoplakia has been reported to be about 2.6%.

Etiology:

The etiology of leukoplakia is attributed to the evil of six S's, namely, Smoking, Spirits, Spices, Sepsis, Sharp tooth edge and Syphilis. Other factors which have been associated include vitamin deficiency, endocrine disturbances, galvanism, actinic radiation, blood group A and viral agents. In developing countries, tobacco chewing has been cited as the main reason. Evidence shows that the development of leukoplakia is related more to the amount of fresh tobacco that contacts the mucosa than the total number of hours of contact with tobacco. The lesions with smokeless tobacco tend to be white or yellowish-white, but with heavy use of tobacco the color may change to brownish-yellow. The site for development of the lesion is generally influenced by the tobacco habits practiced by the individuals. They are the buccal mucosa, commissures, tongue, alveolar mucosa, floor of the mouth, lips, gingiva, hard and soft palate.

Precancerous nature of leukoplakia:

Leukoplakia may be persistent, regress spontaneously, recur or progress to oral cancer. It has been reported that regression occurs in about 40% of the cases. When a lesion develops cracks, bleeding or areas of redness and erosion it may indicate that the lesion is turning malignant. About 1 to 20% of the lesions have been reported to become malignant over 1 to 30 years. Lesions over 1 cm are reported to have the highest risk.

Clinical types of leukoplakia:

a) Homogenous leukoplakia : characterized by a white, well-demarcated plaque with an identical reaction pattern throughout the entire lesion. The surface texture can vary from a smooth thin surface to a leathery appearance with surface fissures. The lesions are usually asymptomatic.

b) Non homogenous leukoplakia : may have white patches or plaque intermixed with red tissue elements. Due to the combined appearance of white and red areas, it is also called erythroleukoplakia and speckled leukoplakia.

As the oral cancers affect all intraoral sites, Leukoplakia also involves all intraoral sites and there is a definite site and tobacco habit relationship.

ERYTHROPLAKIA

Erythroplakia is defined as a red lesion of the oral mucosa that cannot be characterized as any other definable lesion. The lesion appears as an eroded red area with a distinct demarcation against the normal appearing mucosa. It has been associated with reverse smoking. The global prevalence of erythroplakia has been reported to be in the range of 0.02 to 0.1%.

SMOKER'S PALATE

Smokers palate is a common reaction of the palatal mucosa to smoking. It is also known as "stomatitis nicotina". The lesion characteristically consists of a diffuse white palate with numerous excrescenes having central red dots, usually corresponding to the orifices of minor salivary glands. The global prevalence of smokers palate is found to vary from 0.1% to 2.5%. Although the etiology is related to the high temperature, rather than the chemical composition of the smoke, a synergistic effect might exist.

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PRECANCEROUS CONDITION

"It is a generalized state associated with a significantly increased risk of cancer".

Eg: Oral submucous fibrosis, and lichen planus.

ORAL SUBMUCOUS FIBROSIS (OSMF)

Oral submucous fibrosis is a precancerous condition. The global incidence is estimated at 2.5 million individuals. The prevalence in India is reported to be 5% in women and 2% in men.

Etiology :

Betel nut with or without tobacco, chillies, nutritional deficiency states, genetic susceptibility, autoimmunity and collagen disorders have been suggested as factors associated with the disease. It has also been observed to be more in individuals with blood group A.

It has been reported that betel nut can affect the mucosa in many ways, including

1) being a constant irritant,
2) tannins can precipitate proteins and hence damage the mucosa,
3) phenol can cause a burning sensation,
4) arecoline (alkaloid) can stimulate fibroblast proliferation and collagen synthesis.

Clinical aspects:

The presence of palpable fibrous bands is a characteristic diagnostic criterion for oral submucous fibrosis. The fibrous bands occur especially in the buccal mucosa, retromolar areas and around the rima oris. When the tongue is affected, it becomes devoid of papillae and appears smooth. The mobility of the tongue especially with regard to protrusion becomes impaired. The opening of mouth becomes restricted. In severe cases, the patient cannot even protrude the tongue beyond the incisal edges and there is a progressive closure of the oral opening. The common initial symptoms are burning sensation of the oral mucosa aggravated by spicy food followed by either hyper salivation or dryness of mouth. Blanching of oral mucosa is another common feature, caused by the impairment of the oral vascularity.

LICHEN PLANUS

Oral lichen planus is a chronic mucocutaneous condition in which the mucosal and skin manifestations can occur independently, concurrently, or sequentially. The etiology of lichen planus involves a cell mediated, immunologically induced degeneration of the basal cell layer of the epithelium. The prevalence varies from 0.5% to 2.2%

The affected areas of the oral mucosa are not bound down or rendered inelastic by lichen planus, and the keratotic white lines cannot be eliminated either by stretching the mucosa or rubbing the surface.

An association of oral lichen planus, diabetes mellitus, and hypertension - triad is referred to as Grinspan's syndrome which predisposes to the development of squamous cell carcinoma.

Clinical aspects of lichen planus :

The most frequently affected site in the oral cavity is the buccal mucosa. Generally, oral lichen planus is asymptomatic. Experience of burning sensation in patients with pain in the affected area has however been reported. There are four different forms of lichen planus.

1) Reticular: It is the most commonly found form, which is characterized by criss-crossing lacy white striae giving it a white lace like appearance.
2) Papular: is characterized by small white dots, which intermingle with the reticular form. It is usually present in the initial

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Phase of the disease.

3) Plaque-like : It shows a homogenous well-demarcated white plaque which may or may not be surrounded by striae. Clinically they appear very similar to homogenous leukoplakia.
4) Erythematous: is characterized by a homogenous red area.
5) Ulcerative: are the most disabling form of oral lichen planus. The ulcers are surrounded by an erythematous zone displaying radiating white striae. It may be associated with a burning sensation during food intake.

SQUAMOUS CELL CARCINOMA

Epidermoid carcinoma can occur as carcinoma of lip, carcinoma of the tongue, carcinoma of floor of mouth, carcinoma of buccal mucosa, carcinoma of gingiva, carcinoma of palate or carcinoma of maxillary sinus.

It can appear as a red, white or mixed red-and-white lesion, a change in the surface texture or the presence of a mass or ulceration. The lesion may be flat or elevated and ulcerated or nonulcerated and may be minimally palpable or indurated. Loss of function involving the tongue can affect speech, swallowing and diet. Lymphatic spread usually involves the submandibular and digastric nodes, the upper cervical nodes and finally, the remaining nodes of the cervical chain.

THE TNM SYSTEM OF TUMOR STAGING

The TNM System for the classification of malignant tumors was developed by Pierre Denoix between 1943 and 1952. The Union Internationale Contre le Cancer (UICC) (i.e., International Union Against Cancer) adopted the TNM system in 1954, and Pierre Denoix served as President of the UICC from 1973 to 1978.

The TNM System for describing the anatomical extent of cancer is based on the assessment of three components:

T- The size of the primary tumor

N- The status of the cervical lymph nodes

M- The presence or absence of cancer in sites other than the primary tumor (metastasis)

Codes describing the Tumor (T)

- TX primary tumor cannot be assessed
- T0 no evidence of primary tumor
- Tis carcinoma in situ
- T1 tumor less than 2 centimeters (cm) in greatest dimension
- T2 tumor more than 2 cm but not more than 4 cm in greatest dimension
- T3 tumor more than 4 cm in greatest dimension
- T4 tumor invades adjacent structures (mandible, tongue musculature, maxillary sinus, skin)

Codes describing Nodal involvement (N)

- NX regional lymph nodes cannot be assessed
- N0 no regional lymph node metastasis
- N1 metastasis in a single ipsilateral lymph node, less than 3 cm in greatest dimension
- N2a metastasis in a single ipsilateral lymph node, more than 3 cm but not more than 6 cm in greatest dimension
- N2b metastasis in multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimension
- N2c metastasis in bilateral or contralateral lymph nodes, none more than 6 cm in greatest dimension
- N3 metastasis in a lymph node, more than 6 cm in greatest dimension

Codes describing Metastasis (M)

- MX Presence of distant metastasis cannot be assessed
- M0 no distant metastasis
- M1 distant metastasis

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Stage grouping

- Stage I T1N0M0
- Stage II T2N0M0
- Stage III T3N0M0
  T1 or T2 or T3N1M0
- Stage IV T4N0 or N1M0
  Any T, N2, or N3M0
  Any T, any N, M1

GLOBAL INITIATIVES IN THE PREVENTION OF ORAL CANCER

THE CRETE DECLARATION ON ORAL CANCER PREVENTION 2005

- A commitment to action

The 10th International Congress on Oral Cancer organized by the Hellenic Cancer Society, International Congress on Oral Cancer, Hellenic Association for the Treatment of Maxillofacial Cancer and the World Health Organization was held from 19-24 April 2005 in Crete, Greece.

The participants from 57 countries emphasized that oral health is an integral part of general health and wellbeing and expressed concern about the neglected burden of oral cancer which particularly affects developing countries with low availability of prevention programs and services for oral health. This culminated in the Crete Declaration on Oral Cancer Prevention 2005 which stated that the following areas of work should be strengthened:

(a) provision of systematic epidemiological information on prevalence of oral cancer and cancer risks in countries, particularly in the developing world.

(b) promotion of research into understanding the biological, behavioral and psychosocial factors in oral cancer, emphasizing the inter-relationship between oral health and general health

(c) integrating oral cancer information into national health surveillance systems which record chronic diseases and common risk factors

(d) dissemination of information on oral cancer, prevention and care through every possible means of communication

(e) active involvement of oral health professionals in oral cancer prevention through control of risk factors such as tobacco, alcohol and diet

(f) training of primary health workers in screening and provision of first-level care in oral cancer

(g) access to health facilities and provision of systems for early detection and intervention, oral health care and health promotion for the improvement of quality of life of people affected by oral cancer.

WHO FRAMEWORK CONVENTION ON TOBACCO CONTROL (WHO FCTC)

The WHO Framework Convention on Tobacco Control (WHO FCTC) is the first treaty negotiated under the auspices of the World Health Organization.

The WHO FCTC treaty opened for signature on 16 June to 22 June 2003 in Geneva, and when closed, had 168 Signatories, which makes it the most widely embraced treaties in UN history. Member States that have signed the Convention indicate that they will strive in good faith to ratify, accept, or approve it, and show political commitment not to undermine the objectives set out in it. The Convention entered into force on 27 February 2005.

The WHO FCTC was developed in response to the globalization of the tobacco epidemic. The spread of the tobacco epidemic is facilitated through a variety of complex factors with cross-border effects, including trade liberalization and direct foreign investment. Other factors such as global marketing, transnational tobacco advertising, promotion and sponsorship, and the international movement of contraband and counterfeit cigarettes have also

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contributed to the explosive increase in tobacco use. The WHO FCTC is an evidence-based treaty that reaffirms the right of all people to the highest standard of health. It asserts the importance of demand reduction strategies as well as supply issues.

The demand reduction provisions are:

- Price and tax measures to reduce the demand for tobacco, and

- Non-price measures to reduce the demand for tobacco, namely:

- Protection from exposure to tobacco smoke
- Regulation of the contents of tobacco products
- Regulation of tobacco product disclosures
- Packaging and labelling of tobacco products
- Education, communication, training and public awareness
- Tobacco advertising, promotion and sponsorship
- Demand reduction measures concerning tobacco dependence and cessation

The supply reduction provisions are:

- To stop illicit trade in tobacco products;
- To stop sales to and by minors; and,
- Provision of support for economically viable alternative activities.

BLOOMBERG INITIATIVE TO REDUCE TOBACCO USE

This initiative, funded by Bloomberg Philanthropies, is the two-year contribution of US$125 million by Michael R. Bloomberg for global tobacco control

It is committed to the scaling up of tobacco control efforts in developing countries, with special emphasis in 15 developing countries (Bangladesh, Brazil, China, Egypt, India, Indonesia, Mexico, Pakistan, Philippines, Poland, Russian Federation, Thailand, Turkey, Ukraine and Viet Nam), where more than two thirds of the world's smokers live and where the health burden from tobacco use is highest.

Five key partner organizations will implement the Bloomberg Initiative, building national capacity, coordinating activities and providing grants to other organizations, mostly at country level, to promote freedom from smoking.

BLOOMBERG INITIATIVE	
	ACTIVITIES
Campaign for Tobacco-Free Kids	In charge of awarding Bloomberg grants
Centers for Disease Control and Prevention (CDC) Foundation	Monitoring/surveillance, to establish systematic, standardized global surveillance and monitoring of the tobacco epidemic.
Johns Hopkins Bloomberg School of Public Health Education/training	The Johns Hopkins Bloomberg School of Public Health will develop training resource materials to help smokers stop and prevent children from starting.
World Health Organization - Tobacco Free Initiative (WHO/TFI)	Coordination mechanism at country level. It will expand the public-sector support and guidance it already provides to help governments develop national tobacco control plans, pass and enforce key laws and implement effective policies and tobacco control measures.
World Lung Foundation (WLF)	In charge of awarding Bloomberg grants and global clearing house for tobacco ads.

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The initiative coordinated by the five key partner organizations will focus on the following four components:

- Refine and optimize tobacco control programs to help smokers stop and prevent children from starting.
- Support public sector efforts to pass and enforce key laws and implement effective policies, in particular to tax cigarettes, prevent smuggling, change the image of tobacco, and protect workers from exposure to other people's smoke.
- Support advocates' efforts to educate communities about the harms of tobacco and to enhance tobacco control activities so as to help make the world tobacco-free.
- Develop a rigorous system to monitor the status of global tobacco use.

PREVENTION AND CONTROL OF ORAL CANCER

Prevention of oral cancer mainly focuses on modifying habits associated with the use of tobacco. India is the fourth largest consumer of tobacco and the third largest producer of tobacco after China and Brazil. There are about 250 million tobacco users in India who account for about 19% of the World's 1.3 billion tobacco users. In India, at least 800,000 deaths every year are related to tobacco use, 700,000 of them due to smoking.

There are three well-known approaches 1) Regulatory or legal approach, 2) service approach and 3) the educational approach.

1) Regulatory approach :

In India, the Cigarette Act 1975 has made it necessary to print warnings on cigarette packets. Bidi, not being an organized industry, was not included and hence there has been no need for printing statutory warnings. In India, a National Cancer Control Program was launched in 1985.

In 2003, the Indian parliament passed the 'Cigarettes and other Tobacco Products Act' to prohibit the advertisement of and to provide for the regulation of trade and commerce in, and production, supply and distribution of cigarettes and other tobacco products.

In 2004 it ratified an international treaty The WHO's Framework Convention on Tobacco Control (WHO - FCTC)

2) Service approach :

The active search for disease among apparently healthy people is a fundamental aspect of prevention. This is embodied in screening.

3) Educational approach:

Role of the dentist

Dentists have an important role in helping patients quit tobacco and, at the community and national levels, to promote tobacco prevention and control strategies.

Dentists,

- Can see the harmful effects of tobacco in the mouth
- Are in an ideal position to counsel patients
- See children and youth as patients and can influence them to adopt a tobacco-free lifestyle
- Treat women of childbearing age and can inform them of the dangers of tobacco use during pregnancy
- Can spend more time with patients and use this time to counsel tobacco users to quit
- Can reinforce messages given to patients by physicians and other caregivers about the dangers of tobacco use and the need to quit
- Can build their patients' interest in discontinuing tobacco use by showing them the actual effects in the mouth
- Have a duty to promote oral health and

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healthy lifestyles among their patients.

- Can speak with authority in the community about the dangers of tobacco use; for example, the need to curb tobacco use in public and educate children about the dangers of tobacco use
- Can be effective advocates for tobacco control in the community.

Tobacco use by dentists is a significant barrier to tobacco cessation counselling. Dentists can be role models by not using tobacco or by quitting successfully.

Dentists must recognize that every interaction on tobacco use, however brief, can lead to a significant change in the patient's attitude and behavior. Smokers can be helped to recognize that temporary abstinence is a small success that can lead to greater success in quitting.

A brief tobacco intervention

- Takes only a few minutes
- Is practical for a busy office
- Assesses, diagnoses, educates, works with the patient
- Is preferred by patients
- Must encourage the patient and not be critical

Guide to counselling for tobacco cessation (5 A's)

1. Ask patients about their use of tobacco at every visit

The dentist sees the inside of the mouth and knows if the patient is using tobacco. Check for the oral signs of tobacco use,

- Stained teeth
- Halitosis
- Periodontal disease
- Tooth mobility
- Discolored patches on the mucosa: White, red, dark precancerous lesions

Mention the observations to the patient to help him or her face facts.

2. Advise non-users to never use tobacco, Advise users to quit

- Encourage never-users to stay away from tobacco, affirm non-use of tobacco and advise them to never use tobacco in future.
- Affirm and congratulate those who have quit tobacco use and offer support if required.
- Advice for quitting should be clear, strong and personalized

Eg: 'Quitting tobacco use is the most important thing you can do to protect your health.'

'Tobacco use is hurting your oral health, your finances and your family's happiness.'

3. Assess the patient's readiness to quit

- Ask every tobacco user if he/she is willing to quit at this time. If the patient is willing to quit (in preparation), assess the level of dependence.
- If the patient is only thinking of quitting but not willing to quit now (in contemplation), provide a 'tailored' message to increase motivation.
- If the patient is not preparing to quit, shift to the 5 'R' method
- Assess the level of dependence

Tobacco users who are heavily dependent on tobacco usually have a harder time quitting than less dependent users.

Level of dependence	
High	Individuals who use tobacco within 30 minutes of waking up or who use it 25 or more times per day
Moderate	Individuals who use tobacco more than 30 minutes after waking up or less than 25 times per day
Low	Those who neither use tobacco before 30 minutes of waking up nor use it more than 25 times a day.

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Assess the risk of relapse

- An individual who has quit before, even for just 30 days, has a lower risk of relapse.
- Those with a higher level of dependence usually need a more intensive intervention to help them avoid relapse.
- Individuals with depression or a concurrent habit such as regular alcohol drinking may be at increased risk for relapse.
- Rigorous follow up reduces the risk of relapse on a schedule. Such patients could be referred to a counsellor or a tobacco use cessation facility.

4. **Assist** with quitting

- Set a firm quit date, ideally within 2 weeks.
- Set support from family, friends, co-workers.
- Review past quit attempts - what helped, or led to relapse.
- Identify reasons for quitting in writing and keep a copy.
- Reduce tobacco use during the two weeks before quitting.
- Anticipate challenges, particularly during the first few weeks, including nicotine withdrawal symptoms.

Help the patient develop coping skills such as avoiding certain situations, taking walks, using distraction techniques, listening to music or doing yoga.

- Remove tobacco products from the home/office
- Throw out all tobacco products in his/her possession.
- Avoid places where tobacco is available.
- Encourage other tobacco users around to quit along with him or her.

Total abstinence is essential to quitting-not a single puff or portion. Withdrawal symptoms typically decrease considerably after 1-3 weeks of quitting.

- Drinking alcohol is strongly associated with relapse.
- Having other tobacco users in the home hinders successful quitting.
- Suggest alternatives to tobacco - Chewing aniseed (saunf) or ajwain, or eating nuts or fruits, drinking water, taking walks or exercising are helpful during periods of craving and can be planned as a part of the daily routine.
- Recommend or provide pharmacotherapy, especially for depressed patients and those who have tried to quit several times and failed.
- Provide reading materials on quitting that are appropriate for the patient's age, culture, language, educational level and pregnancy status.

5. **Arrange** for follow ups

Use revisits, telephone contact, or assist the patient to arrange an appointment with his/her physician or a trained community health worker.

Timing:

Set a schedule. The first follow-up visit should occur within a week of the quit date-that is why it is important to have the patient set the quit date a few days prior to the revisit date for dental work. A second follow-up visit is best within one month of the quit date. Further follow-up visits are helpful after 3 months, 6 months and 1 year.

Actions during follow-up contact

- Congratulate the patient on successes (even small ones).
- Empathize with difficulties.
- Ask the patient to suggest how he/she can overcome the difficulties.
- Assess pharmacotherapy: Ask the patient about the severity of withdrawal symptoms and about any possible side-effects of medication being taken, such as irritation of the mouth, dry mouth, confusion, abdominal pain, back pain, body ache,

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sleep disturbance, dizziness, palpitations.

- Counsel for relapse: If a relapse occurs, encourage a new quit attempt. Tell the patient that relapse is part of the quitting process. Review the circumstances that caused the relapse. Use relapse as a learning experience.
- Reassess the use of pharmacotherapy and problems in general.

Assess the need for intensive counselling:

If the patient is interested, expresses the need or has had particular difficulty previously, intensive counselling is advisable. Patients especially needing it would include those with heavy tobacco use, alcohol use, or depression. People using tobacco for a long duration may suffer from anxiety, restlessness, dysphasia or depressed mood, irritability, low self- esteem and poor coping with stressors; they may also have other addictions. Yet, anyone ready to quit can benefit from intensive counselling for cessation.

Preventive dentistry

Patients should be introduced to the concept of preventive dentistry and these visits should be used for tobacco cessation counselling as well. Six-monthly or yearly check-ups can catch dental and oral problems early, avoiding the need for root canal treatment and extractions, and detect possible oral cancer at an early stage.

Use of pharmacotherapy

Given the difficulties faced by people attempting to stop tobacco use, treatments have been developed to help them by lessening the intensity of withdrawal symptoms.

There are two main types of pharmacotherapy for tobacco use cessation:

1. Nicotine replacement therapies:

These lessen craving and other withdrawal symptoms while the individual learns to stop the behaviors connected with tobacco use. Eventually, though, patients need to give up using nicotine replacement.

Nicotine replacement therapies (NRT) for tobacco use cessation are

- Nicotine gum (available in India in 4 mg nicotine pieces: Gutkha or mint flavour)
- Nicotine patch
- Nicotine inhaler
- Nicotine nasal spray
- Nicotine lozenges

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Basic principles for prescribing NRTs:

Medical supervision is important. Use a lower dose for less dependent tobacco users. A combination of products can be helpful. This must be done with caution, as nicotine toxicity may develop with a combination of products or if patient has not yet quit using tobacco. Some users may have side-effects.

Contra-indicated in: Pregnancy, lactation, cardiovascular disease, peripheral vascular disease, endocrine disorders, inflammation of the mouth and throat, oesophagitis, gastric ulcers, diabetes.

Method of using nicotine gum

Nicotine gum is available in India without a prescription. However, it is best used under medical supervision for a predefined limited period, e.g. 6 weeks (not more than 12 weeks), after which the patient has to face withdrawal. A half-piece of gum, providing 2 mg nicotine is adequate for less dependent tobacco users (those who smoke less than 25 cigarettes daily), but a full piece of 4 mg is for the heavily dependent (those who smoke 25 cigarettes or more daily). The gum is to be chewed slowly (to avoid side-effects such as vomiting and hiccups) for about 5 minutes until it has a peppery taste and then kept between the gum and inner cheek for about 10 minutes. After this, the gum is to be

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chewed for 5 minutes more and kept on the other side of the mouth. This process can be repeated once more after which it is to be discarded in a safe place away from children or pets. Seed mixtures (such as saunf) can eventually be substituted for the gum.

Pregnant and breastfeeding women should be advised to attempt quitting without medication. If they cannot do so, medication is considered safer than continued tobacco use. While counselling adolescents and youth care should be taken to determine whether they are dependent on tobacco or still in the experimental stage. In the latter case, they do not need medication.

Continued tobacco use is more dangerous than the use of NRT for patients with cardiovascular or pulmonary diseases. They should be cautioned not to use tobacco while using NRT. Patients who have recently had myocardial infarction may experience worsening of angina with nicotine use; they would be better off chewing on harmless seed mixtures (not containing supari).

While NRT can help people quit using tobacco in the short term, it does not solve the problem of addiction to nicotine, which must be faced at some point. The temptation to restart tobacco use is eventually very strong in some users of NRT.

Helping patients face withdrawal without pharmacotherapy

- The patient needs the greatest support during the first three days and for the first three weeks after stopping tobacco use, as cravings are strongest and most frequent during this period.
- Craving attacks are not expected to last more than three minutes each, although the addiction distorts the sense of time and the attacks seem much longer. The patient can time them.
- Alternatives such as chewing anise seeds (saunf) are effective for many patients. Deep breathing, taking walks and drinking water are also helpful.

Nicotine withdrawal symptoms

- Craving for tobacco
- Depressed mood
- Insomnia
- Irritability
- Frustration
- Anxiety
- Difficulty in concentration
- Restlessness
- Decreased heart rate
- Increased appetite and weight gain

2. Antidepressants:

They function as anti-craving medications. Many people have successfully quit using tobacco without any medication whatsoever. Patients who would benefit most from pharmacotherapy are those who have attempted to quit several times without success or those who suffer from chronic depression. Available therapies are:

Antidepressants for tobacco use cessation

First-line therapies

- Buproprion SR
- Selegeline

Second-line therapies

- Clonidine
- Nortryptiline

These can be combined with nicotine replacement therapies.

COUNSELLING THOSE UNWILLING TO QUIT

The 5 'R' method

1. Relevance of quitting
2. Risks of continuing tobacco use
3. Rewards of quitting
4. Roadblocks to quitting
5. Repeat these at each visit

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1. Relevance of quitting

Personal relevance is highly motivating. The patient's oral condition, age, gender, other health concerns and family situation are all relevant. Ask the patient to indicate why quitting is personally relevant. Enlighten the patient on what he/she does not know.

2. Risks of continuing tobacco use

Acute risks: Oral wounds do not heal well, periodontal disease develops, blood cholesterol increases, there may be harm to pregnancy (in women), impotence and infertility (in men) and increased levels of carbon monoxide in the blood (in smokers).

Long-term risks: Tooth loss, OSF in users of products containing areca nut (supari), oral and other cancers; heart attack and stroke; lung diseases (in smokers); disability; financial losses due to prolonged healthcare needs.

Environmental risks: For smokers, there is an increased risk of the spouse developing lung cancer and heart disease. Women may give birth to low birth weight children; and children exposed to tobacco smoke are in danger of developing sudden infant death, respiratory infections, asthma, middle ear disease, among others. Chewers spread germs and make a mess by spitting.

3. Rewards of quitting

- Improved oral health: Healthier gums and teeth, better smelling breath
- Feel better/perform better
- Increased energy levels
- Food tastes better
- Money is saved
- Sets a good example to children
- Worry about quitting stops
- Longer and healthier life

4. Roadblocks to quitting

- Fear of withdrawal symptoms
- Fear of failure
- Lack of support
- Enjoyment of tobacco
- Fear of weight gain
- Depression

5. Repeat these at each visit

Repeat the motivational messages each time an unmotivated patient visits. Tobacco users who have tried to quit previously and failed need to hear that most people make repeated attempts before they are successful.

Key counselling concepts

1. A non-judgmental attitude: This puts patients at ease and helps them want to listen to you.
2. Caring: A caring attitude can be expressed through your words and motivates patients to follow your advice.
3. Empathy: Your words affect the patient's attitude. Use your words as therapy to motivate and encourage the patient to quit.
4. Listening: Listen carefully and patiently to what the patient is saying. Listening also conveys empathy.
5. Raising awareness: Raise patients' awareness levels about the negative consequences of tobacco use.
6. Prompting self-evaluation: Ask the patient to think about how tobacco use fits in or conflicts with his goals and values in life. When the patient feels the benefits of quitting tobacco use outweigh the costs, he/she will be more motivated to change.
7. Offering support while emphasizing personal responsibility: Provide encouragement and assistance for quitting. At the same time, the patient needs to accept personal responsibility for change.
8. Asking open-ended questions: These help the patient to disclose his/her values and priorities, and to become more aware of

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those that conflict with each other.

9. Clarifying: You can ask a question to be sure you have understood what the patient said.
10. Reflecting feelings: Rephrase the emotional content of what the patient has said to assure him/her that you have understood.
11. Summarizing: Condense into a few words the essence of what you have heard.
12. Affirming: This conveys respect, acceptance and understanding of the patient's position, even if it is not positive.
13. Eliciting self-motivational statements: Find out, on a scale of 0 to 10, how important quitting is to the patient. How optimistic are they about quitting? What difficult goals have they achieved in the past?
14. Setting realistic goals: Change the patient's behavior in stages by setting realistic goals.
15. Responding to tricky questions: When your patients test you with tricky questions or statements, you will need to come up with answers that will shock them into thinking.
16. Tailoring messages to the patient's stage of change: Quitting is a process rather than an event. The clinician's intervention can help the tobacco user move forward on the road to permanent abstinence. If the patient is not willing to quit at this time but is thinking about it, he/she is in the contemplation phase. If the patient is not thinking about quitting, then he/she is a precontemplator.

Contemplators may be asked: 'When are you thinking of quitting?'

The answer to this question will distinguish between a person who is positively preparing to quit and one in an earlier phase. You can then tailor your messages to the patient's stage of change, as shown in the table on the next page:

ACTION IN THE COMMUNITY

Dentists are highly respected, trusted and influential community leaders in any society. Their voices are heard across a vast range of social, economic and political arenas.

Public education

- Dentists can display educational material on anti-tobacco themes in their clinics and hospitals, and prohibit the use of any kind of tobacco product within 100 metres of their hospitals.
- Dental organizations can reach out to different age and social groups to inform them on tobacco issues, and encourage them to recommend policies to the government on tobacco control.
- Dentists can link up with non-governmental organizations (NGOs) to spread health awareness about the ill-effects of tobacco and promote cessation in schools, colleges and communities.
- Dentists can sensitize youth groups to become efficient awareness generators in the community and monitor the implementation of tobacco control laws.
- Dentists need to keep themselves informed through professional publications and tobacco control organizations on the latest scientific information regarding the harmful effects of tobacco and measures for its control.

Media advocacy

- Dentists can actively engage the media in creating awareness among the masses about tobacco control issues.
- Dentists can prepare educational materials using up-to-date, scientifically accurate information such as posters and school health materials.
- Dentists can write articles in newspapers and magazines about the benefits of implementing tobacco control policies, including letters to the editor.

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- Dentists can participate in talk shows on television and radio to talk about tobacco use issues.
- Dentists can bring into the limelight some success stories related to tobacco control.

ACTION AT THE STATE AND NATIONAL LEVELS

Dentists can use their influence through professional organizations to encourage governments to put in place tobacco control measures. Dentists can be involved in both direct advocacy (influencing decision-makers) and indirect advocacy (building support among the general public to put pressure on decision-makers to initiate change). As members of professional organizations, dentists can play an important role in tobacco control advocacy at the state and national levels.

Making the profession and dental facilities tobacco-free

- Dental associations can prepare a national 'Code of practice on tobacco control for dentists'. This code of practice would highlight the potential role of dentists and their organizations in the treatment of tobacco dependence and provide guidance on organizational changes and activities that can be undertaken to promote a tobacco-free profession.
- Dentists can provide the needed emphasis on tobacco-related health information in the undergraduate and postgraduate curricula and examinations.
- Dentists can motivate hospital administrators and fellow colleagues to keep the hospital environment tobacco-free and thus convey to the public that their institution is committed to protecting public health. Workshops can be organized to motivate all staff members to avoid tobacco use on the premises.
- All conferences and other events organized by associations of dental professionals should be declared completely tobacco-free by the organizers.
- Dentists should avoid accepting or allowing sponsorship of any kind from tobacco companies or their affiliates for professional conferences.
- All government/private healthcare and dental care facilities can carry anti-tobacco slogans on items of stationery.
- Dental associations can share with their members new scientific research findings, new developments in tobacco cessation and new policy developments.
- As members of professional organizations, dentists can raise the issue of litigation against the tobacco industry's unfair marketing practices. Strong professional support in a legal suit can be crucial for the success of such litigations in India.

Advocacy with the state and national governments

- Dental associations can advocate for the inclusion of tobacco cessation as an important component in national health programs such as the National Rural Health Mission, National Cancer Control Program and Reproductive and Child Health Program.
- Dental associations can join hands with civil society groups working in the area of tobacco control to develop a state and a national plan to create awareness among dental professionals on tobacco control issues.
- Dentists along with their professional organizations can lobby with the government to set up community-based tobacco cessation programs.
- Dentists can request the government to appoint a nodal officer at district/block/state level for tobacco control.
- Dentists can advocate with the government to stop the subsidy on

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tobacco farming.

- Dentists can advocate for the levy of a 'health tax' on the sale of every packet of tobacco, beedi, paan masala and cigarettes, which could be used for health education on the dangers of tobacco use.
- Dentists and their associations, along with other health professionals, can participate in the development of a national plan of action for tobacco control in accordance with the Indian Tobacco Control Act, 2003.

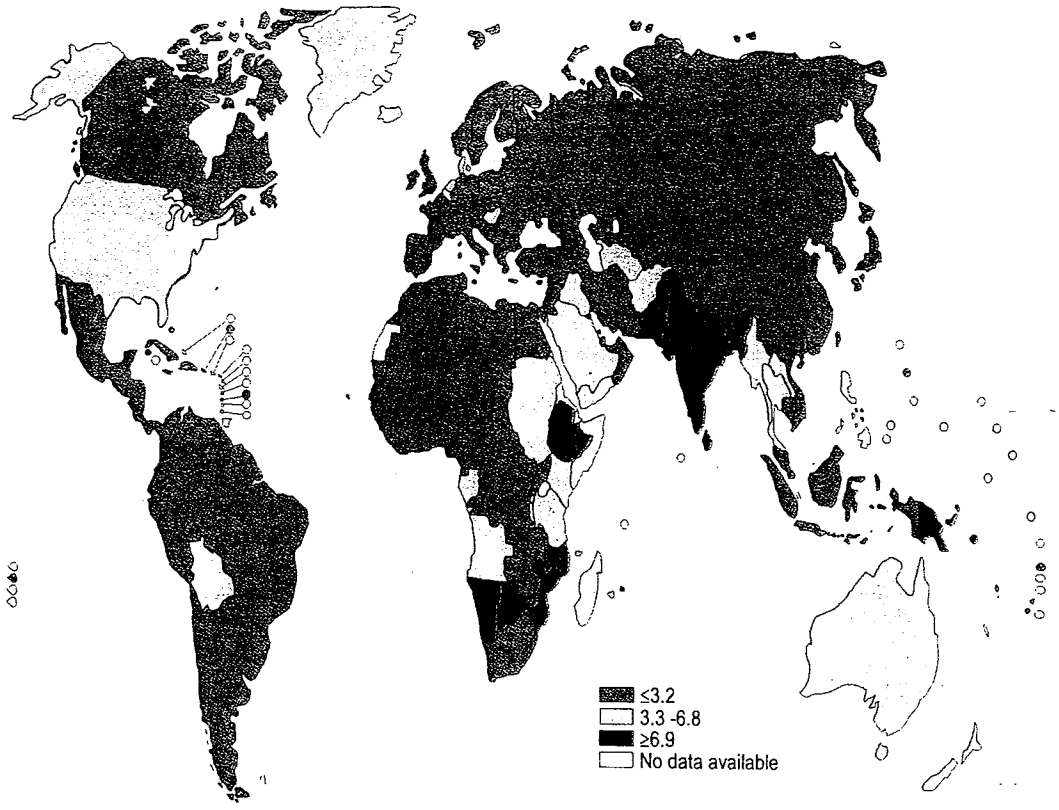
CONCLUSION

"No Tobacco Day' is observed on the 31st of May to highlight the adverse effect of tobacco on health. It has been estimated that a majority of cancer deaths worldwide are due to tobacco. The suffering, disfigurement and death due to oral cancer are easily avoidable since the factors associated with the disease have long been identified. Furthermore, an important aspect of oral cancer is its easy accessibility for diagnosis. This feature coupled with the finding that oral cancer is generally preceded by precancerous lesions provides an excellent opportunity for early detection & control.

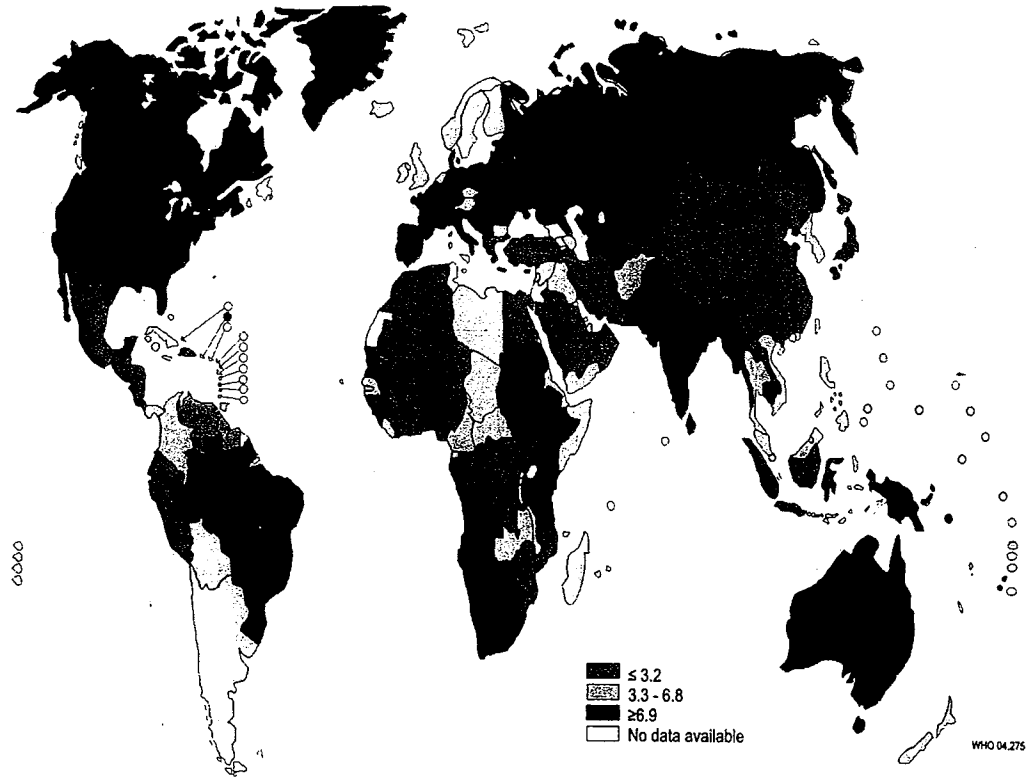
Levels of Prevention	PRIMARY		SECONDARY	TERTIARY	
Preventive Services	Health Promotion	Specific protection	Early diagnosis and prompt treatment	Disability limitation	Rehabilitation
services provided by the individual	-Periodic visits to dental office -Demand for preventive services	-Avoidance of known irritants	- Self examination and referral - Utilization of dental services	Utilization of dental services	Utilization of dental services
Services provided by the dental community	- Dental health education programs -Promotion of research efforts - Lobby efforts	-Avoidance of known irritants	-Periodic screening and referral - provision of dental services	Provision of dental services	Provision of dental services
Services provided by the dental professional	-Patient education	-Removal of known irritants	-Complete examination -Biopsy -Complete excision	-Chemotherapy -Radiotherapy -Surgery	-Maxillofacial and removable prosthodontics -Plastic surgery -Speech therapy

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Incidence of oral cavity cancer (ICD-10: C00-C08)
Age-standardized rate (ASR) per 100 000 world standard population
World, Female (all ages)



Incidence of oral cavity cancer (ICD-10: C00-C08)
Age-standardized rate (ASR) per 100 000 world standard population
World, Male (all ages)



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Chapter 7

EPIDEMIOLOGY, ETIOLOGY AND PREVENTION OF MALOCCLUSION

INTRODUCTION

UNFAVOURABLE SEQUELAE OF MALOCCLUSION

EPIDEMIOLOGY

CLASSIFICATION

ETIOLOGY

PREVENTION

- PREVENTIVE ORTHODONTICS
- INTERCEPTIVE ORTHODONTICS

CONCLUSION

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INTRODUCTION

The term Orthodontia was apparently used first by the Frenchman Le Foulon in 1839. The name of the speciality "Orthodontics" comes from two Greek words "Ortho" meaning right or correct, "Odontos" meaning tooth, "ics" meaning science.

The definition given by the British Society for the study of Orthodontics in 1922 - 'Orthodontics includes the study of the growth and development of the jaws and face particularly and the body generally, as influencing the position of the teeth; the study of action and reaction of internal and external influences on the development and the prevention and correction of arrested and perverted development'.

UNFAVOURABLE SEQUELAE OF MALOCCLUSION

Poor facial appearance

Malocclusion is capable of adversely affecting the facial appearance of an individual.

Risk of caries

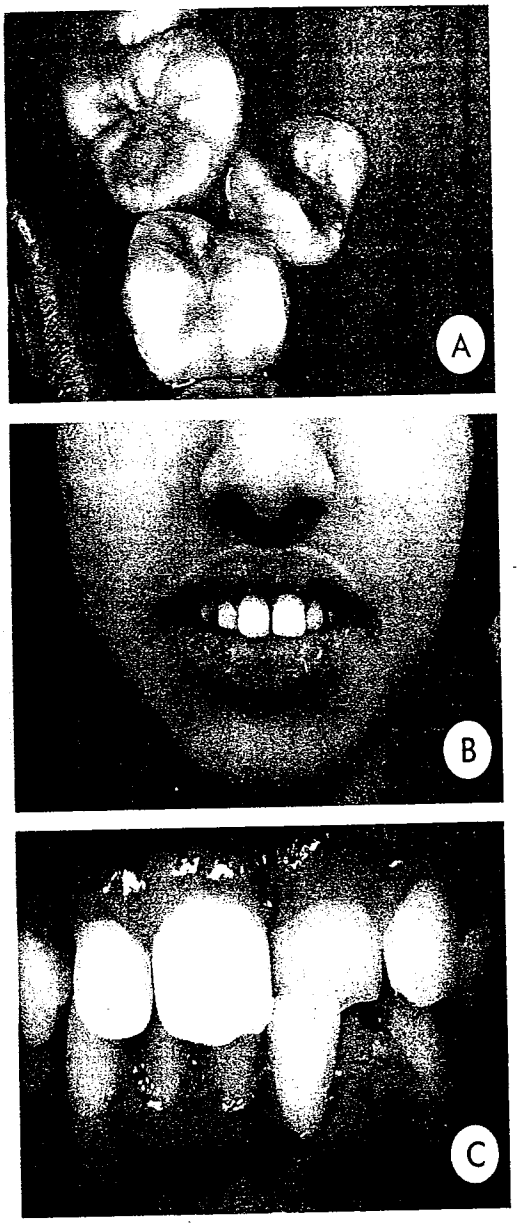
Malalignment of teeth makes oral hygiene maintenance a difficult task, thereby increasing the risk of caries.

Predisposition to periodontal diseases

Malocclusion associated with poor oral hygiene is a frequent cause of periodontal diseases. In addition, teeth that are placed in abnormal positions can be a cause for traumatic occlusion with resultant periodontal tissue damage.

Psychological disturbances

Malocclusion that adversely affects the appearance of a person leads to psychological disturbances. Unsightly appearance of teeth makes a person highly self-conscious and turns him into an introvert. Thus treatment of malocclusion in such patients helps in improving the mental well being and confidence.



(A) Malocclusion predispose to caries due to food trap(B) Proclination can predispose to trauma of anterior teeth (C) Malocclusion can result in traumatic bite

Risk of trauma

Teeth that are severely proclined are at a high risk of injury especially during play or by an accidental fall.

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AUTHORS	YEAR	POPULATION	FINDINGS
Shourie	1942	Children of age group 13-16 yrs in Punjab	Prevalence of malocclusion was almost 50%.
Shaikh	1960	Children of age group 6-13 yrs in Bombay	68% had Class I malocclusion
Miglani, Sharma et al	1963	Children of age group 15-25 years in Madras	19.6% of the children had malocclusion
Shaikh and Desai	1966	7-21 years age group in Bombay	72.9% had malocclusion
Jacob P P et al	1969	Children of 12-15 yrs age group in Trivandrum	44.97% had malocclusion, 4.9% Class II; 0.3% Class III .
Prasad A Rajendra and Savadi S	1971	Girls of age 5-15 yrs in Bangalore city	85.7% had malocclusion with 51.5% Class I; 4% Class II and 0.9% Class III.
Arya N	1976	Age group 5-28 yrs in Nagpur	96.05% had malocclusion
Nagaraja Rao	1980	500 school children of age group 5-15 yrs in Udupi	28.8% had malocclusion; 4.5% Class II; 1.3% Class III.
Gardiner J H et al	1989	10-12 yrs age group in South Kanara	Class II was 14% and 42% showed crowding pattern in maxilla.
Kharbanda, Sidhu, Sundaram	1991	5554 school children of age group 5-13 yrs in Delhi	36.6% malocclusion. The crowding of anterior teeth was 18% in lower arch and 9.5% in upper arch
Guaba K, Ashima G, Tewari A, Utreja A	1998	3164 rural children aged 6-15 years in Raipur Rani and Naraingarh blocks in the district of Ambala in Haryana	2 % of rural children were found to have malocclusion. 14.4 % had Class I, 13.5 % had class II and 1.3 % had Class III malocclusion
V Dhar, A Jain, TE Van Dyke, A Kohli	2007	1,587 government school children of 5-14 years age group in Udaipur district	36.42% had malocclusion

Abnormalities of function

Many malocclusions cause abnormality in the functioning of the stomatognathic system such as improper deglutition, defects in speech, improper respiration, etc.

Temporomandibular joint problems

Malocclusion associated with occlusal prematurities and deep bite is believed to be a cause of TMJ problems such as pain and dysfunction.

EPIDEMIOLOGY OF MALOCCLUSION

Many organized population surveys have been carried out in different parts of the world with the objective of estimating the prevalence of malocclusion and orthodontic treatment needs. Prevalence of malocclusion is estimated to be higher in developed countries as compared to developing countries.

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Indians exhibit a low incidence of variation in molar relation both in the mesial and distal direction. However, Indians have more tendency for Class II relationship than Africans. Class III malocclusion is also much less prevalent in India compared to USA, Netherlands and Kenya.

In India, data from the National Oral Health Survey (2002-2003) states that in children aged 12 years and 15 years, the prevalence of malocclusion was 23.6% and 23.9% respectively. A higher prevalence was found in male children.

Classification

Malocclusion can present itself in numerous ways. Classification involves the grouping together of various malocclusions into simpler or smaller groups. In order to have a system of classification, standards should be set up that represent normalcy. The deviations from the accepted norms should also be grouped into various smaller divisions or categories.

The advantages of classifying malocclusion is that it helps in,

a. Diagnosis and planning treatment for the patient.
b. Visualizing and understanding the problem associated with that malocclusion.
c. Communicating the problem.
d. Easy comparison of the various malocclusions.

A number of systems of classifying malocclusion have been proposed. The most widely accepted and used system was proposed by Edward H. Angle who is considered the "Father of Modern Orthodontics".

ANGLE'S SYSTEM OF CLASSIFICATION

Edward Angle introduced a system of classifying malocclusion in the year 1899. Angle's classification is still in use due to its simplicity in application.

The Angle's classification is based on the following criteria,

a. Angle's classification was based on the mesio-distal relation of the teeth, dental arches and the jaws.
b. According to Angle, the maxillary first permanent molar is the key to occlusion. He considered these teeth as fixed anatomical points within the jaws.
c. Based on the relation of the lower first permanent molar to the upper first permanent molar, he classified malocclusions into three main classes designated by the Roman numerals I, II, and III.

Based on the above mentioned principles, Angle classified malocclusion into the following broad categories.

- CLASS I
- CLASS II
  - DIVISION 1
  - DIVISION 2
- CLASS III

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Angle's Class I

Angle's Class I malocclusion is characterized by the presence of a normal inter-arch molar relation. The mesio-buccal cusp of the maxillary first permanent molar occludes in the buccal groove of mandibular first permanent molar. The patient may exhibit dental irregularities such as crowding, spacing, rotations, missing teeth etc.,. These patients exhibit normal skeletal relation and also show normal muscle function.

Angle's Class II

This group is characterized by a Class II molar relation where the disto-buccal cusp of the upper first permanent molar occludes in the buccal groove of the lower first permanent molar. Angle has sub-classified Class II malocclusions into two divisions :

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Class II, Division 1

The Class II, Division 1 malocclusion is characterized by proclined upper incisors with a resultant increase in overjet. A deep incisor overbite can occur in the anterior region. A characteristic feature of this malocclusion is the presence of abnormal muscle activity. The upper lip is usually hypotonic, short and fails to form a lip seal. The lower lip cushions the palatal aspect of the upper teeth, a feature typical of a Class II, Division 1 referred to as 'lip trap'. The tongue occupies a lower posture thereby failing to counteract the buccinator activity. The unrestrained buccinator activity results in narrowing of the upper arch at the premolar and canine regions thereby producing a V-shaped upper arch. Another muscle aberration is a hyperactive mentalis. The muscle imbalance produced by hyperactive buccinator and mentalis muscles and an altered tongue position accentuates the narrowing of the upper dental arch.

Class II, Division 2

As in Class II, Division 1 malocclusion, the Division 2 also exhibits a Class II molar relationship. The classic feature of this malocclusion is the presence of lingually inclined upper central incisors and labially tipped upper lateral incisors overlapping the central incisors. Variations of this form are lingually inclined central and lateral incisors with the canines labially tipped. The patient exhibits a deep anterior overbite.

The lingually inclined upper centrals gives the arch a squarish appearance, unlike the narrow V-shaped arch seen in Division 1. The mandibular labial gingival tissue is often traumatized by the excessively tipped upper central incisors. The patient exhibits normal perioral muscle activity. An abnormal backward path of closure may also be present due to the excessively tipped central incisors.

Class II, Subdivision

When a Class II molar relation exists on one side and a Class I relation on the other, it is referred to as Class II, Subdivision. Based on whether it is a Division 1 or Division 2 it can be called Class II, Division 1, Subdivision or Class II, Division 2, Subdivision.

Angle's Class III

This malocclusion exhibits a Class III molar relation with the mesio-buccal cusp of the maxillary first permanent molar occluding in the interdental space between the mandibular first and second molars. Class III malocclusion can be classified into true Class III and pseudo Class III.

True Class III

This is a skeletal Class III malocclusion of genetic origin that can occur due to the following causes,

a. Excessively large mandible
b. Forwardly placed mandible
c. Smaller than normal maxilla
d. Retropositioned maxilla
e. Combination of the above causes

The lower incisors tend to be lingually inclined. The patient can present with a normal overjet, an edge to edge incisor relation or an anterior cross bite. The space available for the tongue is usually more. Thus the tongue occupies a lower position, resulting in a narrow upper arch.

Pseudo Class III

This type of malocclusion is produced by a forward movement of the mandible during jaw closure, thus it is also called 'postural' or 'habitual' Class III malocclusion. The following are some of the causes of pseudo Class III malocclusion,

a. Presence of occlusal prematurities, which may deflect the mandible forward.

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b. In case of premature loss of deciduous posteriors, the child tends to move the mandible forward to establish contact in the anterior region.
c. A child with enlarged adenoids tends to move the mandible forward in an attempt to prevent the tongue from contacting the adenoids.

Class III, Subdivision

This is a condition characterized by a Class III molar relation on one side and a Class I relation on the other side.

DEWEY'S MODIFICATION OF ANGLE'S MALOCCLUSION

Dewey proposed a modification of the Angle's classification of malocclusion. He divided Angle's Class I into five types and Angle's Class III into three types.

Class I modifications

TYPE I : Class I malocclusion with bunched or crowded anterior teeth.
TYPE 2 : Class I with protrusive maxillary incisors.
TYPE 3 : Class I malocclusion with anterior crossbite.
TYPE 4 : Class I molar relation with posterior crossbite.
TYPE 5 : The permanent molar has drifted mesially due to early extraction of second deciduous molar or second premolar.

Class III modifications

TYPE 1: The upper and lower dental arches when viewed separately are in normal alignment. But when the arches are made to occlude the patient shows an edge to edge incisor alignment, suggestive of a forwardly moved mandibular dental arch.
TYPE 2: The mandibular incisors are crowded and are in lingual relation to the maxillary incisors.
TYPE 3: The maxillary incisors are crowded and are in cross bite in relation to the mandibular anteriors.

SIMON'S CLASSIFICATION

Malocclusion can occur in antero-posterior, transverse and in the vertical planes. Simon had put forward a craniometric classification of malocclusion that related the dental arches in all these three planes. Simon's system of classification made use of three anthropometric planes i.e., the Frankfort horizontal plane, the Orbital plane and the Mid-sagittal plane.The classification of malocclusion was based on abnormal deviations of the dental arch from their normal position in relation to these three planes.

Frankfort horizontal plane

This is a plane that connects the upper margin of the external auditory meatus to the infra-orbital margin. This plane is used to classify malocclusions in a vertical plane. Two terms are used to describe any abnormal relation of the teeth to this plane. When the dental arch or part of it is closer than normal to the Frankfort plane, it is called attraction. When the dental arch or part of it is farther away from the Frankfort horizontal plane, it is called abstraction.

Orbital plane

This plane is perpendicular to the Frankfort horizontal plane, dropped down from the bony orbital margin directly under the pupil of the eye. According to Simon, this plane should pass through the distal third of the canine. This is called Simon's Law of Canine. This plane is used to describe malocclusion in a sagittal or antero-posterior direction. When the dental arch or part of it is farther from the orbital plane, it is called protraction. When the arch or part of it is closer or more posteriorly placed in relation to this plane, it is called retraction.

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Mid-sagittal plane

The mid-sagittal plane is used to describe malocclusion in the transverse direction. When a part or whole of the arch is away from the mid-sagittal plane it is called distraction. When the arch or part of it is closer to the mid-sagittal plane it is called contraction.

BENNET'S CLASSIFICATION

Norman Bennet classified malocclusion based on its etiology.

Class I : Abnormal position of one or more teeth due to local causes.

Class II : Abnormal formation of a part of or whole of either arch due to developmental defects of bone.

Class III : Abnormal relationship between upper and lower arches and between either arch and facial contour and correlated abnormal formation of either arch.

ACKERMAN-PROFFIT SYSTEM OF CLASSIFICATION

Ackerman and Profitt in 1960 proposed a diagrammatic classification of malocclusion to overcome the limitations of the Angle's classification. Salient features of the classification include,

a. Transverse as well as vertical discrepancies can be considered in addition to antero-posterior malrelations.
b. Crowding and arch asymmetry can be evaluated.
c. Incisor protrusion is taken into account.

This system of classification is based on the Venn symbolic diagram that identifies five major characteristics to be considered and described in the classification.

Step 1 (Alignment)

The first step involves assessment of the alignment and symmetry of the dental arch. It is classified as ideal / crowded / spaced.

Step 2 (Profile)

It involves the consideration of the profile. The profile is described as convex / straight / concave. The facial divergence is also considered i.e., anterior or posterior divergence.

Step 3 (Type)

The transverse skeletal and dental relationship is evaluated. Buccal and palatal cross bites if any are noted. The cross bite is further sub-classified as unilateral or bilateral. In addition, differentiation is made between skeletal and dental cross bite.

Step 4 (Class)

This involves the assessment of the sagittal relationship. It is classified as Angle's Class I / Class II / Class III malocclusion. Differentiation is made between skeletal and dental malocclusion.

Step 5 (Bite depth)

Malocclusions in the vertical plane are noted. They are described as anterior or posterior open bite, anterior deep bite or posterior collapsed bite. It is noted whether the malocclusion is skeletal or dental.

ETIOLOGY

A number of classifications of etiologic factors of malocclusion have been put forward,

MOYER'S CLASSIFICATION

1. Heredity
   a. Neuromuscular system
   b. Bone
   c. Teeth
   d. Soft Parts
2. Developmental defects of unknown origin
3. Trauma

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a. Prenatal trauma and birth injuries
b. Postnatal trauma

4. Physical agents
   a. Premature extraction of primary teeth
   b. Nature of food
5. Habits
   a. Thumb sucking and finger sucking
   b. Tongue thrusting
   c. Lip sucking and lip biting
   d. Posture
   e. Nail biting
   f. Other habits
6. Diseases
   a. Systemic diseases
   b. Endocrine disorders
   c. Local diseases
      i. Nasopharyngeal diseases and disturbed respiratory function
      ii. Gingival and periodontal disease
      iii. Tumors
      iv. Caries
7. Malnutrition

WHITE AND GARDINER'S CLASSIFICATION

A. Dental base abnormalities
   1. Antero-posterior malrelationship
   2. Vertical malrelationship
   3. Lateral malrelationship
   4. Disproportion of size between teeth and basal bone
   5. Congenital abnormalities

B. Pre-eruption abnormalities
   1. Abnormalities in position of developing tooth germ
   2. Missing teeth
   3. Supernumerary teeth and teeth abnormal in form
   4. Prolonged retention of deciduous teeth
   5. Large labial frenum
   6. Traumatic injury

C. Post-eruption abnormalities
   1. Muscular
   a. Active muscle force
   b. Rest position of musculature
   c. Sucking habits
   d. Abnormalities in path of closure
   2. Premature loss of deciduous teeth
   3. Extraction of permanent teeth

PREVENTION OF MALOCCLUSION

There are a number of procedures that can be undertaken to prevent or intercept a malocclusion that may develop or is developing. The terms preventive and interceptive orthodontics are sometimes used synonymously. But it should be understood that preventive orthodontic procedures are aimed at elimination of factors that may lead to malocclusion and are undertaken when the dentition and occlusion are perfectly normal.

Interceptive procedures are undertaken at a time when the malocclusion has already developed or is developing. Some of the procedures carried out in preventive orthodontics can also be carried out in interceptive orthodontics but the timings are different.

PREVENTIVE ORTHODONTICS

Preventive orthodontics is that part of orthodontic practice which is concerned with the patient's and parents' education, supervision of the growth and development of the dentition and the cranio-facial structures, the diagnostic procedures undertaken to predict the appearance of malocclusion and the treatment procedures instituted to prevent the onset of malocclusion.

The following are some of the procedures undertaken in preventive orthodontics,

1. Parent education
2. Caries control
3. Care of deciduous dentition
4. Management of ankylosed tooth
5. Maintenance of quadrant wise tooth shedding time table
6. Checkup for oral habits
7. Occlusal equilibriation
8. Extraction of supernumerary teeth
9. Space maintenance

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10. Management of deeply locked permanent first molars
11. Management of abnormal frenal attachments

Parent education

Preventive dentistry should ideally begin much before the birth of the child. The expecting mother should be educated on matters such as nutrition to provide an ideal environment for the developing fetus. Soon after birth, the mother should be educated on proper nursing and care of the child. In case the child is being bottle fed the mother is advised on the use of physiologic nipple and not the conventional nipple. The conventional nipples are non-physiologic and do not permit suckling by movement of the tongue and the lower jaw. They rather cause sucking of the milk which may lead to various orthodontic problems of the teeth. The physiologic nipples on the other hand are designed to permit suckling of the milk which more or less resembles the normal functional activity as in breast feeding.

The parents should also be educated on the need for maintaining good oral hygiene. The parents should be taught the correct method of brushing teeth.

Caries control

Caries involving the proximal surface of deciduous teeth if not restored leads to loss of arch length by movement of adjacent teeth into that space. Caries should be detected by clinical and radiographic examination. Bitewing radiographs are a valuable aid in detection of caries. Once caries is detected, proper restoration of the affected teeth should be undertaken immediately to prevent loss of arch length.

Care of deciduous dentition

Preventive orthodontics includes care of the deciduous dentition by way of prevention and timely restoration of carious teeth. The deciduous teeth are excellent natural space maintainers until the developing permanent teeth are ready to erupt into the oral cavity. Thus all efforts should be taken to prevent early loss of the deciduous teeth. Simple preventive procedures such as application of topical fluoride and pit and fissure sealants help in preventing caries.

Management of ankylosed teeth

Ankylosis is a condition characterized by absence of the periodontal membrane in a small area or the whole of the root surface, resulting in fusion of the tooth with the alveolar bone. Ankylosed deciduous teeth do not get resorbed and therefore either prevent the deciduous teeth from erupting or deflect them to erupt in abnormal locations. These ankylosed teeth should be diagnosed and surgically removed at an appropriate time to permit the permanent teeth to erupt.

Maintenance of quadrant wise tooth shedding time table

There should be not more than 3 months difference in shedding of deciduous teeth and eruption of permanent teeth in one quadrant as compared to other quadrants. Delay in eruption may be due to one of the following factors,

a. Presence of over-retained deciduous teeth or roots
b. Supernumerary tooth
c. Cysts
d. Over-hanging restoration in deciduous teeth
e. Fibrosis of gingiva
f. Ankylosed primary teeth

Checkup for oral habits

Habits such as finger and thumb sucking, nail biting, tongue thrusting and lip biting should be identified and patient/parents educated on the ill effects of these habits. Prevention starts with proper nursing and use of a physiologically designed nursing nipple and

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pacifier to enhance normal functional and deglutitional activity.

Occlusal equilibriation

All functional prematurities should be eliminated as they can lead to deviations in the mandibular path of closure and also predispose to bruxism. Using articulating paper, the premature contact area is detected and selective grinding is carried out. Sometimes abnormal anatomical features like enamel pearls may cause premature contact, which can be eliminated by grinding.

Extraction of supernumerary teeth

Presence of supernumerary and supplemental teeth can interfere with the eruption of nearby normal teeth. They can deflect adjacent teeth to erupt in abnormal positions. Presence of an unerupted mesiodens prevents the two maxillary central incisors from approximating each other. Thus supernumerary teeth should be identified and extracted before they cause displacement of other teeth.

Space maintenance

Premature loss of deciduous teeth can cause drifting of the adjacent teeth into the space. It can result in abnormal axial inclination of teeth, spacing between teeth and shift in the dental midline. Premature loss of deciduous anteriors leads to very little orthodontic changes. If the deciduous first molars are lost prematurely, lateral shift of anteriors takes place. - In case of premature loss of deciduous second molars, the permanent first molars migrate mesially thereby leaving insufficient space for the erupting second premolars which can get impacted within the jaw or get deflected and erupt in an abnormal location. Space maintainer is a device used to maintain the space created by the loss of a deciduous tooth.

Classification of space maintainers

Several authors have classified space maintainers.

According to Hitchcock,

1. Removable or fixed or semi-fixed
2. With bands or without bands
3. Functional or non functional
4. Active or passive
5. Certain combinations of the above

According to Raymond C. Thurow,

1. Removable
2. Complete arch
   Lingual arch
   Extra-oral anchorage
3. Individual tooth

According to Heinrichsen,

1. Fixed space maintainers :
   Class I
   a) Non-functional types
      i) Bar type
      ii) Loop type
   b) Functional types
      i) Pontic type
      ii) Lingual arch type
   Class II - Cantilever type (distal shoe, band & loop)
2. Removable space maintainers :
   Acrylic partial dentures
   Complete dentures
   Removable distal shoe space maintainers

Requirements of space maintainers

A space maintainer should fulfill the following requirements,

1. It should maintain the entire mesio-distal space created by a lost tooth.
2. It must restore the function as far as possible and prevent over-eruption of opposing teeth.
3. It should be simple in construction.
4. It should be strong enough to withstand the functional forces.

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5. It should not exert excessive stress on adjoining teeth.
6. It must permit maintenance of oral hygiene.
7. It must not restrict normal growth and development and natural adjustments which take place during the transition from deciduous to permanent dentition.
8. The space maintainer should not come in the way of other functions.

REMOVABLE SPACE MAINTAINERS

They are space maintainers which can be removed and reinserted into the oral cavity by the patient. Removable space maintainers can be classified as functional and non-functional space maintainers. Functional space maintainers incorporate teeth to aid in mastication, speech and esthetics whereas non-functional space maintainers have only an acrylic extension over the edentulous area to prevent space closure.

Advantages of removable space maintainers

1. They are easy to clean and permit maintenance of proper oral hygiene.
2. They maintain or restore the vertical dimension.
3. They can be worn part time allowing circulation of blood to the soft tissues.
4. They serve other important functions like mastication, esthetics and phonetics.
5. Dental check-up for caries detection can be undertaken easily.
6. Room can be made for permanent teeth to erupt without changing the appliance.
7. They stimulate eruption of permanent teeth.
8. Band construction is not necessary.
9. They help in preventing development of tongue thrust habit into the extraction space.

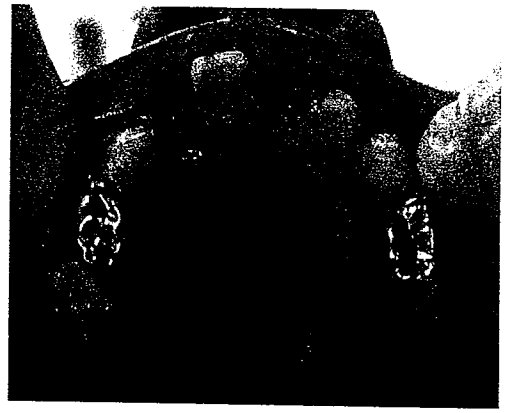
Disadvantages of removable space maintainers

1. They may be lost or broken by the patient.
2. Unco-operative patients may not wear the appliance.
3. Lateral jaw growth maybe restricted if clasps are incorporated.
4. They may cause irritation of the underlying soft tissues.

Commonly used removable space maintainers

1. Acrylic partial dentures

Acrylic partial dentures can be readily adjusted to allow the eruption of teeth. The inclusion of artificial teeth in the denture restores masticatory function. Clasps can be fabricated on deciduous canines and molars for retention.





Arcylic partial denture used as space maintainer

2. Complete dentures

These dentures not only restore masticatory function and esthetics, but also guide the first

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permanent molars into their correct position. The posterior border of the denture should be placed over the area approximating the mesial surface of the unerupted first permanent molar. The denture will have to be adjusted and a portion of it cut away as the permanent incisors erupt, and the posterior border contoured to guide the first permanent molars into position. When the permanent incisors and first permanent molars have erupted, a partial denture space maintainer can be used until the remaining permanent teeth erupt.

3. Removable distal shoe space maintainers

An "immediate" acrylic partial denture with an acrylic distal shoe extension has been used successfully to guide the first permanent molar into position when the deciduous second molar is lost shortly before the eruption of the first permanent molar. The tooth to be extracted is cut away from the stone model and a depression is cut into the stone model to allow the fabrication of the acrylic extension. The acrylic will extend into the alveolus after the removal of the primary tooth. The extension may be removed after the eruption of the permanent tooth.

FIXED SPACE MAINTAINERS

Space maintainers which are fixed or fitted onto the teeth are called fixed space maintainers.

Advantages of fixed space maintainers

1. Bands and crowns are used which require minimum or no tooth preparation.
2. They do not interfere with passive eruption of abutment teeth.
3. Jaw growth is not hampered.
4. The succedaneous permanent teeth are free to erupt into the oral cavity.
5. They can be used in unco-operative patients.
6. Masticatory function is restored if pontics are placed.

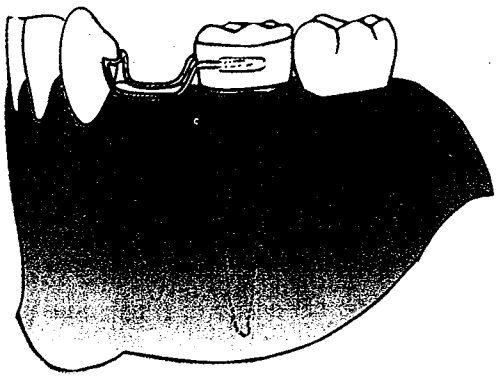
Disadvantages of fixed space maintainers :

1. Elaborate instrumentation with expert skill is needed.
2. They may result in decalcification of tooth material under the bands.
3. Supra-eruption of opposing teeth can take place if pontics are not used.
4. If pontics are used it can interfere with vertical eruption of the abutment tooth and may prevent eruption of replacing permanent teeth if the patient fails to report.

Commonly used fixed space maintainers

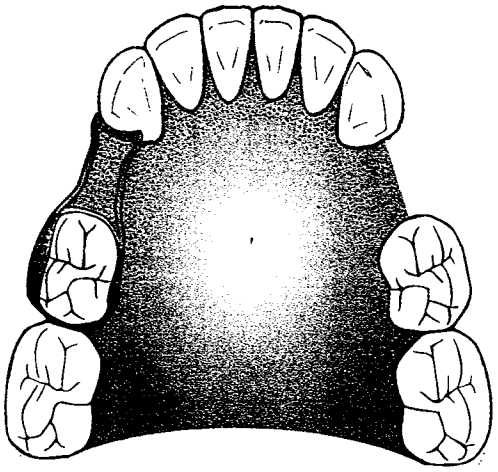
1. Band and loop space maintainer

Band and loop space maintainers are one of the most common space controlling appliances used in dental practice. The tooth distal to the extraction space is banded and a loop of thick stainless steel wire is soldered to it with its mesial end touching the tooth mesial to the extraction space. It is a unilateral fixed appliance indicated for space maintenance in the posterior segments when a single tooth is lost.



Band and Loop space maintainer

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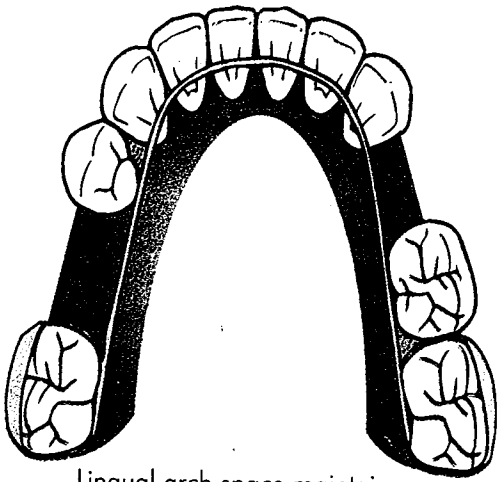


2. Crown and loop space maintainer

Crown and loop appliances are similar to band and loop space maintainers in all respects except that a stainless steel crown is used for the abutment tooth. The crown is used in preference to the band when the abutment tooth is highly carious, exhibits marked hypoplasia or is pulpotomized.

3. The lingual arch space maintainer

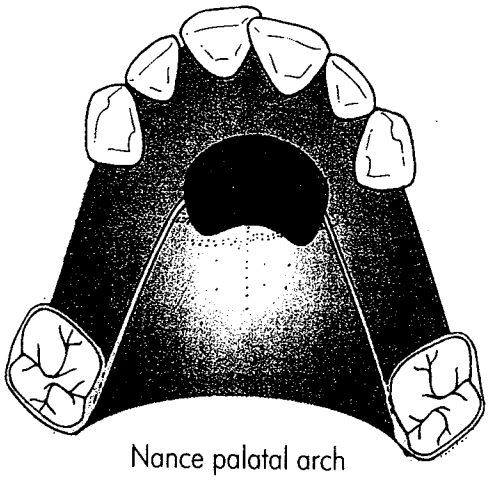
The lingual arch is the most effective appliance for space maintenance in the lower arch. The classical mandibular lingual arch consists of two bands cemented on the first permanent molars or on the second deciduous molars, which are joined by a stainless steel wire contacting the lingual surface of the four mandibular incisors. The appliance is usually indicated to preserve the spaces created by multiple loss of primary molars. It helps in maintaining the arch perimeter by preventing both mesial drifting of the molars and also lingual collapse of the anterior teeth.



Lingual arch space maintainer

4. Palatal arches

They are similar to the lingual arch space maintainer. Palatal arches are designed to prevent mesial migration of the maxillary molars. They are constructed using 0.036 inch diameter hard stainless steel wire. The Nance holding arch is a maxillary lingual arch that does not contact the anterior teeth, but approximates the anterior palate. It incorporates an acrylic button in the anterior region that contacts the palatal tissue.

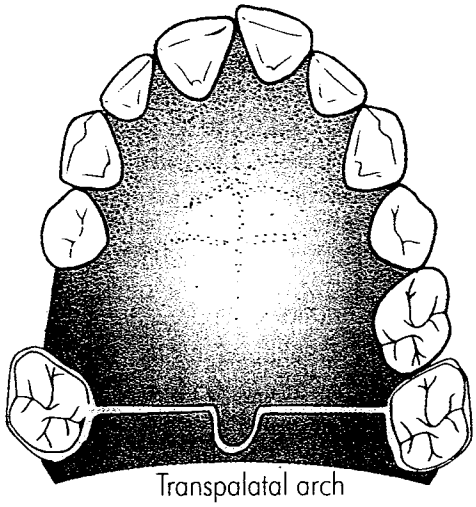


Nance palatal arch

5. The transpalatal arch

The transpalatal arch has been recommended for stabilizing the maxillary first permanent molars when the primary molars require extraction. The transpalatal arch consists of a thick stainless steel wire that spans the palate connecting the first permanent molar of one side with the other. The best indication for transpalatal arch is when one side of the arch is intact, and several primary teeth on the other side are missing.

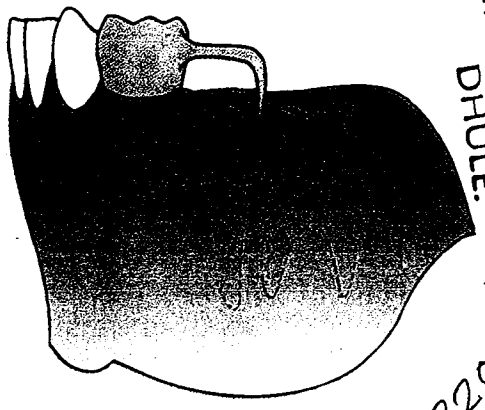
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Transpalatal arch

6. Distal shoe space maintainer

Distal shoe appliance is otherwise known as the intra-alveolar appliance. The distal surface of the second primary molar guides the unerupted first permanent molar. When the second primary molar is removed prior to the eruption of the first permanent molar, the intra-alveolar appliance provides greater control of the path of eruption of the unerupted tooth and prevents undesirable mesial migration. The appliance which is used in practice is Roche's distal shoe or its modifications using crown and band appliances with a distal intra-gingival extension.



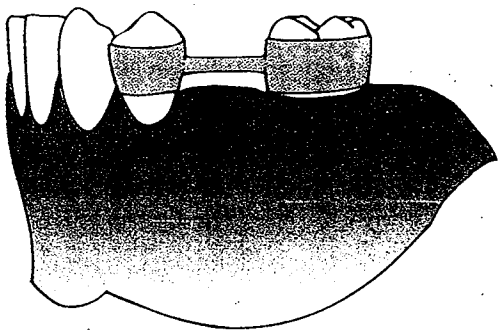
Distal shoe space maintainer

7. Esthetic anterior space maintainer

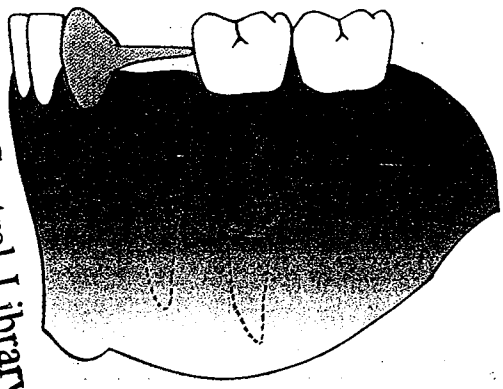
It was described by Steffen, Miller and Johnson in 1971. Its method of construction is simple and also provides an esthetic component. The space maintainer consists of a plastic tooth fixed onto a lingual arch which, in turn, is attached to molar bands.

8. Band and bar space maintainer

This is a fixed space maintainer in which the abutment teeth on either side of the extraction space are banded and connected to each other by a bar. Alternatively stainless steel crowns can be used on the abutments. This type of space maintainer is called crown and bar space maintainer.



Band and bar space maintainer



Crown and bar space maintainer

Management of deeply locked permanent first molars

The deciduous second molars occasionally have a prominent distal bulge which prevents the eruption of the permanent first molars. Slicing the distal surface of the second deciduous molar helps in guiding the eruption of the first permanent molars.

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Management of abnormal frenal attachments

The presence of a thick and fleshy maxillary labial frenum that is attached relatively low prevents the maxillary central incisors from approximating each other. This kind of abnormal frenal attachment in most patients is caused due to hereditary factors. They should hence be diagnosed and treated at an early age.

Presence of ankyloglossia or tongue tie prevents normal functional development due to lowered position of the tongue and abnormalities in speech and swallowing. This condition should be surgically treated to prevent full fledged malocclusions.

INTERCEPTIVE ORTHODONTICS

Interceptive orthodontics has been defined as that phase of the science and art of orthodontics employed to recognize and eliminate potential irregularities and malpositions of the developing dentofacial complex.

The procedures undertaken include,

1. Serial extraction
2. Correction of developing cross bite
3. Control of abnormal habits
4. Space regaining
5. Muscle exercises
6. Interception of skeletal malrelations
7. Removal of soft tissue and bony barrier to eruption of teeth

Serial extraction

Serial extraction is an interceptive orthodontic procedure usually initiated in the early mixed dentition when one can recognize and anticipate potential irregularities in the dentofacial complex and is corrected by a procedure that includes the planned extraction of certain deciduous teeth and later specific permanent teeth in an orderly sequence and pre-determined pattern to guide the erupting permanent teeth into a more favorable position.

Kjellgren in 1929 used the term serial extraction to describe a procedure where some deciduous teeth followed by permanent teeth were extracted to guide the rest of the teeth into normal occlusion. Nance during the 1940's popularized this technique in the United States of America and termed it 'planned & progressive extraction'. Hotz in 1970 called such a procedure as, 'active supervision of teeth by extraction'.

Serial extraction is based on two basic principles:

Arch length - tooth material discrepancy

Whenever there is an excess of tooth material as compared to the arch length, it is advisable to reduce the tooth material in order to achieve stable results. This principle is utilized in serial extraction procedures where tooth material is reduced by selective extraction of teeth so that the rest of the teeth can be guided to normal occlusion.

Physiologic tooth movement

Human dentition shows a physiologic tendency to move towards an extraction space. Thus by selective removal of some teeth the rest of the teeth which are in the process of eruption are guided by the natural forces into the extraction spaces.

Indications of serial extraction

1. Class I malocclusion showing harmony between skeletal and muscular system.
2. Arch length deficiency as compared to the tooth material is the most important indication for serial extraction. Arch length deficiency is indicated by the presence of one or more of the following features :

a. Absence of physiologic spacing

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b. Unilateral or bilateral premature loss of deciduous canines with mid-line shift
c. Malpositioned or impacted lateral incisors that erupt palatally out of the arch
d. Markedly irregular or crowded upper and lower anteriors
e. Localized gingival recession in the lower anterior region is a characteristic feature of arch length deficiency
f. Ectopic eruption of teeth
g. Mesial migration of buccal segment
h. Abnormal eruption pattern & sequence
i. Lower anterior flaring
j. Ankylosis of one or more teeth

3. Where growth is not enough to overcome the discrepancy between tooth material and basal bone

4. Patients with straight profile and pleasing appearance

Contra-indications of serial extraction

a. Class II & III malocclusion with skeletal abnormalities
b. Spaced dentition
c. Anodontia / oligodontia
d. Open bite and deep bite
e. Midline diastema
f. Class I malocclusions with minimal space deficiency
g. Unerupted malformed teeth e.g. dilaceration
h. Extensive caries or heavily filled first permanent molars
i. Mild disproportion between arch length and tooth material that can be treated by proximal stripping

Advantages of serial extraction

Serial extraction carried out during the mixed dentition and early permanent dentition periods has a number of advantages,

a. Treatment is more physiologic as it involves guidance of teeth into normal positions making use of the physiologic forces.

b. Psychological trauma associated with malocclusion can be avoided by treatment of the malocclusion at an early age.
c. It eliminates or reduces the duration of multibanded fixed treatment.
d. Better oral hygiene is possible thereby reducing the risk of caries.
e. Health of investing tissues is preserved.
f. Lesser retention period is indicated at the completion of treatment.
g. More stable results are achieved as the tooth material and arch length are in harmony.

Disadvantages of serial extraction

a. Serial extraction requires clinical judgement. There is no single approach that can be universally applied to all patients. Each patient has to be assessed and a suitable extraction time table planned.
b. Treatment time is prolonged as the treatment is carried out in stages spread over 2-3 years.
c. It requires the patient to visit the dentist often. Thus patient co-operation is needed.
d. As extraction spaces are created that close gradually, the patient has a tendency of developing tongue thrust.
e. Extraction of the buccal teeth can result in deepening of the bite.
f. If the procedures are not carried out properly there is a risk of arch length reduction by mesial migration of the buccal segment. Thus a poorly done serial extraction program can be worse than none at all.
g. Ditching or space can exist between the canine and second premolar.
h. The axial inclination of teeth at the termination of the serial extraction procedure may require correction. This necessitates short term fixed appliance therapy.

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Procedure

The diagnostic exercise prior to treatment should involve comprehensive assessment of the dental, skeletal and soft tissues. A tooth material - arch length discrepancy must ideally exist. An arch length deficiency of not less than 5 - 7 mm should exist to undertake this procedure. Study model analysis should be carried out to determine the arch length discrepancy. Mixed dentition analysis helps in determining the space required for the erupting buccal teeth. The eruption status of the dentition is evaluated from an orthopantomogram.

The skeletal tissue assessment should involve comprehensive cephalometric examination to study the underlying skeletal relation. Serial extraction produces the best results in a Class I skeletal pattern.

The soft tissue assessment by clinical examination and cephalograms help in the diagnosis. Serial extraction is generally undertaken in patients exhibiting harmonious soft tissue pattern.

Dewel has proposed a 3 step serial extraction procedure.

Step 1:

The deciduous canines are extracted to create space for the alignment of the incisors. This step is carried out at 8-9 years of age.

Step 2:

A year after the first step, the deciduous first molars are extracted so that the eruption of first premolars is accelerated.

Step 3:

The erupting first premolars are extracted to permit permanent canines to erupt in their place.

In some cases a modified Dewel's technique is followed wherein the first premolars are enuleacted at the time of extraction of the first deciduous molars. This is frequently necessary in the mandibular arch where the canines often erupt before the first premolars.

Most cases of serial extraction need fixed appliance therapy for the correction of axial inclination and detailing of the occlusion.

Correction of developing cross bite

Anterior cross bite is a condition characterized by reverse overjet wherein one or more maxillary anterior teeth are in lingual relation to the mandibular teeth.

Anterior cross bites should be intercepted and treated at an early stage so as to prevent a minor orthodontic problem from progressing into a major dentofacial anomaly. An old orthodontic maxim states " The best time to treat a cross bite is the first time it is seen."

Anterior cross bite should be treated early for the following reasons :

a. This type of malocclusion is self-perpetuating i.e., if the cross bite is present in the deciduous dentition, it may manifest in the mixed and permanent dentition as well.
b. Simple anterior cross bites that are not treated early have the potential of growing into skeletal malocclusion that later need complicated orthodontic treatment combined, at times, with surgical procedures.

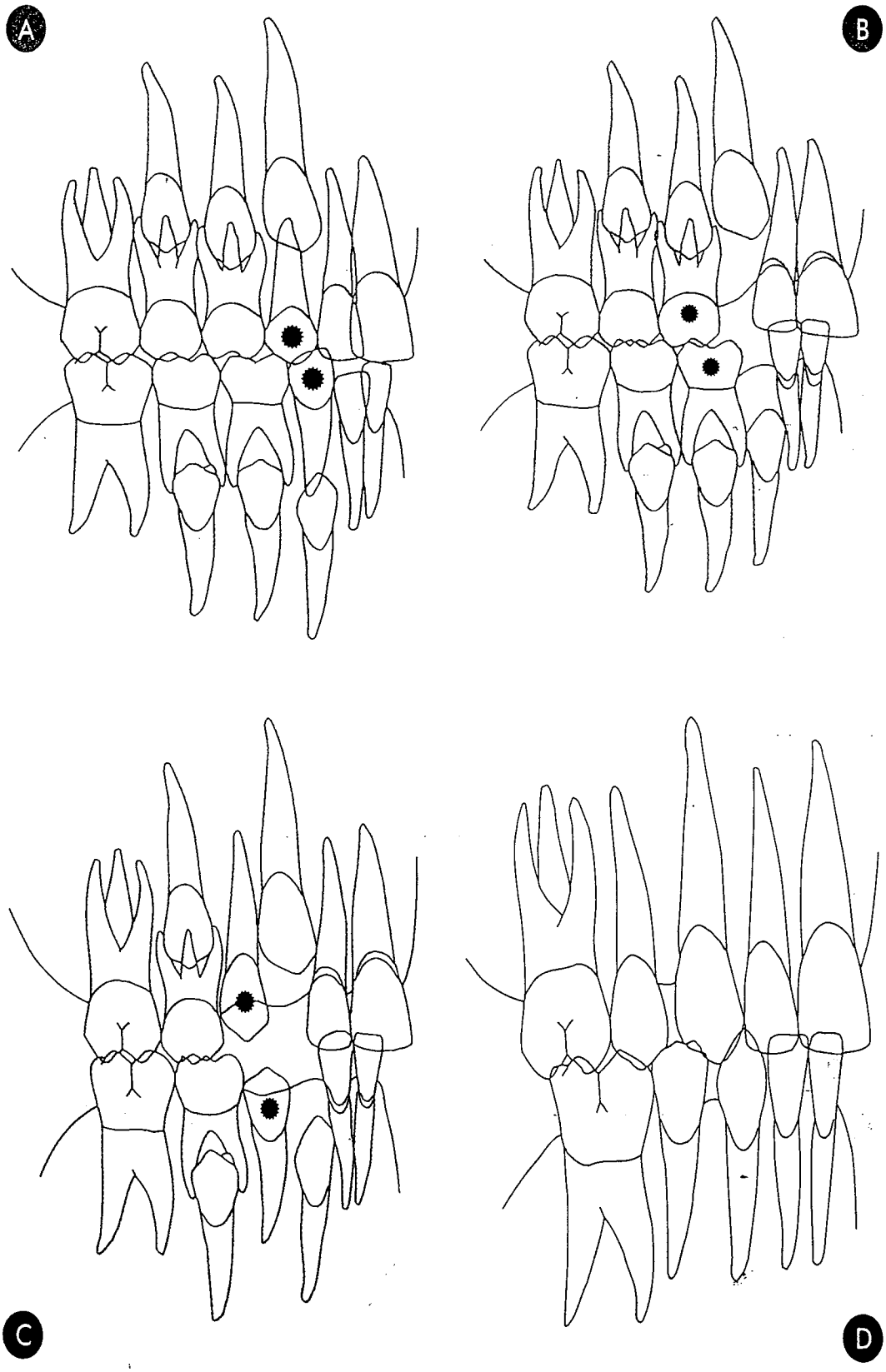
Anterior cross bites can broadly be classified as :

a. Dento-alveolar anterior cross bite
b. Functional anterior cross bite

Dento - alveolar anterior cross bite

Anterior cross bite in which one or more maxillary anterior teeth are in lingual relation to the mandibular anteriors is termed dento-alvelolar anterior cross bite. This kind of anterior cross bite is often manifested as single tooth cross bite and usually occurs due to over retained deciduous teeth that deflect

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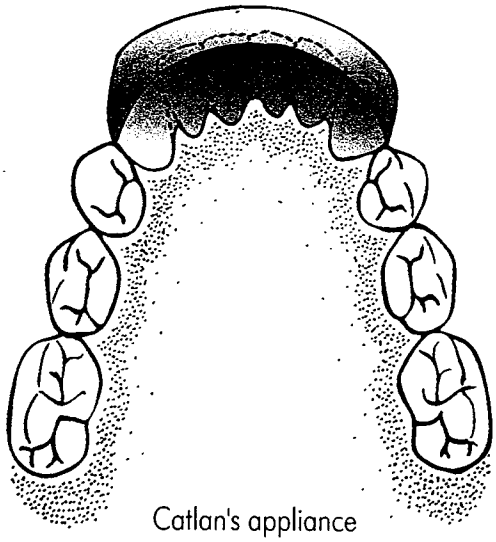


Dewel's method of serial extraction (A) Step one - extraction of deciduous canines to create space for the alignment of the incisors.(B) Step two - extraction of deciduous first molars to accelerate the eruption of first premolars.(C) Step three - extraction of the erupting first premolars to permit the permanent canines to erupt. (D) Serial extraction completed

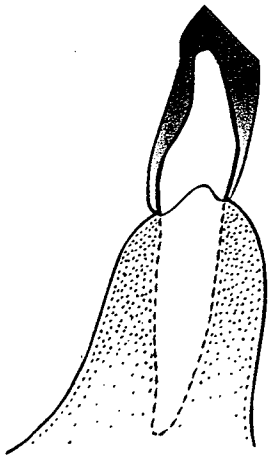
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Tongue blade used to treat developing anterior cross bite



Catlan's appliance



Side view of Catlan's appliance

the erupting permanent teeth into a palatal position. These dento-alveolar cross bites can be effectively treated using tongue blades, Catlan's appliance and double cantilever springs with posterior bite plate.

Functional anterior cross bites

Some anterior cross bites are referred to as functional cross bites. This type of cross bite is the so called pseudo Class III malocclusion where the mandible is compelled to close in a position forward of its true centric relation. Functional cross bites occur as a result of occlusal prematurities that cause a deflection of the mandible into a forward position during closure. These are to be treated by eliminating the occlusal prematurities.

CONTROL OF ABNORMAL HABITS

Habits refer to certain actions involving the teeth and other oral or perioral structures which are repeated often enough by some patients to have a profound and deleterious effect on the position of teeth and occlusion. Some of the habits that can affect the oral structures are thumb sucking, tongue thrusting and mouth breathing.

Thumb sucking

One of the habits that is most frequently practiced by children and is capable of producing damaging effects on the dento-alveolar structures is the thumb sucking habit. The presence of this habit upto 2 1/2 to 3 years of age is considered quite normal. Persistence of this habit beyond 3 1/2 - 4 years of age can have a damaging influence on the dento-alveolar structures and should hence be intercepted. Thumb sucking habit is intercepted by using removable or fixed habit breakers.

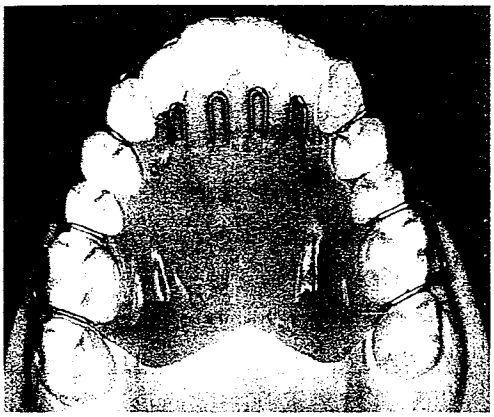
Tongue thrusting

Tongue thrust is defined as a condition in which the tongue makes contact with any teeth anterior to the molars during

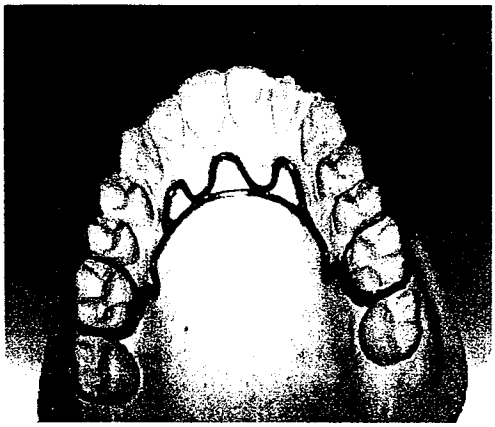
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swallowing. This is a deleterious habit that can clinically present with open bite and anterior proclination.

The tongue thrust habit should be intercepted by using habit breakers. The patient should be trained and educated on the correct technique of swallowing.



A



B

Habit breaker (A) Removable (B) Fixed

Mouth breathing

Mouth breathing habit has a profound effect on the dento-facial region. It can be obstructive or habitual in nature. Obstructive mouth breathing is usually a result of nasal obstruction such as nasal polyps, nasal tumors, chronic nasal inflammatory conditions and deviated nasal septum. Habitual mouth breathing is one where oral breathing persists as a habit after the removal of the nasal obstruction.

Mouth breathing affects the oro-facial equilibrium due to lowered mandibular and tongue posture and can therefore produce severe malocclusion.

Interceptive procedures should involve identification and removal of the cause. Persistence of habitual oral breathing is an indication to use a vestibular screen to intercept the habit.

Space regaining

If a primary molar is lost early and space maintainers are not used, a reduction in arch length by mesial movement of the first molar can be expected. In such patients, the space lost by mesial movement of the molar can be regained by distal movement of the first molar.

Not all patients who have lost arch length by mesial molar movement are ideal candidates for space regaining. The space regaining procedures are preferably undertaken at an early age prior to the eruption of the second molar. Some of the commonly used space regainers are Gerber space regainer, Space regainers using jack screws, Adam's space regainer, Space regaining using cantilever spring

Muscle exercises

The dental tissues are blanketed from all directions by muscles. Normal occlusal development depends upon the presence of normal oro-facial muscle function. Muscle exercises help in improving aberrant muscle function.

Exercise for the masseter muscle:

An exercise to strengthen the masseter muscle involves the clenching of teeth by the patient while counting to ten. The patient is asked to repeat this for some duration of time.

Exercises for the lips (circum-oral muscles):

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A number of exercises have been suggested for the lip and cheek muscles.

a. Stretching of the upper lip to maintain lip seal is an important therapeutic measure in patients having short hypotonic lips. To aid in the stretching, the patient is asked to hold a piece of paper between the lips.
B. Holding and pumping of water back and forth behind the lips.
c. Massaging of the lips.
d. Button pull exercise : A button of 1½ inch diameter is taken and a thread passed through the button hole. The patient is asked to place the button behind the lips and pull the thread, while restricting it from being pulled out by using lip pressure.
e. Tug of war exercise : This is similar to the button pull exercise. This involves use of two buttons, with one placed behind the lips while the other button is held by another person to pull the thread.

Exercises for the tongue:

One elastic swallow

This exercise is used for correction of improper positioning of the tongue. A 5/16 inch intra-oral elastic is placed on the tip of the tongue and the patient is asked to raise the tongue and hold the elastic against the rugae area and swallow.

Tongue hold exercise

A 5/16 inch elastic is positioned over the tongue in a designated spot for a prescribed period of time with the lips closed. The patient is then asked to swallow with the elastic in place and lips apart.

Two elastic swallow

Two 5/16 inch elastics are placed over the tongue, one in the midline and the other on the tip and the patient is asked to swallow with the elastics in position.

The hold pull exercise

The tip of the tongue and the midpoint are made to contact the palate and the mandible is gradually opened. This exercise helps in stretching the lingual frenum.

Interception of skeletal malrelations

Skeletal malocclusion if diagnosed at an early age can be intercepted so as to reduce the severity of the malocclusion that may occur. These growth modulation procedures are aimed at normalizing the skeletal relationship.

Interception of class II malocclusions:

Class II skeletal malocclusion usually occurs as a result of either excessive maxillary growth, deficient mandibular growth or a combination of both. Maxillary growth can be restricted by use of face bow with head gear. Class II malocclusion due to deficient mandibular growth is usually treated by myofunctional appliances.

Interception of class III malocclusions:

Class III malocclusion occurs as a result of mandibular prognathism, maxillary retrognanthism or a combination of both. Chin cup with head gear helps in restriction of mandibular growth while face mask therapy is used for cases of maxillary deficiency.

Removal of soft tissue and bony barriers

Whenever a permanent tooth fails to erupt at the appropriate time, its eruption may be stimulated by surgically exposing the crown. Over retained primary teeth, ankylosed primary teeth and supernumerary teeth are other possible causes of non eruption of succedaneous teeth, which should be ruled out prior to this procedure.

The surgical procedure involves excision of the soft tissue and removal of any bone overlying the crown of the unerupted tooth. The extent of tissue removal should be such that the greatest diameter of the crown of the

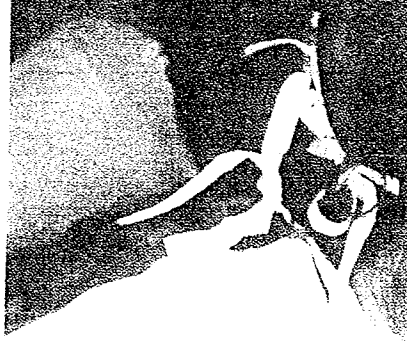
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tooth is exposed. In other words the surgically created opening in the tissue is slightly larger than the greatest dimension of the tooth. The surgical wound is given a cement dressing for a period of 2 weeks.

CONCLUSION

Normal alignment of teeth not only contributes to the oral health but also goes a long way in the overall well being and personality of an individual. Correct tooth position is an important factor for esthetics, function and for overall preservation or restoration of dental health. While most malocclusions may not adversely affect the health of an individual, they nevertheless are capable of producing undesirable functional and esthetic imbalances.

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Chapter 8

BEHAVIORAL SCIENCES IN DENTISTRY

INTRODUCTION

SOCIOLOGY

- STRUCTURAL ASPECTS OF SOCIETY
- FUNCTIONAL ASPECTS OF SOCIETY

CULTURAL ANTHROPOLOGY

SOCIAL PSYCHOLOGY

ECONOMICS

POLITICAL SCIENCE

HEALTH BEHAVIOR AND LIFE STYLE

LIFE STYLE AND ORAL HEALTH

SOCIAL STRATIFICATION AND ORAL HEALTH

RISK BEHAVIOR

UTILIZATION OF DENTAL SERVICES

BEHAVIOR OF THE CHILD IN THE DENTAL OFFICE

CONCLUSION

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INTRODUCTION

Social environment is as important as the physical and biological environment in relation to health and disease in man. The effect of social environment on health is clearly reflected in the differences in disease patterns of rural versus urban and developing versus developed countries.

The term social environment denotes the complex of psychosocial factors influencing the health of the individual and the community. This environment is unique to man and includes cultural values, customs, habits, beliefs, attitudes, morals, religion, education, income, occupation, standard of living, community life and the social and political organization.

The five social sciences include,

- Sociology
- Cultural anthropology
- Social psychology
- Economics
- Political science.

The first three are together called ' Behavioral Sciences'.

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SOCIOLOGY

It is the science concerned with the organization or structure of social groups. It is the science of behavior of man in a society or group of human beings. Society is a group of people who must be mentally aware of each other.

Sociologists define society as "a system of uses and procedures of authority and mutual aid of many groups coupled with division of control of human behavior and liberty". Although animals also live in groups, human society is different from animal society in one component, namely the element of culture. It can be simply understood as ' an art of adding experience '. This addition can be done by telling something to the fellowmen of the same generation as also to the next generation. So, with this extra element, man has given himself the name ' social animal '. Man learns from experience and can plan for the future. He works in the shadow of the past for a better tomorrow.

STRUCTURAL ASPECTS OF SOCIETY

a) Social institution:
It is a social structure and machinery through which human society organizes, directs and executes the multifarious activities required to satisfy human needs Eg: School, Hospital, Parliament etc. Family is a social institution

b) Community :
It is defined as a group, small or large, living together in such a way that the members share not one or more specific interests but rather the basic conditions of a common life. Eg: People living within a residential layout.

c) Association:
They are groups of people united for a specific purpose or a limited number of purposes and are based on utilitarian interest. Eg: Indian Dental Association.

FUNCTIONAL ASPECTS OF SOCIETY

A. Social Norms

They are, "the rules that a group uses for appropriate and inappropriate values, beliefs, attitudes and behaviors". These rules may be explicit or implicit. Failure to stick to the rules can result in severe punishments, the most feared of which is exclusion from the group.

Social norms indicate the established and approved ways of doing things, of dress, of speech and of appearance. These vary and evolve not only through time but also vary from one age group to another and between social classes and social groups. What is deemed to be acceptable dress, speech or

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behavior in one social group may not be accepted in another. Deference to the social norms maintains one's acceptance and popularity within a particular group whereas ignoring the social norms makes one unacceptable, unpopular or even an outcast from a group.

Social norms tend to be tacitly established and maintained through body language and non-verbal communication between people in their normal social discourse.

There are three types of norms: folkways, mores and taboos.

Folkways

Famed American sociologist, William Graham Sumner, is credited with coining the term folkways in his monumental work entitled "folkways: a study of the sociological importance of manners, customs, mores, and morals" in 1907. Folkways are the patterns of conventional behavior in a society, norms that apply to everyday matters. They are the conventions and habits learned from childhood. Generally, conformity to folkways is ensured by gentle social pressure and imitation. Breaking or questioning a folkway does not cause severe punishment, but may cause the person to be laughed at, frowned upon, or scolded. In Indian culture, folkways include welcoming guests with respect called "Athithi devobhava" (guest is like god).

Mores

Mores are much more strictly enforced than folkways. They are norms or customs which express fundamental values of society. Mores derive from the established practices of a society rather than its written laws. They consist of shared understandings about the kinds of behavior likely to evoke approval, disapproval, toleration or sanction, within particular contexts.

Mores are distinguished from folkways by the severity of response they invoke. While breaking a folkway is likely to turn heads of passersby, breaking a more will offend observers and possibly bring punishment. Some important mores are converted into laws in order to ensure implementation. Eg:

Taboo

Taboo is a strong social prohibition (or ban) against words, objects, actions, or discussions that are considered undesirable or offensive by a group, culture, society, or community. Breaking a taboo is usually considered objectionable or abhorrent. Some taboo activities or customs are prohibited by law and transgressions may lead to severe penalties. Other taboos result in embarrassment, shame and rudeness.

E.g.: Abstinence from beef, pork and smoking in Hindus, Muslims and Sikhs respectively.

B. Customs and habits

Custom is a broad term embracing all the norms classified as folkways or mores. It refers to practices that have been repeated by a number of generations, practices that tend to be followed simply because they have been followed in the past. Customs have a traditional, automatic, mass character.

Habits are habituated routines of behavior that are repeated regularly, tend to occur subconsciously, and tend to occur without directly thinking consciously about those behaviors. A habit is a purely personal affair, not entailing any obligation. E.g.: Smoking a cigarette after dinner.

C. Etiquettes and conventions

Etiquette is a code that governs the expectations of social behavior, according to the contemporary conventional norm within a society, social class, or group. Usually unwritten, it may be codified in written form. An etiquette may reflect an underlying ethical code, or it may grow more as a fashion. Etiquette is dependent on culture. What is excellent etiquette in one society may shock

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another. Etiquette evolves within culture. Eg: The manner in which a fork and a knife are used becomes associated with the upper class in the western world, whereas in India, using the hand for eating is the norm even among the elite.

A convention is a set of agreed, stipulated or generally accepted standards, norms or criteria, often taking the form of a custom. A convention may retain the character of an "unwritten" law or custom (e.g. the manner in which people greet each other, such as by shaking each other's hands) or may become law and a regulatory legislation may be introduced to formalize or enforce the convention (e.g. laws which determine which side of the road vehicles must be driven).

D. Social values

They constitute an important part of the selective behavior of man. Values refer to those standards of judgement by which things and actions are evaluated as good or bad. Thus, values are directive principles of human action and serve as criteria of selection.

Personal values evolve from circumstances with the external world and can change over time. Personal values developed early in life may be resistant to change. Groups, societies, or cultures have values that are largely shared by their members. The values identify those objects, conditions or characteristics that members of the society consider important, that is, valuable.

Norms are rules for behavior in specific situations, while values identify what should be judged as good or bad. Norms are said to be the enactment of social values.

Eg: Flying the national flag on Independence day is a norm, but it reflects the value of patriotism. Wearing dark clothing and appearing solemn are normative behaviors at a funeral. They reflect the values of respect and support of friends and family.

It is a norm that no man should be differentiated in terms of sex, caste, colour or creed while practicing the art of medicine. The value behind it is that " all men are born free and equal ".

CULTURAL ANTHROPOLOGY

Anthropology is the study of man and his works. It has two main divisions,

a) Physical anthropology
b) Cultural anthropology

Physical anthropology is the study of man as a biological organism. Cultural anthropology is the branch dealing with man's behavior and products. Its main theme is culture.

Culture is the accumulation of learned behaviors, beliefs and skills of mankind as a whole. It comprises everything which one generation can hand down to the next.

The Oxford dictionary defines culture as, " the training and refinement of mind, tastes and manners, the condition of being thus trained and refined ".

Culture has three parts. It is an experience which is " learned, shared and transmitted".

The branches of cultural anthropology are ;

1. ETHNOLOGY : The comparative study of cultures.
2. ARCHEOLOGY : The study of past cultures and civilizations using their remains as the principal source of information.
3. LINGUISTICS : The study of speech patterns of man i.e. the study of languages and dialects.
4. SOCIAL ANTHROPOLOGY : A specific branch of cultural anthropology dealing with comparative study of kinship and non kinship organization patterns in different societies.

An appreciation of the cultural meanings of health and disease is important in understanding, why people accept or do not accept professional health care. Furthermore, an understanding of cultural

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background is important when attempting to change health beliefs and attitudes. Cultural beliefs about the sources of illness and correspondingly appropriate forms of treatment may be interpreted as a barrier to professional health care. A person may delay seeking dental treatment from a dentist due to reliance on home remedies. This could reduce the effectiveness of any health education or treatment activity planned for improving the oral health status of the community.

Health care providers' ignorance of cultures can also impair their communication with patients, resulting in culturally irrelevant services or misinterpretation of side effects of folk medicines. Successful communication requires recognition and consideration of cultural diversity and differing communication styles. Dismissal of beliefs held by people from other cultures -- termed ethnocentrism -- can create a barrier of misunderstanding. Developing a deeper understanding of cultural beliefs and practices and an acknowledgement of respect for these practices by health care providers could improve the use of health care services in the community.

SOCIAL PSYCHOLOGY

It deals with human nature and attitudes in general. Social psychology studies, how and why perceptions, thoughts, opinions, attitudes and behavior vary in different groups and societies i.e. it studies the effect of social environment on individual psychology.

ECONOMICS

It studies the economic aspects of man i.e. production, distribution and consumption of the three basic essentials for his living namely food, shelter and clothing. Scarcity or excess of these are found to affect human behavior.

POLITICAL SCIENCE

It deals with the constitution, the government and the laws of the state, which impose some sort of discipline on man's movements or behavior.

HEALTH BEHAVIOR AND LIFE - STYLE

Health behavior

"Any activity undertaken by an individual, regardless of actual or perceived health status, for the purpose of promoting, protecting or maintaining health, whether or not such behavior is objectively effective towards that end".

- WHO Health Promotion Glossary, 1986

It is a broad concept implying actions, undertaken by people which have positive or negative consequences to health.

Example for positive behavior: effective tooth cleaning practices.

Example for negative behavior or risk behavior: Frequent consumption of sugary foods.

It is the activity undertaken by individuals for the purpose of preventing disease or detecting it at an asymptomatic stage. E.g. flossing the teeth, undergoing regular dental check ups.

Illness behavior:

It is the interpretation of symptoms or signs of illness, especially pain and the search for relief. It is a social process drawing on past experience and involving interaction with others in defining a solution to an oral health problem. This process is called illness behavior. It is the activity undertaken by individuals who perceive themselves as having a health problem for the purpose of defining their health and discovering and undertaking an appropriate remedy.

Labeling behavior:

In the case of conditions that are visible and that affect the social identity or acceptability of a person, more complex processes of

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decision making are involved. In such instances, both the pressures from others and the will to accede to such pressures are much greater. This process of influence and response is called labeling behavior.

Factors influencing preventive behavior

Before the dentist can establish sound principles of diagnosis and subsequent application of technical skills to control behavior, he or she must be familiar with those factors that influence behavior. They are,

1. Growth and development:

A child's development involves physical, intellectual and emotional aspects of growth and these are constantly changing in magnitude and expanse. An intellectual age of three years signifies a maturational readiness to accept dental treatment.

2. Family and peer influences:

Psychosocial factors are probably the strongest influences on human behavior. The parent's attitude moulds, shapes and directs behavior in the early period of the offspring's development whereas in the later years, it is affected by factors such as attitudes of peers, socioeconomic status and education.

3. Past medical and dental experiences:

Past bad medical / dental experiences will adversely shape and influence preventive behavior.

4. Dental office environment:

A dental office that reflects drabness or lack of warmth lends little to brightening an individuals mind or his or her attitude. Both technical skill and the dentist's behavior affects individual behavior.

Szasz and Hollender in 1956 described three types of relationship that can occur between professional caregivers and patients. The first type is termed "activity-passivity", where the professional is in complete active control and the patient is a passive recipient of treatment. This usually occurs when the patient is under a general anesthetic. A second type of relationship is "guidance-co-operation", when the professional guides like a teacher while the patient co-operates like a student. This describes a situation where the dentist is treating a conscious patient. The third type is termed "mutual participation". This is most clearly shown in preventive care where the dentist and patient share responsibility for the maintenance of oral health.

LIFESTYLE AND ORAL HEALTH

Lifestyle / lifestyles conducive to health

"Lifestyle is a way of living based on identifiable patterns of behavior, which are determined by the interplay between an individual's personal characteristics, social interactions, and socioeconomic and environmental living conditions".

- WHO Health Promotion Glossary, 1998

These patterns of behavior are continually interpreted and tested out in different social situations and are therefore not fixed, but subject to change. They are learned through social interaction with parents, peer groups, friends and siblings or through the influence of schools, mass media etc. They are subject to change based on experience and reinterpretation. Individual lifestyles, characterized by identifiable patterns of behavior, can have a profound effect on an individual's health and on the health of others. If health is to be improved by enabling individuals to change their lifestyles, action must be directed not only at the individual but also at the social and living conditions which interact to produce and maintain these patterns of behavior.

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It is important to recognize, however, that there is no "optimal" lifestyle to be prescribed for all people. Culture, income, family structure, age, physical ability, home and work environment will make certain ways and conditions of living more attractive, feasible and appropriate.

Lifestyle Interventions

Lifestyle interventions must be based on the co-operation and full participation of the individuals and groups concerned, since if they were dominated by professionals, they would not be health-promoting.

Any action for change can only be affected by individuals working collectively and only if they are capable of assuming responsibility for their environment. This demands a level of knowledge and skill that most people do not have and if wider social change is to be brought about, steps must be taken to train people to take responsibility.

The workplace is the most highly structured organization that most individuals belong to and one which is affected by social factors that may be health risks or may constitute an effective psychosocial immunity system. Therefore, it is an especially favorable site for preventive intervention. Those aspects of working life that are detrimental to health should be eliminated and factors that are conducive to health (such as social support at work) should be strengthened.

Successful intervention must first accept that the social forces already at work in influencing health for the better are of paramount importance. This means that ways must be found of strengthening the influence of factors conducive to healthy life-styles. The public should be informed of the merits and demerits of the various options open to them and resources should be made available to make the option chosen possible. These tasks would require an unfamiliar range of knowledge and skills and new educational methods, methods based on mutual learning and teaching, respecting the essential contribution of lay expertise and lay responsibility to effective action.

Ethical issues in lifestyle interventions

Privacy:

Lifestyle interventions encroach upon the private world of the individual-this in itself may be detrimental to health. It is absolutely vital to ensure that the individuals concerned are fully involved from the outset in taking decisions on the strategies. The imposition of predetermined behavior changes upon people must be avoided. All individuals and communities must be able to choose on the basis of full knowledge and information, so that they will be encouraged in their pursuit of health and given the means to attain it.

Anxiety:

Consciousness raising activity may raise anxiety levels and this may be harmful to health. When people discover that the habits and behavior implicit in their way of life and which they enjoy, constitute serious health risks, the anxiety and worry that may be created in them may be high enough to be health-damaging in themselves. Furthermore, the efforts required to change the behavior may be beyond their powers so that they are left with the health risks and the associated anxiety. It is no use identifying health risks without concomitant intervention strategies that make the healthier choices the easier.

Confidentiality:

When data on lifestyles are acquired, people must feel confident that their private lives will not be further exposed and that data will not be misused.

Choices:

The essence of health promotion is choice.

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People must be free to refuse and this must be a prime requisite for all intervention strategies. At the same time, people should assume their social responsibilities towards each other.

SOCIAL STRATIFICATION AND ORAL HEALTH

Different social classes are associated with different personality characteristics. Although all members of a social class do not share a given personality trait, members of one social class exhibit a given characteristic more than members of another class do. The disadvantaged social groups have been reported to have a higher proportion of teeth or tooth surfaces with unmet need for treatment, number of teeth missing due to caries and lower number of restored teeth compared with the advantaged groups

Social factors are involved not just in the etiology of oral problems, they are also implicated in the very processes by which those problems come to be defined and seen as socially significant. An important way in which social factors determine oral health is in patterns of active prevention and self-care. In oral health care, there is a range of clearly defined actions that people can carry out to maintain and enhance their health. These actions or practices, however, vary strongly by social group and reflect powerful society-wide cultural influences that are more closely linked to behavior.

A social group is a collection of individuals who must have some features to qualify being termed as a group. It must have two or more persons who are in communication over an appreciable period of time and who act in accordance with a common function or purpose.

The common characteristics of social groups are:

1. There is a sense of unity and belonging,
2. They have a we-feeling and help each other,
3. They have common objectives and interests,
4. Each group has its own code of conduct and behavior,
5. Every member of the group is expected to follow its norms.

Type of groups

The word 'Group' may be defined as a gathering of two or more people who have a common interest.

They can be in-groups or out-groups. The groups with which the individual identifies himself are his in-groups, his family, tribe, sex, college, occupation or religion, by virtue of his awareness of likeness or consciousness of kind. The group to which a member does not belong to, are his out-groups. An out-group is defined by the individual in relation to the in-group and with a feeling of 'they' and 'we'.

Groups can be classified as

- Primary group
- Secondary group
- Reference group

A primary group is the one which is small and the members of which come into direct face-to-face contact with each other for mutual help, companionship and discussion on issues of common interest. The group is of small size, stable and the members share a similar background. (Concept is similar to in-group). Eg: A family

The secondary group is the one in which the relationship of the members is of a formal and impersonal nature. The groups are larger in size and may be spread over a large geographical area. These groups are regulated by formal rules and all the members strive to achieve a common goal. Eg: A political party, voluntary organizations.

Reference groups are those groups to which an individual relates himself psychologically.

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One of the basic characteristics of man is his desire to imitate others. When an individual comes across another one who is viewed as superior, socially acceptable or high in status, there is a natural desire to imitate that person. Such behavior is termed reference behavior. The groups whose behavior is being imitated are known as reference groups. Eg: A group of doctors or successful industrialists.

Groups can also be classified as

- Formal groups
- Informal gatherings

Characteristics of formal groups:

- Are well organized
- Have a purpose or goal
- Have set memberships
- Have recognized leaders
- Have definite rules
- Have regular meetings
- Attention is paid for the welfare of the members

Eg: Dental Association

Characteristics of informal groups:

- Are not organized
- People come and go at will
- There is no membership or a feeling of belonging
- No special activity is planned by the people
- No rules apply
- There is no leader
- There is more concern for the self and less for those of other people present

Eg: A gathering of patients at a clinic

Socialization is a process which enables an individual to take part in group life and acquire many of the characteristics thought of as human. Socialization takes place within groups. Early or primary socialization occurs within friendly, small intimate groups, for e.g. a family (Primary group). Later, the individual enters groups that are larger and impersonal (Secondary groups) and this is the process of secondary socialization (schools, work-related groups, old age homes).

Socialization plays an important part in the development of appropriate oral health care habits. Positive oral health attitudes in parents and emotional as well as practical support to children are considered important to 'dental socialization.' Studies have shown that the family serves as a major influencing agent on health behavior. In adults, oral health conditions improved when social network activity was strong.

Theoretical explanations of social inequalities in oral health

The Black report (Blane, 1985) considered 4 possible explanations for the existence of a gradient between health and social class.

1. Artifact explanations
2. The social selection explanation (or natural selection)
3. The materialist (or structuralist) explanations
4. Cultural (or behavioral) explanations.

Artifact explanations:

According to this explanation, a relationship between social class and health are not really present, but are only due to the way data are collected. Eg: reliance on death certificates may bias findings inappropriately. However, even when investigators have taken such problems into account, class difference remains.

The social selection explanation:

This proposes that health inequalities are created by a process whereby the healthy move up the social hierarchy and the less healthy move down. A person who is unhealthy may find it difficult to find skilled employment and may need to take on less well paid jobs. Conversely, a healthy person may find it easier to gain higher educational qualifications and so, move up the social class scale. E.g. In oral health, studies have

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shown that school teachers rate the behavior and personality of attractive children more highly and expect them to have higher academic achievements than their less attractive peers.

Perhaps, having good oral health can improve a person's chances of obtaining a skilled position.

The materialistic explanation:

According to this explanation, inequalities in health have their origins in social and financial deprivation. The lower social classes live in relatively more unhealthy environments, do more dangerous and insecure work and have poor housing and lower incomes. These factors are assumed to interact together resulting in a cumulative effect. When living standards rise in general, rich and poor improve their life expectation and the gap in life chances is maintained. Here, the whole structure of society is implicated.

Behavioral explanations:

These explain inequalities in terms of differences in knowledge and behavior. Perhaps people from higher social classes have a greater appreciation of the role of diet and regular preventive care and are more likely to act on this knowledge. This explanation has received much support.

Cultural deprivation or cultural poverty: It is the perspective that the distinct pattern of behavior, knowledge and health attitudes within certain social groups is a consequence only of lack of education.

It seems likely that both materialist and behavioral explanations contribute to socio-economic differences in oral health. Although the two models are inter-related, it is important to recognize that both material circumstances and behavior have separate influences. Also, the social selection theory must be considered of minor importance to the explanation of inequalities in oral health.

Social science in dental public health

One of the important developments in public health during the last decade is that the social scientists have been called in to aid in adapting new health programs to existing cultural patterns.

When applied to a practical problem such as dental program planning, social science in effect adds a new dimension to the process of surveying and evaluation. The social scientist becomes necessary when we want to know why effort and effect do not match other. He helps us in the assessment of the process our program is using or plans to use and in finding out how well this process fits with the socio-cultural group with which we are working. Social scientists can also play a major role in public health experiments.

Studies by behavioral scientists have resulted in the description of certain social classes and the reaction of each to dental care. They are,

1. The upper middle class :

They are defined as, "the professional and business executive group, well educated, living in preferred areas in well maintained, usually spacious homes ". The members of this class, "seek out expert advice and in areas where they feel it is important, follow the advice with considerable religiosity. They take a long range view of life and want to feel prepared to know how to prevent or at least to deter as long as possible the unavoidable : aging, disease, decay and death".

They value their teeth, are interested in preventive dentistry and actively pursue various types of dental care. The dentist is visualized as a professional who not only repairs teeth and stops pain but also prevents decay and loss of teeth and makes a person's teeth more attractive and useful. The

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members of this class are much impressed with the desirability of having their own teeth for as long as possible.

2. The lower middle class :

They include generally the owners of small businesses, minor executives, teachers, salesmen and white-collar workers. " They are a highly moralistic group, usually with at least a high school education and live in well maintained, clean, pleasant neighborhoods". They wish to be considered proper and consider duty a value in and of itself. They are the most compulsive in their dental care attitudes and practices of any social class. "The dentist is regarded as an authority - not always a friendly authority but someone who `fixes` teeth". The dentist is also viewed as one who gives directions as to how teeth should be cared for and who is useful for preventive dentistry. The necessity to be clean, good, conforming and socially presentable makes for a high standard of dental care among people at this status level.

3. The upper lower class :

They are regarded as "the group which needs to become the objective of major educational efforts regarding dental care and this is primarily because they are the most accessible to these attempts and offer the best possibilities of behavioral and attitudinal changes". They are generally skilled and semiskilled blue-collar workers. They are people of limited education and live in modest neighborhoods. They are law-abiding, respectable and hard working. "They set fewer regulations for themselves than the lower middle class and are indulgent of themselves and permissive with their children. In rather sharp contrast to the higher status groups, upper lower class people are resigned to whatever happens and feel if there is little they can do to save off the inevitable", including loss of teeth. They acquire artificial dentures at a relatively early age and are reasonably happy with them. These people typically do not have continuing personal relations with physicians or dentists. As a group, these people are often happier receiving their care from a clinic than from an individual practitioner.

4. The lower class :

Also called the underprivileged or disadvantaged, consists of unskilled laborers, people who shift from job to job, have a limited education, live in slum areas and exhibit no stable pattern of life. They are the ones who reveal the most consistent neglect of teeth and they require careful understanding if they are to receive adequate care in public health facilities.

Trithart in 1968 has summarized the attitudes of the underprivileged people toward health care, in the following listing;

Castration complex

There is a reluctance to be at the complete mercy of the health practitioner. This is marked by reluctance to have a general anesthetic or sedation for dental or surgical procedures.

Contradiction of common sense

Some dental or medical procedures such as the continuation of a drug after acute symptoms have subsided seem to contradict common sense.

Coming in crowds

Disadvantaged people do not like to be outnumbered by the people providing treatment. For this reason, they tend to come in crowds, with family and friends, to private dental offices or public clinics.

The last ditch effort

The disadvantaged people often turn to medical or dental treatment by health professionals as a last resort after all individual efforts have failed. They are in a sense, challenging health professionals to

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salvage something from an almost hopeless situation.

If It hurts, you are a quack

This group has the general feeling that medical and dental treatment should be painless and if it hurts, the practitioner does not know what he is doing.

Unclean or dirty feeling

The aseptic cleanliness of a dental office may convey the feeling of personal uncleanliness. This feeling can be reinforced by the dentist washing his hands after treatment.

The clinic was built there, not here

Since many health facilities such as hospitals and out-patient clinics are located at inconvenient places for the underprivileged, many of them tend to think and say, "if you really cared about me you would have built the hospital or clinic here instead of there".

Cold professional attitudes

Many disadvantaged people complain about the cold, impersonal objective attitude and conduct of health professionals. They value empathy as well as professional competence as an essential characteristic of the practitioner.

Difference in pain threshold

There may be a wider variation in the pain threshold of the disadvantaged compared to the population in general. The pain threshold for those in poor health may also be low.

Complication of the unknown

Fear of the unknown, a natural human tendency is accentuated with the underprivileged people, since there are so many things that are unknown to them.

The pills don't work

There is a tendency to expect immediate results from the administration of any drug. Any time lag between administration of a drug and relief from symptoms may be considered a failure of the drug and its use may be discontinued.

Appointments are not important

Appointments of any kind have never been an integral part of the lives of the underprivileged. Patience and understanding are essential in educating them to the value of keeping appointments.

Central Library,
C.P.M. Dental College,
DHULE.

Teeth lost anyhow

There is a feeling that despite competent and conscientious personal and professional care, the ultimate loss of teeth is one of the natural vicissitudes of life. Patience, understanding and continuing education are essential to overcome this fatalistic attitude.

Traditions

3289

Impoverished families and neighborhoods have strong and deep-seated traditions. To communicate and deal with disadvantaged people, it is important that these traditions be recognized and understood. These traditions should also not be discredited unless they are actually harmful to health.

One very practical problem upon which social scientists can help is the estimation of the proportion of a population in need of public aid in obtaining health care. Social workers, with special training in social sciences are experts at appraising personal and family economic problems and in organizing sensible patterns for health care, education and home life. The social worker can help the public health dentist in appraising the accessibility of low-income patients to health care facilities and the cultural fit of the family to the type of care found in these facilities.

RISK BEHAVIOR

Risk behavior (WHO health promotion

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glossary, 1998)

"Specific forms of behavior which are proven to be associated with increased susceptibility to a specific disease or ill-health".

Risk behaviors are usually defined as "risky" on the basis of epidemiological or other social data. Changes in risk behavior are major goals of disease prevention, and traditionally health education has been used to achieve these goals. Within the broader framework of health promotion, risk behavior may be seen as a response or mechanism for coping with adverse living conditions. Strategies to respond to this include the development of life skills, and creation of more supportive environments for health.

Risk factor

"Social, economic or biological status, behaviors or environments which are associated with or cause increased susceptibility to a specific disease, ill health, or injury".

- WHO health promotion glossary, 1998

As is the case with risk behaviors, once risk factors have been identified, they can become the entry point or focus for health promotion strategies and actions.

HARMFUL DENTAL HEALTH BEHAVIORS

Alcohol use

It is implicated in the etiology of cancer of the mouth, pharynx, larynx, oesophagus and the liver. It also contributes to ill health, crime, poverty, broken homes, social conflicts and social degradation. Altering the environment is the most effective way of reducing alcoholism in the community. Social ambiance must be altered so that alcohol is not regarded as a reward or as something that is glamorous and a status symbol. The cost of alcohol can also be greatly increased by taxation. However, this approach penalizes the poor. It may have an effect on overall community consumption but not necessarily on the most addicted and heaviest drinkers.

Smoking

It is a pernicious scourge of the world today. In most communities, it is the greatest single health hazard, a self imposed risk. Smokers suffer the highest relative risk with respect to cancer. The demise of smoking as a socially acceptable habit will be achieved from persistent action and a variety of concentrated approaches. Increased life expectancies and concomitant changes in health statistics would result from successful national programs of smoking prevention. People must be made aware of the hazards of smoking. This awareness results in ;

1. Individuals being motivated not to smoke.
2. Smoking becomes less socially acceptable which will reinforce decisions not to smoke.

Even if a " smoke-free society "is a relative goal, the fact remains that millions still smoke and will continue to do so, at least for the immediate future.

Nutrition

Nutrition and food consumption involve complex interactions of social, cultural, economic, behavioral and psychological factors. Adequate intakes of sources of energy and of essential nutrients are necessary for satisfactory rates of growth and development and maintenance of health. Deficiencies can lead to specific diseases and increased susceptibility to others. Excessive or inappropriate consumption may contribute to adverse conditions such as obesity. Frequent consumption of highly cariogenic foods, especially in between meals can cause dental caries.

Nutrition is the foundation on which other aspects of health and life style depend for their development.

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Drug use

Drug misuse is a complex, social and health problem. The term "problem drugs" earlier meant only morphine or its derivative, heroin. As more and more people become dependent on drugs, there has arisen an alarming misuse of stimulants, depressants, hallucinogens and narcotics cutting across all social strata. The solution for this must come through education and social change.

The greatest gains in preventing premature death and disability can be achieved through community supports for healthier life-styles. The entire burden for improved health must not be placed on the individual alone. The responsibilities must be shared between individuals and their families; between families and their community and between communities and their governments. Each level of organizational influence on behavior must assume some responsibility for setting the economic and environmental conditions that will support healthful life-styles.

UTILIZATION OF DENTAL SERVICES

Definition:

Utilization is the actual attendance by members of the public at health care facilities to receive care

The factors which influence an individual to utilize a health service are,

1. Individual must feel susceptible to the disease.
2. Individual must feel that the disease is potentially serious in its effects in regard to him.
3. Individual must feel that a course of action that will prevent or alleviate the disease is available to him.

Need for dental care

The different types of need for dental care are,

a) Normative need: It is the requirement for care as determined by expert opinion.
b) Felt need: (Perceived need): It is the requirement of or care as determined by the patient or the public.
c) Expressed need: (Demands for health care) It arises out of attempts by members of the public to seek attention for their perceived needs.

The four different approaches to estimating need are,

1. Surveys of dental health status (normative needs)
2. Surveys of need for dental care using questionnaires (felt needs)
3. Analyses of service or treatment records (expressed needs)

There is generally a discrepancy between the need as determined by professionals (normative need) and the expressed need of people (felt needs).

Factors affecting utilization

1. Age:

Utilization is low for the youngest age group, highest for the teenage to young adults, followed by a constant decline for the remaining ages.

2. Sex:

Females tend to utilize dental services more than males.

3. Education:

The utilization rate increases with increase in the level of education and the education level of the head of the household is an important predictor of how frequently the family members will utilize dental services.

4. Socio-economic status:

Higher social classes utilize the dentist more frequently than the lower social classes. Family income remains an important factor in determining utilization of dental care even when the financial barrier to receiving care is

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reduced. This indicates that socially determined patterns of behavior associated with high incomes are often related to higher status occupations and good educational background, because these three factors are often positively associated with each other.

5. Occupation:

Persons in professional occupations visit their dentist more frequently than semi- or non-skilled manual workers. Members of professional families are also more likely to regularly go for preventive visits.

6. Residence:

Proportionately, more persons in urban than in rural areas visit the dentist regularly. Utilization also varies with the size of the community; the larger the community, the greater the utilization rate and the smaller the community, the less likely is the utilization.

7. Socio-cultural factors:

Medical sociologists have suggested that the particular symptoms acted upon are defined by the culture, ethnic or reference group and that the structure of the group and the health orientation and value system play an important role in defining utilization behavior. Some people attend regularly for preventive and therapeutic care before symptoms appear while others attend only when they experience pain or discomfort.

Although most people feel susceptible to dental disease, they do not consider it as serious. Perceptions, particularly negative attitudes and beliefs, affect people's responses to illness and utilization of health services. Factors such as fear and the belief in the inevitability of tooth loss are deterrents, as well as beliefs about benefits and the barriers to obtaining care.

Knowledge about dental health and dental services are also an important prerequisite for utilization of preventive and therapeutic services. Whether the individual finally presents for treatment will depend on anxiety, fear of the dentist, financial and psychological factors.

8. Organizational factors:

The way the health services are organized may play an important role in determining patterns of utilization. If change is to be effected, a mere increase in manpower is not enough. It is necessary to change the basis of the system and to radically change the system of delivery. More emphasis should be placed on organizational structure than on the personal pathologies of the under-utilizers. Organization structure which may deter certain social classes should be modified.

9. Cost of health services:

Cost is a major barrier to utilizing dental services. Although it is generally believed that if the financial barrier to dental care were lifted, the patients would rush to the dentist in droves, the evidence does not bear out that impression. In other words, even if payment is no longer a problem, there is still a large group of people out there who do not perceive of themselves as patients or who do not realize that they need to be patients or who do not even want to be patients. They might also not know that they are eligible for care at no expense to themselves. Even when cost barriers are reduced, wide variations still remain in the utilization of services because social, cultural and demographic factors are all important determinants.

Triggers for the utilization of health services are,

Many people suffer from pain and other symptoms for considerable lengths of time before consulting a professional. Often, symptoms were tolerated until some event the trigger occurred.

- The occurrence of an interpersonal crisis

A change in personal relationships, such as a

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domestic crisis can change the evaluation of what may have been perceived as an otherwise minor symptom.

- Perceived interference with social or personal relations

Symptoms that interfere with normal social relations may create more concern, such as toothache preventing someone from going on a holiday.

- Perceived interference with vocational or physical activity

Symptoms that interfere with the normal activities of daily life will be evaluated as abnormal.

- Temporalizing of symptomatology

This involves the potential patient setting a deadline by deciding that they will consult, if the symptom has not disappeared by a certain date.

- Sanctioning

This relates to pressure from friends and relatives to use health services. The process of consultation with friends is described as accessing the "lay referral network". If a person has few friends or relatives to consult and there is consensus of advice from them that a symptom requires attention, then a professional will be consulted sooner. If, however, there is little similarity of beliefs, then the lowest rate of utilization of formal health care will follow.

BEHAVIOR OF THE CHILD IN THE DENTAL OFFICE

Human personality is the characteristic patterns of thought, emotion and behavior that define an individual's personal style and influence his or her interactions with the environment. Oral habit development, fear and anxiety formation are some of the aspects of personality, which are of interest to a dental professional. The development of these aspects of personality can be explained with the help of the science of psychology

Many theories have been proposed to explain and identify the processes involved in personality development. These theories can be divided into two groups: Psychodynamic theories and Behavior learning theories.

Only some theories will be discussed in this chapter.

Psychodynamic theories

1. Classical Psychoanalytical Theory by Sigmund Freud (1905)
2. Developmental Tasks Theory by Erik Erikson (1963)

Behavior learning theories

1. Classical Conditioning Theory by Ivan Pavlov (1927)
2. Operant Conditioning Theory by B.F.Skinner (1938)
3. Theory of Cognitive Development by Jean Piaget (1952)
4. Social Learning Theory by Albert Bandura (1963)

PSYCHODYNAMIC THEORIES:

Classical Psychoanalytical Theory by Sigmund Freud

Freud compared the human mind to an iceberg. The small part that shows above the surface of the water represents the conscious experience and the much larger mass below the water level represents the unconscious store house of impulses, passions and inaccessible memories that affects thoughts and behaviors. He believed that unsatisfied drives and unconscious wishes cause all psychological events. According to him, personality is composed of three major systems: the id, the ego and the superego. Each system has its own functions but the three interact to govern behavior.

The id is the most primitive part of the personality from which the other two systems develop later. It seeks immediate gratification of impulses like the need to eat, to drink, to eliminate wastes, to avoid pain etc. It

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operates on pleasure principle and endeavors to obtain pleasure.

The ability to understand that their impulses cannot always be gratified immediately comes with the development of ego. Children learn that hunger must wait until someone provides food and that the satisfaction of relieving the bladder or bowel must be delayed until the bathroom is reached. So ego obeys the reality principle.

The super ego represents the internalized representation of the values and morals of the society as taught to the child by the parents and other elders. It strives for perfection.

In a well-integrated personality, ego remains in firm but feasible control. Violating the superego's standards or even the impulse to do, produce anxiety. Expressing the impulse in disguised form can avoid punishment by the society and thereby reduce the anxiety. These strategies are called as the ego's mechanisms of defense. Denial is an example of a defense mechanism. For example, a patient may deny the existence of an abscessed tooth because of the anxiety associated with the necessary dental treatment.

Freud believed that an individual progresses through several developmental stages that affect personality. The developmental stages according to Freud are:

1. Oral stage

The first year of life is called by Freud as the oral stage and is characterized by passiveness and dependency. The primary zone of pleasure is the oral region because hunger is satisfied by oral stimulation. Children will put their thumb or anything else they can reach, into their mouths. If the child does not receive sufficient gratification of pleasure at this particular age, fixation to this stage occurs as the individuals grows older. Oral dependency in the form of digit sucking habit is an example of this seen in older individuals.

2. Anal stage

This stage occurs between the ages 1and 3 years and is marked by the egocentric behavior. During this stage, the anal zone becomes the primary zone of pleasure. Gratification is derived from expelling or withholding feces. Over emphasis by adults on toilet training will result in compulsive, obstinate and perfectionist behavior in later life and is called "anal personality". Less controlled toilet training results in an impulsive personality in later life.

3. Phallic stage

The sex identification, which occurs between 3 and 6 years of age, is an important feature of this stage. The children begin to direct their awakened sexual impulses towards the parent of the opposite sex. This character observed in males is called "Oedipus complex", characterized by the tendency of the young child boy being attached more to the mother than the father. Freud believed that the boys of this age fear that the father will retaliate against these sexual impulses by castrating him. This was labelled as "Castration anxiety". The character observed in females is called "electra complex" where the young girl child develops an attraction towards the father.

In a phobic child, these unconscious, unacceptable wishes and feelings are transformed into fear of a specific object or situation which has a symbolic significance to the individual.

4. Latency Stage

This stage occurs during the ages of six and twelve and is a period of consolidation. Their attention turns to the skills needed for coping with the environment. The superego becomes firmly internalized.

5. Genital Stage

This stage begins with puberty and is

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characterized by reopening of the ego's struggle to gain mastery and control over the impulses of id and superego. Fluctuating extremes in emotional behavior and preoccupation with philosophical and abstract thoughts, predominate due to the struggle to attain a firm sense of self.

Developmental Tasks Theory by Erik Erikson

Erikson was of the view that Freud overemphasized the biological and sexual determinants of developmental change and underemphasized the importance of child rearing experiences, social relationships and cultural influences on the development of ego or self. A developmental task or crisis that needs to be resolved in order to continue a healthy pattern of development defined each stage of development. The different stages according to this theory are:

1. Trust versus mistrust:

The major concern of this stage is the establishment of trust. Infants develop trust when their world is consistent and predictable i.e., when they are fed, warmed and comforted in a consistent manner. This stage can be equated with the oral stage of Freud.

2. Autonomy versus shame, doubt:

This is during the toddler period when children begin to assert independence. Erikson believed that it was important to give children a sense of autonomy. Parents who shame their children for misbehavior could create basic doubt about being independent.

3. Initiative versus guilt:

The child at this stage begins to be task-oriented and plans new activities. However the child may develop excessive guilt about the acts that are initiated.

4. Industry versus inferiority:

When the children enter school, they begin to perform tasks and acquire skills. Achievements and the sense of competence become important. A child who has no particular competences or who experiences repeated failures might develop strong feelings of inferiority.

5. Identity versus role confusion:

The major conflict during adolescence is one's role and identity in a society. The failure to solve this conflict can result in role confusion or diffusion in society.

The psychodynamic approach to personality development was often criticized due to the lack of research support and the use of a medical or disease oriented model for explanation. This led to the development of behavior learning theories.

BEHAVIOR LEARNING THEORIES :

It is based on the philosophy that learning is the key to the development of behavior and not merely instinctive needs.

Classical Conditioning Theory by Ivan Pavlov

Ivan Pavlov proved that two events observed to occur together would tend to be associated or paired together by the observer. Through such a pairing, the control of the response reflex can be shifted from one stimulus to another such that eventually a neutral stimulus alone will elicit the response reflex. In his famous experiment with the dog, he showed that the sight and smell of food produced an unconditional response of salivation in the animal. He then presented the food together with ringing a bell. The sound of the bell was called a neutral stimulus because it did not cause any response by itself. But the two events occurring together also led to the unconditioned response of salivation. Later the mere ringing of the bell alone was enough to bring about salivation i.e. salivation became conditioned.

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An application of this theory into a dental situation is the example of a young child entering a dental clinic being presented with a stimulus like the sound of a handpiece. This might evoke an unconditioned response of anxiety in the patient. The initial stimulus of sound of the handpiece when presented with the sight of the dentist will also bring about the unconditioned response of anxiety. The sight of the dentist is the neutral stimulus here. Later, the mere sight of the dentist alone without the sound of the handpiece will bring about the conditioned response of anxiety.

Dental avoidance behavior seen in some patients can be explained on the basis of this theory.

Theory of Operant Conditioning by B.F. Skinner

The main concept of this theory is that an individual learns to produce a voluntary response where the consequences or the outcome are instrumental in bringing about the recurrence of the stimulus. The individual's response is changed as a result of previous responses. Behaviors that operate or control the environment are called "operants". The relationship between the operants or behaviors and the consequences that follow them is called "contingency". Operant conditioning is classified into four contingency arrangements like: positive reinforcements, negative reinforcements, punishment and response cost or time out.

Positive reinforcement: occurs when a behavior, good or bad is followed by a rewarding event. Many a times, just praising a patient for maintaining his oral hygiene properly can stimulate him to continue his meticulous oral hygiene behavior at home.

Negative reinforcement: occurs when a behavior is followed by the termination of an aversive event, thus increasing the likelihood of the behavior.

On the other hand, punishment and time out reduce the likelihood of the behavior's recurrence.

Punishment: exists when a behavior is followed by the onset of an aversive event.

Time out or response cost: refers to a behavior being followed by the termination of a positive event.

In a dental setting, the dentist and auxiliary often unknowingly arrange incorrect reward contingencies that result in reinforcement of fear responses and the extinction of no-fear responses. Many dentists, for instance, negatively reinforce fear behavior. When a patient becomes nervous, a typical response is to stop and reassure him. The main effect in this instance is that the fear is negatively reinforced because it is followed by the cessation of the aversive procedure and is positively reinforced by the dentist's soothing words.

Theory of Cognitive Development by Jean Piaget

The word "cognitive" refers to elements of perception, awareness, judgement and the ability to comprehend empirical knowledge. A central concept in Piaget's theory is the operation or the operational structure. Operations are actions, which the child performs mentally and which have the added property of being reversible. In other words, it is the manipulation of ideas that can be reversed allowing the person to return mentally to the beginning of the thought sequence. Piaget calls the major mechanisms that allow children to progress from one stage of cognitive functioning to the next as assimilation, accommodation and equilibration.

For example: Assimilation can be seen when a 5-year old girl has learned that objects that fly in the sky are called birds. But when she sees a low- flying helicopter and tries to assimilate it to her idea of a bird, the noise,

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size and shape does not fit into her existing idea of a bird. Here assimilation is not possible. She realizes that she needs a new category for this new object. Parents might supply her with a new word- "helicopter" and explain the difference between the two. This is accommodation, i.e. the individual's tendency to change in response to environmental demands. As a result of this new knowledge, the child is temporarily in a state of "equilibrium" or cognitive harmony. The process of establishing equilibrium is known as equilibration. The processes of assimilation, accommodation and equilibration function through out life as one adapts one's behavior and ideas to changing circumstances.

The progress in cognitive competence is assumed to be gradual and orderly during childhood. Piaget delineated a sequence of 4 qualitatively distinct stages,

- Sensorimotor stage (0-18 months)

The first 18 to 24 month period is considered as sensorimotor period. Intelligence is manifested in action. This period starts with the automatic inborn reflexes seen in infants which includes their ability to suck, cry, move their arms and legs, track a moving object and orient to a sound. Then the co-ordination of these reflexes improves. For example, a hungry infant who flails about may accidentally brush his finger against his lips and subsequently repeat that action, which is not an inborn reflex. By the end of the sensorimotor stage, the child will have transformed himself or herself from an organism totally dependent on reflex and other hereditary equipment to a person capable of symbolic thought.

- Preoperational stage (18 months to 7 years)

The essential characteristic of this stage is imitation and the child pretend plays using his imagination. There are instances where children imitate their dentists. A doll may be taken as a patient. They learn to enact their dental visit.

- Concrete operational stage (7 to12 years)

Children at this stage understand certain basic logical rules and are therefore able to reason logically and quantitatively in ways that were not evident in preoperational stage. They are able to focus their attention on several attributes of an object or event simultaneously and to understand the relations between dimensions. The child is also able to arrange objects according to some quantified dimensions such as weight or size. The main limitation of this stage is their inability to reason about abstractions, hypothetical propositions or imaginary events.

- Formal operational stage (12 years onwards)

At this stage, the individual uses a wider variety of cognitive operations and strategies in reasoning and solving problems. The individual is highly versatile and flexible in thought and reasoning and can see things from a number of perspectives or points of view.

Frankl et al in 1962 introduced a behavioral rating scale, which was modified by Wright in 1975 and is as follows;

Rating No. 1: Definitely negative

- Refuses treatment
- Cries forcefully
- Is extremely negative, associated with fear

Rating No. 2: Negative

- Is reluctant to accept treatment
- Displays slight negativism

Rating No. 3: Positive

Accepts treatment with tense co-operative, whining or timid behavior.

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Rating No. 4: Definitely positive

Looks forward to and understands the importance of good preventive care.

Social Learning Theory by Albert Bandura

In the social learning theory, reinforcement is considered a facilitative rather than a necessary condition for learning. Behavior is motivated largely by our social needs. Reinforcements serve to regulate the behavior but are relatively inefficient methods for learning behaviors. The concepts of modelling and vicarious reinforcements are essential components of this theory. Modelling is imitation through observational learning or the learning and performance of a behavior as a consequence of observing another person. Modelling is governed by the attention of the observer, retention of the act mentally, motoric reproduction of the act and reinforcements and motivation. Vicarious reinforcement results in the change of the response consequences of the model. For example, anxious dental patients observing other patients undergoing dental treatment without unpleasant consequences will tend to lose their fears of dentistry.

Behavior management

Behavior management is as much an art form, as it is a science. It is not a mere application of individual technique formulated to "deal" with individuals but rather a comprehensive methodology meant to build a relationship between the patient and the dental professional which ultimately builds trust and relieves fear and anxiety. Since childhood experiences play an important role in forming adult behavior, proper behavior management right from an early age will help in the development of a proper oral health attitude.

Wright in 1975 defined behavior management as "the means by which the dental health team effectively and efficiently performs treatment for a child and at the same time instills a positive dental attitude".

Communicative management

Communicative management is used universally for both the cooperative and uncooperative child. It comprises of a host of communication techniques which, when integrated together, enhances the evolution of a compliant and relaxed patient. It is an ongoing subjective process rather than a singular technique and is often an extension of the personality of the dentist. Since these comprise the elements of usual and customary communication, they are appropriate for all patients. In addition, no specific consent or documentation is necessary prior to use.

The specific techniques associated with this process are

- Voice control
- Nonverbal communication
- Tell- show-do
- Modelling
- Positive reinforcement
- Systematic desensitization
- Distraction
- Parental presence/absence
- HOME

Voice control

Voice control is a controlled alteration of voice volume, tone, or pace to influence and direct the patient's behavior.

Objectives of voice control:

1. To gain the patient's attention and compliance.
2. To avert negative or avoidance behavior.
3. To establish appropriate adult-child roles.

Nonverbal communication

Nonverbal communication is the reinforcement and guidance of behavior

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through appropriate contact, posture, and facial expression.

Objectives of nonverbal communication:

1. To enhance the effectiveness of other communicative management techniques.
2. To gain or maintain the patient's attention and compliance.

Tell-Show-Do

Addleston in 1959 introduced the concept "Tell-show-do" as a behavior modification procedure to introduce children to dental equipments and procedures.

The technique involves verbal explanations of procedures in phrases appropriate to the developmental level of the patient (Tell); demonstrations for the patient of the visual, auditory, olfactory, and tactile aspects of the procedure in a carefully defined, non-threatening setting (Show); and then, without deviating from the explanation and demonstration, completion of the procedure (Do). The tell-show-do technique is used with communication skills (verbal and nonverbal) and positive reinforcement.

Objectives of Tell-Show-Do:

1. To teach the patient important aspects of the dental visit and familiarize the patient with the dental setting.
2. To shape the patient's response to procedures through desensitization and well-described expectations.

Modelling

3289

Bandura in 1969 developed a behavior modification technique called "modelling" or "imitation". According to this technique, learning occurs only as a result of a direct experience, which can be brought about by witnessing the behavior and the outcome of that type of behavior of other people. There are four requirements for the modelling technique. They are,

- Concentrated attention must be expended towards the witnessing of the model.
- There must be sufficient retention of desirable behavior in the absence of a model.
- One must be able to reproduce effectively the behavior modelled.
- The newly acquired behavior must be appropriately rewarded to retain it.

Modelling could be used to alleviate anxiety and encourage preventive care at home. While observing a model undergo an examination or treatment, the patient would gain information about the kinds of equipments that he or she will encounter and it helps in reducing uncertainty. Modelling can be done using films or live models.

Reinforcement

The term "reinforcer" means, any consequence which increases the likelihood of a behavior being shown. The reinforcer could be primary, based on primary biological needs (E.g. Food, water) or secondary, which are things not intrinsically rewarding (Eg: Praise). Another distinction is between positive and negative reinforcers.

Positive reinforcement

A "positive reinforcement" is a consequence, which is pleasant and increases the likelihood of behavior when it is offered. Positive reinforcement is an effective technique to reward desired behaviors and thus strengthen the recurrence of those behaviors. Social reinforcers include positive voice modulation, facial expression, verbal praise, and appropriate physical demonstrations of affection by all members of the dental team. Nonsocial reinforcers include tokens and toys.

Negative reinforcement

An unpleasant event that can be avoided through some kind of action is called a "negative reinforcement". The threats of failing an examination or being asked to leave a course of study are negative

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reinforcers. A student may begin reading textbooks and studying in order to avoid such circumstances.

Systematic desensitization

Research carried out by Wolpe in 1952, led to the development of a behavior modification technique, called "systematic desensitization". This technique is characterized by two elements, gradational exposure of the child to his or her fear and induced state of incompatibility with his or her fear.

The therapist creates a list of steps arranged as a hierarchy from the least to the most stressful. The patient while in a state of deep relaxation is exposed one step at a time, each step presented repeatedly until there is no evidence of stress on the patient's part. Thus the patient is desensitized to the predominant fear.

Distraction

Distraction is a type of cognitive approach, which is aimed at preventing any kind of anxiety-provoking thoughts that heightens a patient's anxiety level. It is a technique of diverting the patient's attention from what may be perceived as an unpleasant procedure. Since the patient's attention is drawn away, they are less likely to dwell on anxiety.

Objectives of distraction

1. To decrease the perception of unpleasantness.
2. To avert negative or avoidance behavior

Parental presence / absence

This technique involves using the presence or absence of the parent to gain cooperation for treatment. A wide diversity exists in practitioner philosophy and parental attitude regarding parents' presence or absence during pediatric dental treatment. It is a fact that communication between dentist and child is paramount and that this communication demands focus on the part of both parties. Children's responses to their parents' presence or absence can range from very beneficial to very detrimental. It is the responsibility of each practitioner to determine the communication methods that best optimize the treatment setting; recognizing his/her own skills, the abilities of the particular child, and the desires of the specific parent involved.

Hand-Over-Mouth Exercise (HOME)

HOME is an accepted technique for intercepting and managing demonstrably unsuitable behavior that cannot be modified by basic behavior management techniques. The technique is specifically used to redirect inappropriate behavior and re-establish effective communication.

Method

The dentist firmly but gently places his hand on the child's mouth and whispers in his ear that when he cooperates, the hand will be removed. When the patient indicates his willingness to co-operate, either by nodding his head or by stopping the screaming, the hand is removed and the patient reevaluated.

Maintenance of a patent airway is mandatory. Upon the child's demonstration of self control and more suitable behavior, the hand is removed and the child is given positive reinforcement. Communicative management techniques should then be used to alleviate the child's underlying fear and anxiety.

The decision to use HOME must take into consideration,

- Other alternate behavioral modalities.
- Patient's dental needs.
- The effect on the quality of dental care.
- Patient's emotional development.
- Patient's physical considerations.

Written informed consent from a legal guardian must be obtained and documented in the patients record prior to the use of HOME. The patient's record should include

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informed consent and indication for use.

Objectives:

1. To redirect the child's attention, enabling communication with the dentist so that appropriate behavioral expectations can be explained
2. To extinguish excessive avoidance behavior and help the child regain self control
3. To ensure the child's safety in the delivery of quality dental treatment
4. To reduce the need for sedation or general anesthesia

Indications:

1. A healthy child who is able to understand and cooperate, but who exhibits hysterical avoidance behaviors.

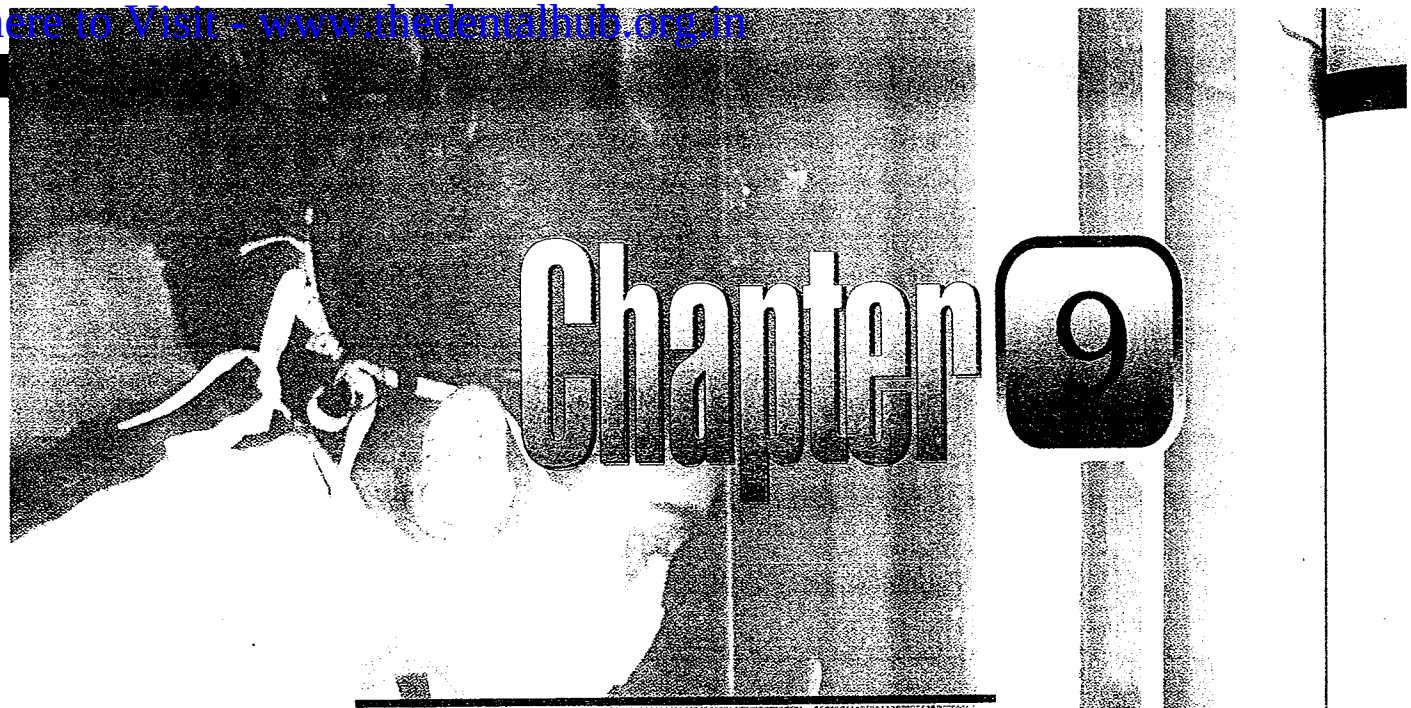
Contraindications:

1. In children who, due to age, disability, medication, or emotional immaturity are unable to verbally communicate, understand and cooperate.
2. Any child with an airway obstruction.

CONCLUSION

Behavioral science plays a major role in understanding the individual, his community and his environment. The desire to understand behavior and help maintain people at an almost perfect state of oral health rather than wait to treat them after they have developed oral or dental disease has been at the forefront of promoting a healthy lifestyle and modifying habits so as to reach optimal oral health status.

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Chapter 9

ORAL HEALTH EDUCATION AND HEALTH PROMOTION

INTRODUCTION
DEFINITION
OBJECTIVES
APPROACHES TO ACHIEVE HEALTH
MODELS OF HEALTH EDUCATION
PRINCIPLES
CONTENTS
STAGES IN THE ADOPTION OF NEW IDEAS AND PRACTICES
HEALTH EDUCATION AND PROPAGANDA
COMMUNICATION
EDUCATIONAL AIDS USED IN HEALTH EDUCATION
METHODS IN HEALTH EDUCATION
HEALTH PROMOTION
CONCLUSION

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INTRODUCTION

The word education is derived from the Latin word "Educare" and "Educere" which means to bring out and to lead. Health education is the process of imparting information about health in such a way that the recipient is motivated to use that information for the protection or advancement of his own, his family's or his community's health.

Health education is an active learning process, which aims at favorably changing attitudes and influencing behavior with respect to health practices. The same principles, which govern any learning situation, are inherent in the process of health education. For example, there must be motivation to learn, a value placed on the learning and participation of the learner. Education is a learning process or a series of learning experiences through which an individual informs and orients himself to develop skills and intelligent action.

Health education is vital to the practice of prevention. It is the channel for reaching the people and alerting them to the doctor's services and to all other community health resources. A "health-educated" person is well aware of his own responsibility and of the steps he himself must take to receive the full benefits of prevention at all levels.

DEFINITION

"Health education comprises consciously constructed opportunities for learning involving some form of communication designed to improve health literacy, including improving knowledge, and developing life skills which are conducive to individual and community health.

- WHO Health Promotion Glossary, 1998

"Health literacy represents the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health".

- WHO Health Promotion Glossary, 1998

"Health education is a process that informs, motivates and helps people to adopt and maintain healthy practices and lifestyles, advocates environmental changes as needed to facilitate this goal and conducts professional training and research to the same end"

- National Conference on Preventive Medicine in USA

OBJECTIVES

The objectives of health education are,

- **Informing people (Cognitive objective)** People are informed about the different diseases, their etiology and how to prevent them. Information increases knowledge and helps people become aware of their health problems and this helps in preventing disease and promoting health.
- **Motivating people (Affective objective)** It is concerned with clarifying, forming or changing attitudes, beliefs, values or opinions. The mere presence of information does not improve health. After proper health information is given, it is necessary to motivate them to alter their lifestyles so that it becomes favorable to promoting health and preventing disease. Motivation has been defined as "a combination of forces which initiate, direct and sustain behaviors".
- **Guiding into action (Behavioral objective)** It is concerned with the development of skills and action. A person who has obtained health information might be motivated to change his behavior and lifestyle. However he might need professional help and guidance so as to bring about these changes and to sustain these altered lifestyles.

The final goal of any health education program is to make realistic improvements in the basic quality of life.

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APPROACHES TO ACHIEVE HEALTH

1. Regulatory or legal approach
2. Administrative or service approach
3. Educational approach
4. Primary health care approach

Legal or regulatory approach:

This is the form of approach that makes use of the law to protect the health of the public. The government makes laws and regulations in order to safeguard the health of its people. Examples for this type of approaches include,

- Epidemic Diseases Act,
- Pollution Act,
- Food Adulteration Act and
- Environmental Act.

Drawbacks:

- They are applicable only at certain times or in limited situations.
- They may not alter the behavior of the individual.
- These laws are not democratic since they interfere with an individual's personal choices.

Administrative or service approach:

This form of approach intends to provide all the health facilities to the people with the hope that they will use it.

Drawbacks:

It becomes a failure if the service is not based on the felt needs of the people.

Eg: A dental program using sophisticated equipment, providing all kinds of treatment free of charge might become a failure if it is planned in an area where there is an epidemic of gastroenteritis.

Educational approach:

This form of approach is found to be the most effective means for achievement of changes in the health practices and life-styles of the community. The components of this approach are motivation, communication and decision-making. The results obtained from this approach may be slow, but they are permanent and enduring. Another important factor in this approach is that sufficient time should be allowed for the individual to bring about the desired changes in his behavior.
It may involve not only learning new "facts" but "unlearning" wrong information as well.

Primary health care approach:

This is an approach that involves full participation and active involvement of the people starting from the planning stage till the delivery of health services. This is based on the principles of primary health care, i.e., community participation. This can be achieved by providing the necessary guidance to help people identify their health problems and to find solutions to these problems.

MODELS OF HEALTH EDUCATION

Medical model

The model is concerned with the recognition and treatment of disease and technological advances to facilitate this process. Health information is provided to the people hoping that they will use this information to improve their health. However since this model gave no importance to the social, cultural and psychological factors, it did not bridge the gap between knowledge and behavior.

Motivation model

When people did not use the information provided to them, it was felt that just providing information is not sufficient; the individual must be motivated to translate the health information into action.

Social intervention model

However, with the complex public health problems present today, it has become necessary to focus not only on the individual

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but also on his social environment, which shapes his behavior and the behavior of the community.

An effective health education model should be based on precise knowledge of human ecology and understanding of the interaction between the cultural, biological, physical and social environmental factors.

PRINCIPLES OF HEALTH EDUCATION

The principles of health education, can be categorized as follows:

1. Credibility
2. Interest
3. Participation
4. Motivation
5. Comprehension
6. Reinforcement
7. Learning by doing
8. Known to unknown
9. Setting an example
10. Good human relations
11. Feedback
12. Community leaders

1.Credibility

It is the degree to which the message is perceived as trustworthy by the receiver. It should be scientifically proven, based on facts and should be compatible with local culture and social goals

2.Interest

If the health education topic is of interest to the people, they will listen to it. The health educator should identify the "felt needs" of the people and then prepare a program that they can actively participate in to make it successful.

Felt needs is the requirement of or care as determined by the patient or the public.

3.Participation

The health educator should encourage people to participate in the program. Once the people are given a chance to take part in the program it leads to their acceptance of the program. Certain methods like group discussions, panel discussions etc. provide opportunities for people's participation.

4. Motivation

Motivation can be defined as "the fundamental desire for learning in an individual".

Motives are of two types- Primary motives and Secondary motives.

The primary motives in life are inborn desires and/or forces, which drives an individual into action. Food, clothing and housing are examples of primary motives.

The secondary motives are desires that are the results of outside forces. Examples for secondary motives are gifts, love, a word of praise, rewards etc.

Health education can be facilitated by the motivation provided by the desire to achieve individual goals. For example, for a teenager, esthetics might be a motive to take care of his /her teeth whereas for an adult, the expenses of undergoing restorative care might be the motivating factor for taking care of his/her teeth.

5. Comprehension

It refers to the level of understanding of the people who receive the health education. The health educator should first determine the level of literacy and understanding of the audience and act accordingly. Words that are strange or new to the people should not be used. Usage of technical or medical terms, which are not familiar to the common man should be avoided.

Eg:A statement saying "Eat food items which are non cariogenic" may not be comprehensive to the layman. A better way of explaining would be " Avoid food s

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stuffs which are sweet and which stick to your teeth like toffees and pastries. Eat food items like fruits and raw vegetables which in addition to being healthy, also help in keeping your teeth clean."

6. Reinforcement

This is the principle that refers to the repetition needed in health education. It is not possible for the people to learn new things in a short period of time. So, repetition is a good idea. This can be done at regular intervals and it helps people to understand new ideas or practices better. This principle can be called as a "booster dose" in health education.

7. Learning by doing

Just by listening to new ideas or seeing new things, it might be difficult to implement them. If the learning process is accompanied by doing the new things, it is better instilled in the minds of the people. This principle is based on the famous Chinese proverb "if I hear, I forget; If I see, I remember; If I do, I know".

Eg: It is difficult to even remember the method of tooth brushing if the procedure is only heard on the radio. It might be difficult to master the act of proper tooth brushing even by watching a demonstration. However, after the demonstration, if it is practiced under the guidance of an expert, the proper method of tooth brushing can be learnt

8. Known to unknown

Before the start of any health education program, the health educator should find out how much the people already know and then give them the new knowledge. The existing knowledge of the people can be used as the basic step upon which new knowledge can be placed.

Eg: A health education program with the aim of introducing a toothbrush to a rural population will be better appreciated if the communicator starts the program with "what are you using to clean your teeth at present? And then going into details like " why are you using it"? and then connecting it to the toothbrush and then providing details about the toothbrush.

9. Setting an example

The health educator should follow what he preaches. He should set an example for other people to follow. Eg: A health educator who participates in a program highlighting the ill effects of tobacco should not be seen smoking since it sends a wrong signal and the seriousness of the situation is lost.

10. Good human relations

This principle states that the health educator should have good personal qualities and should be able to maintain friendly relations with the people. The health educator should have a kind and sympathetic attitude towards the people and should always be helpful to them in clarifying their doubts or repeating what is not understood.

11. Feedback

For any program to be successful it is necessary to collect a feedback to find out if any modifications are needed to make the program more effective.

12. Community leaders

Community leaders can be used to reach the people of the community and to convince them about the need for health education. The leaders can also be used to educate the people, as they will have a rapport and will be familiar with the people of their community. The leader will

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have an understanding of the needs of the community and advise and guide them.
Health education for rural people can be achieved through the head of the village, whereas school children can be approached through the headmaster or school teacher.

CONTENTS OF HEALTH EDUCATION

The contents of health education can be categorized into seven main divisions as follows;

- Human biology
- Nutrition
- Hygiene
- Family health care
- Control of communicable & non communicable diseases
- Prevention of accidents
- Use of health services

Human biology:

Teaching of human biology starts from the kindergarten itself. The children are taught about the parts of the human body and their functions. They are also taught the importance of good health and methods to keep physically fit. Teaching is also directed towards the need for exercise, adequate rest and sleep. Information is also provided about the adverse habits like smoking, use of alcohol, methods of first-aid etc.

Nutrition:

The people should be taught about the nutrient value of foodstuffs and the effect of nutrition on health. The main aim of including nutrition as a content of health education is to help people choose optimum and balanced diets, which contain all the necessary nutrients for optimal health.

Hygiene:

The people are taught about the importance of hygiene and methods of maintaining hygiene. The teaching of hygiene has two aspects -

A) Personal hygiene: The aim is to promote good standards of personal cleanliness. Measures of basic hygiene are taught here like bathing, tooth brushing, grooming etc.
b) Environmental hygiene: This comprises of two aspects - Domestic and Community.
Domestic hygiene includes keeping the house and its surroundings clean, proper ventilation, adequate light and fresh air, proper disposal of waste materials, avoidance of pests, insects etc.
Community hygiene includes the care of the surroundings ensuring proper garbage disposal, adequate sewage and drainage.

Family health care:

People have to be taught about the importance of family health care. The main aim here is to strengthen and improve the health of the family as a unit rather than as an individual. The importance of improving maternal oral health to improve the oral health of the child should also be stressed.

Control of communicable & non-communicable diseases:

People have to be taught about the communicable and non-communicable diseases. The aim is to provide elementary knowledge so that they can better understand common signs and symptoms of disease and prevention, thereby promoting health.

Prevention of accidents:

Accidents have become a major feature of modern human life. The people have to be taught about basic safety rules and how to prevent common accidents, which takes place in their homes, in their work place or on the road. Health education programs can be conducted to educate the students, parents

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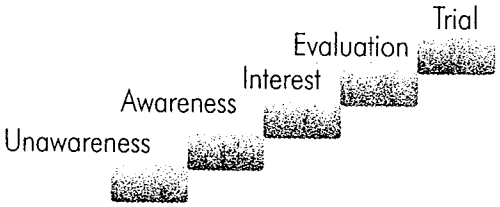
and teachers about the use of mouth guards when playing contact sports so as to prevent oro - facial trauma

Use of health services:

Provision of any form of health service will be a failure if the people are not aware of the presence of such services. Therefore the people have to be informed about the various health services and preventive programs available to them. They also have to be educated on the proper use of these services. They should be encouraged to always participate in the health programs conducted in the community.

STAGES IN THE ADOPTION OF NEW IDEAS AND PRACTICES

There are different stages through which an individual passes through before he adopts a new idea or practice. Social psychologists have identified five main stages, which can be represented in a step - ladder pattern.



Stage of unawareness:

This is the stage in which the individual is not aware of the new idea or practice.

Stage of awareness:

This is the stage in which the individual has some general information about the new idea or practice, but he does not know much about it's usefulness, limitations etc.

Stage of interest:

This is the stage in which the individual shows interest in knowing more about the new idea or practice. The individual is keen to listen to or read about the new method.

Stage of evaluation:

This is the stage in which the individual tries to find out the advantages and disadvantages of the new method. He evaluates whether the new practice will be beneficial to him and his family. After proper evaluation the individual takes a decision to accept or reject the new idea.

Stage of trial:

This is the stage in which the individual decides to put the new idea or method into practice. Additional information and proper guidance should be given at this stage to the individual to eliminate problems encountered in putting the new method into practice.

Stage of adoption:

This is the stage in which the individual finally accepts the new idea or practice as beneficial to him and adopts it.

The individual can also reject the idea or practice at any stage, either because he feels it is not of any benefit to him, or because of economic or cultural reasons or because adequate information was not made available to him.

All these stages need not be followed in adopting a new idea or practice. Some stages may be skipped. The adoption of the practice as part of his own existing values is called **internalization.**

These stages of can also be summarized as: (given by Prochaska and DiClemente, 1992)

1. The pre-contemplation stage

   Here, the person is engaged in a certain type of behavior, which is unhealthy and he is continuing with this behavior
2. The contemplation stage

   Here, the person is thinking of changing his behavior and studying the pros and cons.
3. The preparation stage

   Here, the person has decided to make the

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change and is preparing himself by making plans

4. The action stage
   Here, the actual behavior change is done
5. The maintenance stage
   Here, the person is maintaining the changed behavior.

HEALTH EDUCATION AND PROPAGANDA

3289

Propaganda is merely a publicity campaign aimed at presenting a particular thing or concept in a favorable light in such a way that the public may accept it without thinking about it analytically.

Health education on the other hand, promotes active thinking and assessment of the problem by the people and encourages them to decide for themselves whether they want to change and in what manner. The differences can be outlined as follows:

COMMUNICATION

Communication is regarded as a two way process of exchanging or shaping ideas, feelings and information to bring about desired changes in human behavior.

According to the "Soil, Seed and Sower" principle, the people to whom health education is given can be compared to the soil, the health facts to be given can be compared to the seeds and the media used to transmit the facts can be compared to the sower.

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Definition:

Health communication is defined as "a key strategy to inform the public about health concerns and to maintain important health issues on the public agenda. The use of the mass and multimedia and other technological innovations to disseminate useful health information to the public, increases awareness of specific aspects of individual and collective health as well as importance of health in development".

-WHO Health Promotion Glossary, 1998

The ability to communicate is the primary factor that distinguishes human beings from animals. And it is the ability to communicate well that distinguishes one individual from another.

Communication is essentially the transfer of ideas, messages or information from one

Health Education	Propaganda
1. Knowledge and skills are actively acquired in this process.	1. Knowledge is instilled in the individual's mind in this process.
2. The process drives the people to think for themselves.	2. Contains ready made slogans which prevents thinking in individuals.
3. Primitive desires are disciplined in this process.	3. Primitive desires are stimulated and aroused.
4. The process of health education results in a reflective behavior and makes people to use judgement before acting upon it.	4. The process results in a reflexive behavior and makes people to aim at impulsive actions.
5. The process appeals to reason.	5. The process appeals to emotion.
6. The process helps in developing individuality, personality and self expression.	6. The process develops different patterns of attitudes and behaviors according to the medium used.
7. In this process, the knowledge is acquired through self reliant activity.	7. In this process, the knowledge is passively received and is spoon-fed.
8. The entire process is aimed at developing good habits, favorable attitudes and skills in individuals and is behavior oriented.	8. The entire process brings no change in individual's attitude or behavior and is information oriented.

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person to another. Communicating is like a two-way street, which entails the relation between the sender and the receiver. In this process, a cycle of communicating messages is formed between the sender and the receiver. The sender is required to conceive the message he/she wishes to send, encode this message and then transmit. The receiver then is required to receive the message, decode is and clarify his/her understanding of the message. It is effective when it gets the desired action or response.

From the sender's perspective one needs to have the following essential skills:

- Skills to compose the message
- Skills to send the message

From the receiver's perspective one needs to have the following essential skills:

The skill of receiving a message

- Without assumptions
- Placing biases aside
- Actively listening

COMPONENTS OF COMMUNICATION

The components of communication are,

Sender

- He is the originator of the message
- His objectives should be clearly defined
- He should know the interests and needs of his audience
- He should know the message
- He should know the channels of communication
- He should know his abilities and limitations

Receiver

The audience may be a single person or a group.

The 2 types of audience are

- Controlled

  It is held together by a common interest. It is a homogenous group.

Eg: A group of school children in a school

- Uncontrolled

  It is a group, which has gathered together because of curiosity.

Eg: An audience of a street play in a busy area. People gather around out of curiosity. They are from different walks of life with differing literacy levels, different socio economic status, sharing nothing in common

Message

It is the information transmitted by the communicator to the recipient. A good message must be,

- In line with the objective
- Based on felt needs
- Clear and understandable
- Specific and accurate
- Timely and adequate
- Interesting
- Culturally and socially appropriate

Channels of communication

It is the media used for communication. The media selected should be capable of making the communication effective. The media chosen should be

- Efficient in transmitting the message
- Attractive to the audience
- Easily understandable by the people
- Able to bring about good response and interaction by the people.

The most common channel of communication is interpersonal or face-to-face communication. The other methods are mass media like T.V, radio and folk media like folk songs, dramas.

Feedback

It is the flow of information from the audience

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to the sender. It provides an opportunity to modify the message and render it more acceptable.

Eg: Opinion polls, interviews, questionnaire surveys

TYPES OF COMMUNICATION

1. One way and two way communication

One way communication (Didactic):

It is a type of communication where the flow of information is one-way - from the sender to the receiver. The drawbacks are,

- Knowledge is imposed
- Learning is authoritative
- There is little audience participation
- No feedback

Two way communication (Socratic/ Dilectic):

In this method there is participation from both the sender and the receiver.

- Learning is active and democratic
- It is more likely to influence behavior

2. Verbal and non-verbal communication

Verbal communication is the traditional way by word of mouth. Non-verbal communication involves a whole range of bodily movements and facial expressions like smile, raised eye brows, frowning.

3. Formal and informal communication

Formal communication follows lines of authority, whereas informal communication is conversing with friends or colleagues.

BARRIERS IN COMMUNICATION

They can be classified as,

a. Psychological barriers: Emotional disturbances; depression, neurosis or any other psychosomatic disorder can cause psychological barriers in communication. When interacting with individuals with psychological problems, special methods and utmost care should be adopted in order to convey the message to them.

b. Physiological barriers: They include difficulties in self-expression, difficulties in hearing or seeing, difficulties in understanding etc. When dealing with special groups, Eg: the deaf, dumb or blind, the channels of communication should be selected in such a way as to target that group effectively.

c. Environmental barriers: They are due to excessive noise, difficulties in vision and congestion. These can be overcome by making small groups and using appropriate channels of communication.

d. Cultural barriers: Communication must take into consideration the cultural factors like patterns of behavior, habits, beliefs, customs, attitudes, religion etc., Care should be taken to send the message across effectively without hurting the sentiments of the people.

The verbal barriers are:

- Attacking
- Interrogating
- Criticizing
- Blaming
- Ordering
- Threatening
- Shouting

- The non-verbal barriers are:
  - Flashing eyes
  - Rolling eyes
  - Gestures out of exasperation

- Keys to successful communication
  - Personal contact is important.
  - Always be courteous
  - Be consistent and clear
  - Listen to others and show interest

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EDUCATIONAL AIDS USED IN HEALTH EDUCATION

The aids used for transmitting health education are the main constituent of the armamentarium of the health education process. If used properly, they contribute to the formation of desirable concepts, provide interest for abstract ideas and make learning permanent.

A wide variety of media are used for this purpose. They can be basically classified into three categories as;

1) Auditary aids
2) Visual aids and
3) A combination of audi - visual aids.

Auditary aids:

The auditary aids are based on the principles of sound, electricity and magnetism. The modern world makes use of different types of audio aids. The most commonly used audio aids in health education are,

a) Megaphones
b) Public addressing systems or microphones
c) Gramophone records and discs
d) Tape recorders
e) Radios
f) Sound amplifiers

All the above mentioned auditary aids are useful in reproducing any kind of words spoken and also helps in repeating the same. Apart from being used as a teaching aid, they can be used for entertainment and mass communication.

Visual aids:

The visual aids are based on the principles of projection. Visualization helps individuals to understand better.

The visual aids can be classified as,

a) Projected aids:

These are visual aids, which needs projection from a source on to a screen.

The various projected aids include,

- Films or Cinemas
- Film strips
- Slides
- Overhead projectors
- Transparencies
- Bioscopes
- Video cassettes
- Silent films

The advantages of using the above aids are that

- Real life situations can be enacted in films
- Complete process is self explanatory
- Creates a special interest among the audience to watch a film
- Situational effects can be shown in a film, which will leave a lasting impression in the viewer's mind

b) Non-projected aids:

These are visual aids, which do not require any projection. The commonly used aids without projection are,

- Blackboard
- Pictures, cartoons, photographs,
- Charts, posters
- Flip charts, flashcards
  Consists of a series of charts with an illustration on each of them pertaining to the topic being presented. They are meant to be shown one after the other either by flipping each card (which will be in the form of a book) or by flashing each card so as to hold the attention of the group and send the message across.
- Flannel boards
  A hard board covered with flannel or Khadi over which pictures, backed with coarse sand paper, can be displayed. This allows pictures to be shown in a sequence maintaining continuity. It is also economical.
- Printed materials like leaflets, pamphlets, folders, booklets and brochures
- Models, specimens,

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Combination of audio-visual aids:

These are the modern media available. The advantage of this type of media is that sound and sight can be combined together to create a better presentation. They include,

(a) Televisions
(b) Tape and slide combinations
(c) Video cassette players and recorders
(d) Motion pictures or cinemas
(e) Multimedia Computers

These also include the traditional media, such as,

a) Folk dances
b) Folk songs
c) Puppet shows
d) Dramas

Points to remember when using educational aids in health education:

1. They should be considered as educational tools only. The end product is not the result of the tools but depends upon the "teacher", his technical skills, and the elements of the learning process.
2. The selection and use of audio-visual material should be guided by program objectives.
3. They should be suitable for the groups who are targeted.
4. Educational aids will be more effective when they are used in a good environment with good lighting, ventilation, temperature and comfortable seating.

METHODS OF HEALTH EDUCATION

Health education can be done targeting three main divisions:

1) Individual approach

When an individual comes to the dental clinic or a health centre because of illness, the opportunity should be used to educate him on matters of interest such as the cause and nature of his illness, its prevention, beneficial diet, oral hygiene etc.

This approach can also be used by public health personnel, since they will be visiting homes and can interact with the individual and their families.

Advantages:

- Can be done in a dentist's consultation room (two-way communication)
- Discussion, argument and persuasion of an individual to change his behavior is possible
- There is opportunity for the individual for asking questions and clearing doubts.

Disadvantages:

- Only small number can benefit
- Health education is given only to those who come in contact with the dental surgeon or with public health personnel.

2) Group approach

Group education is an effective way of educating the community. Suitable medium should be selected based on the group targeted

a. Chalk and talk (Lectures)

A lecture is defined as "a carefully prepared oral presentation of facts, organized thoughts and ideas by a qualified person".

The chalk lends the visual component.

The characteristics of a lecture are,

- Should have an opening statement which gives the theme of the lecture
- Group should not be more than 30 people
- The duration of the talk should not exceed 15 to 20 minutes
- Should be based on topic of current interest

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- Its effectiveness depends upon the ability of the speaker to write and draw legibly

Disadvantage:

One way communication. Learning is passive

b. Symposium:

- A series of speeches on a selected topic
- Each speaker presents a brief aspect of the topic.
- There is no discussion among speakers
- In the end, the audience may ask questions
- The chairman makes a summary at the end of the session

c. Group discussions:

- A group is an aggregation of people interacting in a face-to-face situation.
- Process of identifying problems & finding solutions collectively by members of group
- An effective group should consist of 6-12 members
- The participants are seated in a circle
- There should be a group leader who initiates the subject, prevents side conversations, encourages everyone to participate and sums up the discussion.
- There should be a recorder who prepares a report on issues discussed and agreements reached

Disadvantage:

There may be unequal participation Some members may be shy and some may be dominating.

d. Panel discussion:

- Panel of 4 to 8 experts sit and discuss a topic in front of an audience.
- Headed by a chairman who opens the session, introduces the speakers and keeps the discussion going.
- Audience are allowed to ask questions
- Chairman sums up the different views presented

e. Workshop:

- It consists of a series of meetings with emphasis on individual work with the help of resource persons.
- The total workshop is divided into small groups and each group will select a chairman and a recorder.
- The individuals work, solve a part of the problem, contribute to group discussion and leave the workshop with a plan of action for the problem.

f. Conferences or seminars:

- Programs range from half day to one week.
- Held on a regional, state or national level.
- They usually have a theme

g. Role playing / socio drama:

- The size of the group should be about 25. The audience should take active part by suggesting alternative solutions and even by taking part in the drama.
- The situation is dramatized to make communication more effective.
- It is followed by a discussion of the problem.
- Puppet shows used in villages is a type of socio drama
- Useful for children's health education

h. Demonstrations:

- Procedure is carried out step-by-step in front of an audience.
- The method involves the audience in discussion and has a high motivational value.
- The audience can then carry out the procedure themselves with expert help.

3) Mass approach

Health education for a large community or the general public can be given using the mass media of communication. Mass

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communication literally means communication that is given to a community where the people gathered together do not belong to one particular group.

Advantages

- Large number of people can be reached
- People of all socio-economic status irrespective of their caste, creed and religion have access to health education.

Disadvantage: One way communication

Various mass media used are:

Television

- Coverage to large number of people
- Can also reach illiterate people
- Can influence public opinion effectively
- Provides entertainment as well as education
- Disadvantage is the high cost

Radio

- Has a broader audience than television
- Can also reach illiterate people
- Economical and easily accessible medium
- Care should be taken to select the proper
- language and length of talk

Newspapers / press

- Widely disseminated form of literature
- Disadvantage is the low readership in rural areas because of illiteracy.

Documentary films

- Provide realism and motion
- Disadvantage is the high cost

Posters

- They should catch the eye and must be artistic
- Message should be simple and short
- Should be placed in locations were people frequent like bus stands, hospitals
- They should be changed frequently to maintain their effect

Health exhibition

- Should be conducted during a fair or festival
- Personal communication is possible

Health magazines

- Topic should be authored by an expert
- Should be in a simple language that the public can understand

Health information booklets

- The Ministry of Health issues a number of booklets and educational pamphlets on various diseases, methods of prevention and advice to teachers regarding health education in schools.

Internet

- There are a number of internet sites providing health education to the community.

Disadvantages:

- It is expensive and accessible to only the elite few
- There are chances of providing misleading information without any scientific basis. Therefore, people should be advised to seek information only from websites belonging to authorized bodies or associations.

HEALTH PROMOTION

Health promotion is "the process of enabling people to increase control over, and to improve their health".

-Ottawa Charter for Health Promotion, First International Conference on Health Promotion, Ottawa, 21 November 1986

Health promotion not only embraces actions directed at strengthening the skills and capabilities of individuals, but also action

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directed towards changing social, environmental and economic conditions so as to alleviate their impact on public and individual health. Participation is essential to sustain health promotion action.

The five priority action areas for health promotion:

1. Building healthy public policy

Health promotion puts health on the agenda of policy makers in all sectors and at all levels, directing them to be aware of the health consequences of their decisions and to accept their responsibilities for health.

Legislative policy can have a very powerful influence on health by creating a social environment, which protects or improves health.

Fiscal policy is a part of health promotion, which seeks to influence the cost of items influential to health. Taxation of unhealthy products can increase their cost, making them less affordable. However this concept is debatable, since it might increase pressure on the most disadvantaged groups in society who are often heavily dependent on these unhealthy products, resulting in a worsening of their health status.

Eg:At present, unhealthy options such as carbonated beverages are cheaper than healthy alternatives such as fluoridated tooth pastes. Dental professionals need to lobby the Government and become involved in facilitating changes in public policies to reduce the cost of healthy products so as to enable a large number of people to select healthy options.

2. Creating supportive environments for health

Health promotion generates living and working conditions that are safe, stimulating, satisfying and enjoyable. The protection of the natural and built environments and the conservation of natural resources must be addressed in any health promotion strategy. The way society organizes work should help create a healthy society. This is termed 'Organizational change'.

The overall guiding principle for the world, nations, regions and communities alike, is the need to encourage reciprocal maintenance - to take care of each other, our communities and our natural environment. The WHO initiative, Health Promoting Schools Program" supports this style of working. (Refer chapter school dental health program)

Eg: Establishing smoke-free areas, healthy catering services.

3. Strengthening community action for health

Health promotion works through concrete and effective community action in setting priorities, making decisions, planning strategies and implementing them to achieve better health. At the heart of this process is the empowerment of communities - the ownership and control of their own endeavors and destinies. Community development draws on existing human and material resources in the community to enhance self-help and social support, and to develop flexible systems for strengthening public participation in and direction of health matters. This requires full and continuous access to information, learning opportunities for health, as well as funding support.

Eg:Establishing self-help groups, where people affected by particular oral health problems share their experiences and identify solutions.

4. Developing personal skills

Health promotion supports personal and

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social development through providing information, education for health, and enhancing life skills. By doing so, it increases the options available to people to exercise more control over their own health and over their environments and to make choices conducive to health. Enabling people to learn, throughout life, to prepare themselves for all of its stages and to cope with chronic illness and injuries can be facilitated in school, home, work and community settings by educational, professional, commercial and voluntary bodies.

Eg: Increasing patient's knowledge about the role of sugar and plaque in the etiology of dental diseases and to develop tooth brushing skills and promote self care.

5. Re-orienting health services

Reorienting health services requires a stronger attention to health research as well as to changes in professional education and training. There must be a change of attitude and organization of health services, with the health sector moving increasingly in a health promotion direction, beyond its responsibility for providing clinical and curative services. The focus must be on development of appropriate high quality oral health care which places greater emphasis on preventive care and on ways of supporting and maintaining oral health.

Eg:Dentists can be encouraged and rewarded for effective prevention and research activities.

The responsibility for health promotion in health services is shared among individuals, community groups, health professionals, health service institutions and governments. They must work together towards a health care system, which contributes to the pursuit of health.

Approaches to health promotion

1. Preventive

This approach aims at reduction in disease levels in which health professionals act as experts and the patients are passive recipients of preventive care. This is called 'top-down' authoritative style of working.

Eg:Screening program for oral cancer detection and prevention.

Limitation: Does not address the underlying cause of the disease.

2. Behavior change

It is an expert led approach based upon the assumption that the provision of information will lead to a sustained change in behavior. This approach aims to encourage individuals to take responsibility for their health and adopt healthier lifestyles. It persuades a person to change in a particular direction.

3. Educational

This approach uses a range of methods to help individuals make informed choices about their health related behavior. Although this approach is largely led by the expert, it does not persuade a person to change, but provides individuals with choices, which they can select on their own.

4.Empowerment

This approach helps people in identifying their own concerns and priorities, and in developing the confidence and skill to address these issues. This is a 'bottom-up approach' in which the health professional acts as the facilitator. He helps individuals or communities identify their problems and seek appropriate solutions. Empowerment helps to strengthen community action for health.

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Community development is a way of empowering groups to become more actively engaged in improving their health and wellbeing.

5. Social change

This approach aims to change the physical, social and economic environments to promote health and well - being. To achieve this requires changes in policy and political support through lobbying and policy planning.

Each of the approaches has certain strengths and weaknesses, so a combination of approaches is the best way to promote oral health.

CONCLUSION

Health education and health promotion have the potential to tackle the underlying determinants of oral health and thereby improve the oral health of all sections of society. The success largely depends upon developing partnerships across agencies and actively involving local people in the whole process.

Health education seldom has an immediate direct impact on behavior. It predisposes behavior through changes in knowledge, attitude, beliefs, values and perceptions.

Health education is vital to the practice of prevention. It is the channel for reaching the people and alerting them to health services and resources. The focus of health education is on people & their actions through planning and teamwork. Its goal is to make realistic improvement in the basic quality of life.

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Chapter 10

SCHOOL DENTAL HEALTH PROGRAM

INTRODUCTION

DEFINITION

ASPECTS OF SCHOOL DENTAL HEALTH PROGRAMS

OBJECTIVES

IDEAL REQUIREMENTS

ADVANTAGES

ELEMENTS / COMPONENTS

SOME SCHOOL DENTAL HEALTH PROGRAMS

- LEARNING ABOUT YOUR ORAL HEALTH
- TATTLE TOOTH PROGRAM
- ASKOV DENTAL DEMONSTRATION
- NORTH CAROLINA STATEWIDE PREVENTIVE DENTAL HEALTH PROGRAM
- HEAD START PROGRAM
- SCHOOL HEALTH ADDITIONAL REFERRAL PROGRAM (SHARP)
- TEENAGE HEALTH EDUCATION TEACHING ASSISTANTS (THETA)
- BRIGHT SMILES, BRIGHT FUTURES

WHO'S GLOBAL SCHOOL HEALTH INITIATIVE

INCREMENTAL CARE

COMPREHENSIVE CARE

CONCLUSION

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INTRODUCTION

School health is an important aspect of any community health program. It is an economical and powerful means of raising community health in future generations.

Towards the end of the nineteenth century, William Fisher, a dentist of England was so concerned by the high caries experience and lack of treatment in the child population that he devoted much time campaigning for compulsory inspection and treatment of children in schools.

The beginning of School Health Service in India dates back to 1909, when for the first time medical examination of school children was carried out in Baroda city.

The Bhore Committee in 1946 reported that School Health Services were practically non-existent in India, and where they existed, were in an underdeveloped state.

In 1953, the Secondary Education Committee emphasized the need for school nutrition programs.

In 1960, the Government of India constituted a School Health Committee, and submitted its report in 1961.

In January 1982, a Task Force constituted by the Government of India to propose an intensive School Health Service Project, submitted its report. The report stated that only 14 states had done some progress with their own health department budget. It also highlighted the reasons for the poor state of school health programs.

The "Tokyo Declaration" was made on July 19th, 2001 at the 1st Asian Conference on Oral Health Promotion for School Children, held in Tokyo. The declaration stated that this conference would be held on a regular basis with the aim of exchanging information, building a cooperative system, improving oral health among children, and contributing to the well-being of mankind and the development of each country and region based on mutual cooperation.

The "Ayutthaya Declaration" was made on February 23rd, 2003 at the 2nd Asian Conference of Oral Health Promotion for School Children held in Ayutthaya, Thailand. The declaration called upon national authorities in health and education to ensure the implementation of systematic school health programs for promoting oral health and general health in children, based on the World Health Organization's Health Promoting Schools Initiative.

The "Bangalore declaration" was made on January 28th, 2005 at the CAMHADD / WHO workshop on prevention and promotion of oral health through schools held at Bangalore. It called upon national authorities in health and education to ensure implementation of school-based oral health programs for children.

DEFINITION

School Health Services

are defined as the "procedures established

a) to appraise the health status of pupils and school personnel
b) to counsel pupils, parents, and others concerning appraisal findings
c) to encourage the correction of remediable defects
d) to assist in the identification and education of handicapped children
e) to help prevent and control disease and
f) to provide emergency service for injury or sudden sickness".

(by The Committee on Terminology of the American Association for Health, Physical Education, and Recreation 1951)

ASPECTS OF SCHOOL HEALTH SERVICE

1) Health appraisal:

It is defined as "the process of determining

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the total health status of the child through such means as health histories, teacher and nurse observations, screening test; and medical, dental and psychological examinations". Teachers have far more contact with school children than do physicians and dentists.

Periodic dental examination should be encouraged by the school through a program of education for the parents and the child. The program should be based on prevention and long term oral hygiene practices The school curriculum should be planned to give dental health instruction, the time proportionate to its importance.

2) Health counseling:

Following appraisal comes health counseling, which is defined as "the procedure by which nurse, teachers, physicians, guidance personnel, and others interpret to pupils and parents, the nature and significance of the health problem and aid them in formulating a plan of action which will lead to solution of the problem".

Schools should be strongly encouraged to eliminate sales of candy and sweetened beverages in school.

3) Emergency care and first aid:

Since teachers are the first to realize any emergency in a school, they should be trained in handling simple emergencies such as traumatic injuries to teeth during contact sports.

The dental and the school administration should work out policies dealing with dental emergencies arising in or during extra curricular activities.

4) School health education:

It is the process of providing learning experiences for the purpose of influencing knowledge, attitudes, or conduct relating to individual or community health. It should cover the aspects of (a) personal hygiene (b) environmental health and (c) family life.

5) Maintenance of school health records:

These records are useful in analyzing and evaluating school health programs and to provide a useful link between the home, the school and the community.

6) Curative services:

They include regular dental check ups and prompt treatment wherever possible and referral for special problems

OBJECTIVES

- To help every school child appreciate the importance of a healthy mouth.
- To help every school child appreciate the relationship of dental health to general health and appearance.
- To encourage the observance of dental health practices, including personal care, professional care, proper diet, and oral habits.
- To enlist the aid of all groups and agencies interested in the promotion of school health.
- To correlate dental health activities with the total school health program.
- To stimulate the development of resources to make dental care available to all children and youth.
- To stimulate dentists to perform adequate health services for children.

IDEAL REQUIREMENTS

A school dental health program should

- Be administratively sound
- Be available to all children
- Provide the facts about dentistry and dental care, especially about self-care preventive procedures
- Aid in the development of favorable attitudes toward dental health

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- Provide the environment for the development of psychomotor skills necessary for tooth brushing and flossing
- Include primary preventive dentistry programs-prophylaxis, fluoride programs, and use of pit-and- fissure sealants
- Provide screening methods for the early identification and referral of pathology
- Ensure that all discerned pathology is expeditiously treated

ADVANTAGES

1. The school based dental health programs can bring comprehensive dental care including preventive measures to schoolchildren where they are gathered anyway for non-dental reasons in the largest possible numbers. This is particularly advantageous in dentist - deprived areas.
2. Students can be accessed during their formative years, from childhood to adolescence. These are important stages in people's lives when lifelong oral health related behavior as well as beliefs and attitudes are being developed.
3. School clinics are less threatening than private offices since the children are in familiar surroundings.
4. The children's daily contact with the dental personnel in other roles, such as joining with the teachers in a variety of school activities, may have a lasting effect in their attitudes towards dentistry in general.
5. If the children can be maintained in a state of good dental health it will be relatively easy to maintain their dental health in adult life.
6. A regular dental attendance pattern in early life will be continued after school age.
7. School dental health programs when associated with general health programs, can facilitate valuable consultation on medico - dental problems.
8. The expenses involved and the time used in transportation to private dental office can be saved if the child gets dental care in the school itself.
9. If parents have to escort children to a private dental office, he/she will lose income for that day. This can be overcome by school dental health programs.
10. Utilizing dental auxiliaries can further reduce the cost.
11. The health of school staff, families and community members can be enhanced by programs based in schools.

ELEMENTS/ COMPONENTS of school dental health program

1) Improving school-community relations:

One of the first steps in organizing a dental health program is the formation of an advisory committee. It should include broad representation from parents, teachers, school administrators, dental professionals, health officers and community leaders.

The task of these committees is

- To appraise and publicize the dental needs of the school children
- To address the school administration's concern in the promotion of oral health.
- To make people realize the importance of dental health

2) Conducting dental inspections:

In a situation where the extent of dental diseases among school children is found to be 95% or more, a program of dental inspection becomes a matter of debate. A few are of opinion that it would be a mere waste of resources (money, manpower, material and time) to examine for a disease which occurs almost universally and which demands treatment. The other sections are in favor of dental inspections.

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- Benefits of school dental inspections:
- It serves as a basis for school dental health instruction.
- Every child unless proved otherwise is considered to be free from dental disease, the positive findings, on such children will provide greater motivation towards dental health.
- It builds a positive attitude in the child toward the dentist and dental care.
- The child and the parent are motivated to seek adequate professional care.
- Teachers, students, and dentists concerned with dental health may use the dental inspection as a fact-finding experience.
- Baseline and cumulative data for evaluation of the school dental health program are made available.
- Provides information as to the status of dental needs to plan a sound dental health program.

Limitations:

- Parents and children frequently accept the inspections to be comprehensive and depend entirely upon it rather than a complete dental examination by the family dentist.
- Sometimes the school inspections may tend to discourage rather than promote the development of the habit of visiting the dentist at an early age.
- It is desirable for parents to be present during dental examinations. This procedure is not always feasible in school inspections.

3) Conducting dental health education:

A school dental health program should include a suggested formal approach to teaching dental health in the classroom. The dentist serves as the expert resource person to strengthen the teacher's classroom instruction program. He should give each teacher sincere attention. This is important in developing proper attitudes and personal dental health practices by the teacher which can be passed on to the classroom. Self-contained dental health kit for teacher education and presentation of basic dental health concepts should be made available to every school.

4) Performing specific programs:

A) Tooth brushing programs:

In the classroom, 6-8 children can be taught as a group. Each is given a cup, a napkin, and a kit containing a disclosing tablet, a toothbrush, and a tube of fluoride dentifrice.

The children are demonstrated how to remove some imaginary dirt from between the cuticle and the thumbnail.

The mastery of the 45^0 angulations and the short vibratory strokes can then be repeated on an oversize dentoform model.

Emphasis should be placed on the need to follow a definite brushing sequence to ensure that all tooth surfaces are brushed.

Next, the children are asked to chew a disclosing tablet and to swish it around the mouth for 30 seconds. They are then encouraged to look at each other's teeth with appropriate emphasis on the fact that the red stain colors the plaque in which the bacteria live.

Next a magnifying mirror is passed around so the participants can note that their teeth are no different from those of their neighbors i.e. all people have plaque.

Guided brushing can then begin, with the instructor establishing the sequence of teeth to be brushed.

At the end, the mirror is again passed around to show that progress has been made.

During the entire process appropriate corrections and reinforcement of brushing technique should be emphasized.

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B) Classroom-based fluoride programs:

Two effective fluoride programs are:

1. Fluoride 'mouth - rinse' program:

A once-a-week mouth rinse can be expected to result in 20% to 40% reduction in dental caries.

The kit used in the program consists of fluoride rinse dispenser, cups, napkins and plastic disposal bags.

- The dispenser is graduated so that 2.0 gm of packaged sodium fluoride powder can be placed in the jug and water added to the 1000-ml mark.
- The rinse should be non-sweetened and non-flavored to discourage swallowing.
- Rinsing programs are advised for grades 1 to 12 but not below.
- Five ml of the rinse is dispensed into each cup and all the children are instructed to rinse the solution in the mouth for 1 minute, after which they are to spit carefully into the cup.
- The napkin is used to wipe the mouth, after which it is forced into the bottom of the cup to absorb all fluid. One of the students then collects the cups.

Fluoride mouth-rinsing programs received official recognition of safety from the FDA in 1974 and by the Council on Dental Therapeutics of the ADA in 1975. Aside from the United States, 7 other nations- Denmark, Finland, New Zealand, Netherlands, Norway, Thailand and Sweden - support major mouth rinse programs.

2.Fluoride tablet program:

One tablet is given to each student. The student then chews and swishes the 2.2 mg sodium fluoride (1 mg fluoride) tablet in the mouth for a minute and then swallows. The swish-and-swallow technique not only provides the benefits of a topical application but also provides the optimum systemic benefit during the period of tooth development and maturation. The daily tablet is more effective than the weekly rinse.

C) School water fluoridation programs:

This procedure makes the fluoride available to children, for whom dental caries is a primary problem, as compared to older age groups.

The amount of fluoride added to school drinking water must be greater than that used in communal water supplies, i.e., 4.5 times the optimum concentration since children are in school for shorter hours and less water is consumed during that time. For Individuals not served by a public water supply, alternative methods such as fluoridating the individual school water supply must be considered. In addition to the systemic effects on developing teeth, school water fluoridation also imparts topical effects on erupted teeth.

Studies have shown a reduction in dental caries prevalence by about 40% among children attending schools that support school water fluoride programs

A major disadvantage is that children do not receive benefits until they begin school.

D) Nutrition as a part of school preventive dentistry programs:

School lunch programs are designed to provide the child with an intake of nutrients that approximate one third of the daily intake of essential carbohydrates, proteins, fat, minerals, and vitamins. Sugar discipline can be aided through counseling by the school dietician, dental hygienist or teacher. Emphasis cannot be on a total restriction of sugars. Instead, it should focus on reducing the frequency of intake and selecting sugar products that are rapidly cleared from the mouth.

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Mid Day meal Program of Government of India

The program of providing hot cooked meal was introduced in 7 north eastern districts of the state during 2002-03.

This scheme was extended to the remaining areas under the title Akshara Dasoha during 2003-04.

The scheme consisted of providing free food grains at 3 Kilograms per child / per month to children of class 1 to 5 of Government schools on the basis of 80% of attendance in a month. The scheme was extended to classes 1 to 5 in Government aided schools from 1-9-2004.

The program was extended to VI and VII standards in Government / Government Aided schools in the State from 01-10-2004.

The objectives of the program

- To improve enrolment and attendance
- To reduce school drop outs.
- To improve child health by increasing nutrition level.
- To improve learning levels of children.

These objectives have been substantially attained, with dramatic impact on the enrollment and retention of girl children in particular. Additionally it has provided employment to destitute mothers who work as cooks in the various noon meal centres in the state.

The hot cooked food contains about 400 calories (Per child per day)

Rice - 100 gms.
Pulses - 20 gms
Oil - 03 gms
Salt - 02 gms
Vegetables - 50 gms

E) Sealant placement:

The placement of pit-and-fissure sealants is ideally suited for a school program. First, second, 6th and 7th standards would be desirable levels to selectively intervene to prevent pit-and-fissure lesions. (1st and 2nd standards, because- First permanent molars are sufficiently erupted to place the sealant. 6th and 7th standards - 2nd permanent molars). Sealant placement, when coupled with a follow-up application of fluoride, in addition to the classroom fluoride mouth-rinse or fluoride tablet program, helps provide a continuous protection of the whole tooth.

F) Science fairs:

A science fair not only helps in educating and motivating school children to improve their oral health but also provides an excellent opportunity for dentistry to contribute substantially to the building of a growing reservoir of students who may some day choose a career in dentistry. Local and state dental associations can organize support for these fairs. Literature should be provided for students, outlining possible dental projects and offering the assistance of local dentists to help students develop projects. The student with the best dental project in regional science fairs should be invited to represent their regions and local dental societies at the state science fair or the state dental association meeting.

5) Referral for dental care:

In a few schools dental care is provided at the school itself. However if only emergency treatment is provided, for eg, If the dental auxiliary places eugenol - soaked cotton in a child's cavity to relieve the pain, the parent does not see the child in pain and might conclude that the school has taken care of the dental problem. Therefore the parent should be

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informed and made to understand that such emergency treatment is not a cure and she will have to visit the dentist of her choice for proper dental treatment.

"Blanket" referral:

A program that has proved to be effective in many schools is 'blanket' referral of all children to their family dentists. In this program, all children are given referral cards to take home and subsequently to the dentist, who sign the cards upon completion of examination, treatment, or both. The signed cards are then returned to the school nurse, or classroom teacher, who plays an important role in following up the referrals with the child and parents.

6) Follow-up:

The mere issuance of referral slips to children will be of little value if steps are not taken to make it clear that the school is interested in defect correction. This needs a good follow-up system. The dental hygienist is the logical person to conduct such follow-up examinations.

Leave concessions from school for dental treatment are strongly recommended. That is, children should be excused to keep office appointments with the physician or dentist during school hours. There are two reasons for such concessions:

a) The child is a more co-operative patient when medical / dental services are provided during early or middle part of the day.
b) Dentists can provide better services for children when they have time and do not have to crowd their child patients into after school hours.

Abuse of the school excuse system can be avoided by having printed forms duly signed by the school officials, parents and the dentists to assure that the appointment was actually kept.

SOME SCHOOL DENTAL HEALTH PROGRAMS:

1. "LEARNING ABOUT YOUR ORAL HEALTH" - A PREVENTION ORIENTED SCHOOL PROGRAM:

This program was developed by the 'American Dental Association' (ADA) and their consultants in coordination with the 1971 ADA House of delegates and is presently available to school systems throughout the United States of America.

"Learning about Your Oral Health" is a comprehensive program covering current dental concepts.

The primary goal of this program

- is to develop the knowledge, skills and attitudes needed for prevention of dental diseases among school children.

Consideration is also given to increasing knowledge regarding diet and dental health, stressing on the relationship of sugar, starch and caries. The other topics included in this program are the significance of fluoride, oral safety, consumer health concepts, the role of dental professionals, and the relationship of oral health with total health.

Implementation of the program:

The program is divided into five levels, each level having its own defined specific content. The five different levels are:

Preschool (designed for children too young to read).

Level I (kindergarten through grade 3).
Level II (grades 4 through 6).
Level III (grades 7 through 9).
Level IV (grades 10 through 12).

The core material for each of the five levels is self-contained in a teaching packet that allows the classroom teacher to adapt the presentation to the needs of the students. Each teaching packet includes.

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- A teacher's self-contained guide on "dental health facts" with a section on handicapped children
- A glossary of dental health terms
- A curriculum guide featuring content, goals, behavioral objectives and suggested activities for other classes
- Five lesson plans for the preschool level and seven or more lesson plans for each of the other levels
- Four overhead transparencies
- Twelve spirit masters (for copying)
- Methods and activities for parental involvement

In addition to these teaching materials, supplementary printed material and films suitable for each level are also provided. The ADA in collaboration with the American Cancer Society has developed materials for educating junior and senior high school students to make them aware of the hazards of tobacco usage. This program was developed mainly for general use and can be adapted in full or in part to complement other ongoing programs.

Evaluation of the program:

The behavioral objectives provide the basis for evaluating the effectiveness of the lessons at all levels with the exception of levels I and II, which contain pre-tests and post-tests.

Dr. Oliver L. Ezell conducted the evaluation for the effectiveness of this program in 1974. It was found that the program influenced favorably the oral health behavior than did the traditional approach to oral health education and effected favorable changes in attitudes towards oral health practices.

2."TATTLETOOTH PROGRAM" - TEXAS STATEWIDE PREVENTIVE DENTISTRY PROGRAM

The Tattletooth Program was developed in 1974-1976 as a cooperative effort between Texas Dental health professional organizations, the Texas Department of Health and the Texas Education Agency through a grant from the Department of Health and Human Services to the Bureau of Dental Health. The program was pilot tested in1975 and field tested in spring 1976 in schools within the state of Texas.

In 1989, the Bureau of dental health developed a new program to replace the existing Tattletooth Program. This was called Tattletooth II - A New Generation for Grades K-6. The new curriculum was modified to reflect recommendations obtained from the formative evaluation process.

Separate lesson plans were developed for each grade and a systems approach was used to develop all educational material.

- Three videotapes were produced as part of the teacher-training package.
- The first videotape familiarizes the teachers with the lesson format and content.
- A second videotape, "Brushing and Flossing" was developed for the dual purpose of teacher training and as an educational unit to be used by the teacher with the students.
- A third videotape provides teachers with additional background information as a means of preparing them to teach the lessons.
- The materials that were developed to aid in the implementation of the program consisted of
- A brochure that provided an overview of the program
- A school nurse's brochure.

A letter to school principals and nurses was sent out as part of a package distributed annually by the Bureau of Maternal and Child Health. A two-hour training session using the materials in the new curriculum was televised to the schools via a video network.

Program philosophy and goals:

The program embraces the six elements of

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effective lesson design; anticipatory set, setting the objective, input modeling, checking for understanding, guided practice and independent practice.

The basic goal of the program is to reduce dental disease and develop positive dental habits to last a lifetime. The major thrust of Tattletooth is to convince students that preventing dental disease is important and that they can do it.

Program implementation:

The Texas Department of Health employs 16 hygienists in the eight public health regions to implement the Tattletooth Program.

- The hygienists instruct teachers using videotapes designed for teacher training and provide them with a copy of the curriculum.
- Health promotion activities are encouraged and publicized within the school community.
- Teachers are encouraged to invite a dental professional to demonstrate brushing and flossing in the classroom.
- A field trip to a dental office is strongly recommended for kindergarten children.
- Bulletin board suggestions, a book list, films and videotapes are available on a free loan for appropriate grade levels,
- Other resources used are a list of companies providing supplementary classroom resources and a comprehensive glossary of vocabulary words written for the teacher in English or Spanish that are used in all grade levels.

Topics covered in the curriculum include correct brushing and flossing techniques, awareness of the importance of safety and factual information relating to dental disease, its causes and preventive techniques.

Program evaluation:

The students in grades 3, 5, 7, 9 and 11 were given the Texas Assessment of Academic Skills (TAAS) by the Texas Education agency, to satisfy the legislative requirement that student performance be assessed.

Teacher evaluation is done annually by principals and supervisors using a 65-item checklist.

A major field test conducted in 1975 and 1976 studied 15,000 children in 18 educational service regions. Results of single exposure to the program revealed that,

- Dental health knowledge was significantly increased at all grade levels.
- Plaque levels were decreased by approximately 15% in a randomly selected sample of 2,142 children.
- Over 80% of the teachers judged the program to be helpful and effective, but evaluation questions suggested that they felt a need for additional technical help in brushing and flossing.

In1989, a statewide summative evaluation of the seven levels of the Tattletooth II curriculum was conducted. The results showed,

- Teacher-student interaction was present as a result of the format
- Student responses to the curriculum were positive or very positive.
- Approximately 94% of the teachers felt that teaching oral health can have a positive effect on children's dental health habits.

However, the majority of teachers did not provide the students with the opportunity to practice the skills of brushing and flossing. This was because the dental program no longer provided toothbrushes and floss

3. ASKOV DENTAL DEMONSTRATION:

Askov is a small farming community with a population mostly of Danish extraction. It showed very high dental caries in the initial surveys made in 1943 and 1946.

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During the period from 1949 to 1957, the Section on Dental Health of the Minnesota Department of Health supervised a demonstration school dental health program in Askov, including caries prevention and control, dental health education and dental care.

- All recognized methods for preventing dental caries were used in the demonstration with the exception of communal water fluoridation since until 1955 Askov had no communal water supply.
- Dental care was rendered by a group of five dentists from nearby communities employed by the Minnesota Department of Health. These dentists also gave topical fluoride treatments.

Findings available through a 10 year period revealed

- 28% reduction in dental caries in deciduous teeth of children aged 3 to 5 years
- 34% reduction in caries in the permanent teeth of children 6 to 12 years old
- 14% reduction in permanent teeth of children 13 to 17 years old.
- Improvements in filled-tooth ratios

The program also had many intangible benefits such as good health and dietary habits for the children to carry on to adult life.

The cost of the program was greater and the caries reductions smaller when compared with water fluoridation. However fluoridation is by no means a substitute for such a program. Good health habits are valuable even for persons with resistant teeth and dental care for the indigent is still needed in fluoridated areas.

4.NORTH CAROLINA STATEWIDE PREVENTIVE DENTAL HEALTH PROGRAM:

In 1970, the North Carolina Dental Society passed resolutions advocating a strong preventive dental disease program embracing school and community fluoridation, fluoride treatments for school children, plaque control education in schools and communities and continuing education on prevention for dental professionals.

In 1973, Frank. E. Law prepared a report for the North Carolina Dental Society that defined the extent of the dental disease problem and this resulted in the initiation of a 10-year program to reduce dental disease.

- A steering committee developed a practical plan for a program in the schools. This was the first statewide program of its magnitude.
- Continuation and expansion of the North Carolina Preventive Dentistry Program for Children (NCPDPC) has been made possible through incremental funding from the state legislature and funding through grants awarded by Kate. B. Reynolds Health Care Trust.
- These projects include producing 19 videotapes for classroom teachers in teaching dental health and conducting a statewide oral health survey of a representative sample of North Carolina schoolchildren from kindergarten through grade 12 during the 1986-87 school year.

Central Library, A.C.P.M. Dental College, DHULE.
3289

Program philosophy and goals:

This program is a unique public and private partnership dedicated to the mission of assuring conditions in which North Carolina citizens can achieve optimal oral health. The program activities include preventive and educational components to modify the behavior patterns of individuals to improve their oral health habits through dietary changes, tooth brushing and flossing. Young children are the primary focus for education because the earlier a child is reached, the greater the potential for positively affecting the child's attitudes, values and behavior.

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Fluoride is recognized as the most effective public health measure for dental caries.

Objectives that will facilitate attainment of the goals include:

1. Appropriate use of fluoride
2. Health education in schools and communities
3. Availability of public health dental staff in all counties

Program implementation:

This program is unique in that, it is designed to reach several segments of the population: young children, parents, teachers, dental professionals and community leaders.

In the year 1990, services delivered through the program included

- The fluoridation of water supplies of 130 rural schools,
- Weekly fluoride mouth rinse for more than 416,000 students in 1,051 schools
- Screening and referral for more than 339,000 children.
- Dental health education was presented to 361,000 children and 42,000 adults.
- More than 33,000 dental sealants were applied.

Teachers are believed to be the key in the educational program. To improve their capability for teaching and reinforcement of sound dental principles, they receive pre-service, in-service, and follow- up training and consultation to cover dental health concepts, practice oral hygiene skills and integrate dental health into the curriculum.

The curriculum "Frame work for dental health education" includes,

- Class room and teacher videos and teacher guides for kindergarten through grade six, to help teachers to be more effective in their classrooms.
- Several additional teaching aids are available, such as more than 50 different leaflets, worksheets and handouts on nutrition, fluoride, plaque control, routine dental visits, injury prevention and smokeless tobacco.
- The film library contains some 30 films, videos and slide sets on dental health, which are free on loan to any school in the state.

Program evaluation:

Evaluation is a necessary ongoing process to measure the effectiveness of the dental health program. Evaluation has shown,

- 34% reduction in decayed, missing and filled permanent teeth among children who had 8 years experience drinking fluoridated water at school.
- 53% reduction in decayed, missing and filled permanent teeth among children who had 10 years experience drinking fluoridated water
- 86% reduction in dental caries after 4 years of sealant use on permanent teeth.

5. HEAD START - PRE-SCHOOL DENTAL HEALTH PROGRAM:

Head Start is a program of the United States Department of Health and Human Services initiated in 1965 that focuses on assisting children from low-income families. It is the longest-running program for stopping the cycle of poverty in the United States. It provides comprehensive education, health, nutrition, and parent involvement services to low-income children and their families.

6. SCHOOL HEALTH ADDITIONAL REFERRAL PROGRAMME (SHARP):

(Motivation through home visits)

This program was instituted in Philadelphia with the purpose of motivating parents into initiating action for correction of defects in their children through effective utilization of community resources. The project was carried out by district nurses with the co-

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operation of school personnel. The nurses made daytime visits to families in which the mothers were at home. Working parents were contacted by phone. The one-to-one basis of health guidance between parent and health worker established better rapport between school and home.

7. TEENAGE HEALTH EDUCATION TEACHING ASSISTANTS PROGRAM (THETA Program)

Developed by the National Foundation for the prevention of oral disease for the US Department of Health and Welfare, Division of Dental Health.

Philosophy

Dental personnel train high school children to teach preventive dentistry to elementary school children.

Goals

- To give knowledge & skills to young children.
- Allows high school children to develop understanding of young children
- Introduces them to career opportunities

8. COLGATE'S BRIGHT SMILES, BRIGHT FUTURES

"The Colgate Bright Smiles, Bright Futures" oral health educational program worldwide was developed to teach children positive oral health habits of basic hygiene, diet and physical activity. This program also encourages dental professionals, public health officials, civic leaders and most importantly, parents and educators to come together to emphasize the importance of oral health as part of a child's overall physical and emotional development.

Under this program, children in primary schools receive instructions in dental care from members of the dental profession nominated by the Indian Dental Association. Education is imparted with the aid of audio-visuals and printed literature. Free dental health care packs are distributed to encourage good oral hygiene.

The Teachers Training Program is an integral part of the School Dental Health Program, conducted regularly across the country to promote preventive dental health care.

WORLD HEALTH ORGANIZATION'S (WHO'S) GLOBAL SCHOOL HEALTH INITIATIVE

WHO's Global School Health Initiative, launched in 1995, seeks to mobilize and strengthen health promotion and education activities at the local, national, regional and global levels. The Initiative is designed to improve the health of students, school personnel, families and other members of the community through schools.

The strategies:

1.Research to improve school health programs:

Evaluation research and expert opinion is analyzed and consolidated to describe the nature and effectiveness of school health programs.

2.Building capacity to advocate for improved school health programs:

Technical documents are generated that consolidate research and expert opinion about the nature, scope and effectiveness of school health programs. Each advocacy document makes a strong case for addressing an important health problem, identifies components of a comprehensive school health program, and provides guidance in integrating the issue into the components.

3. Strengthening national capacities:

Collaboration between health and education agencies is fostered and

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countries are helped to develop strategies and programs to improve health through schools.

4. Creating networks and alliances for the development of health-promoting schools:

Initiating regional networks and global alliances with Education International (EI), Centers for Disease Control and Prevention (CDC), Education Development Center, UNESCO and UNAIDS for the development of Health-Promoting Schools and to enable teachers' representative organizations, to improve health through schools.

The goal of WHO's Global School Health Initiative is to increase the number of schools that can truly be called "Health-Promoting Schools".

What is a health promoting school?

"A health promoting school can be characterized as a school constantly strengthening its capacity as a healthy setting for living, learning and working." - WHO TRS 870.

It,

- Fosters health and learning with all the measures at its disposal.
- Engages health and education officials, teachers, teachers' unions, students, parents, health providers and community leaders in efforts to make the school a healthy place.
- Strives to provide a healthy environment, school health education, and school health services along with school/community projects and outreach, health promotion programs for staff, nutrition and food safety programs, opportunities for physical education and recreation, and programs for counseling, social support and mental health promotion.
- Implements policies and practices that respect an individual's well - being and dignity, provide multiple opportunities for success, and acknowledge good efforts and intentions as well as personal achievements.
- Strives to improve the health of school personnel, families and community members as well as pupils and works with community leaders to help them understand how the community contributes to, or undermines, health and education.

Health promoting schools focus on:

- Caring for oneself and others
- Making healthy decisions and taking control over life's circumstances
- Creating conditions that are conducive to health (through policies, services, physical / social conditions)
- Building capacities for peace, shelter, education, food, income, a stable ecosystem, equity, social justice, sustainable development.
- Preventing leading causes of death, disease and disability. Eg: tobacco use, HIV/AIDS,
- Influencing health-related behaviors

INCREMENTAL DENTAL CARE

Incremental care may be defined as "periodic care so spaced that increments of dental disease are treated at the earliest time consistent with proper diagnosis and operating efficiency, in such a way that there is no accumulation of dental needs beyond the minimum."

In private practice, six months is the commonest, though not the only interval between visits. In public health programs, one-year intervals are usually implemented.

This represents the ideal pattern for care where appreciable incidence of new dental disease is to be expected each year.

Treatment programs can be "gotten off the ground" by taking the youngest available

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group the first year and carrying it forward in subsequent years as far as funds permit, each year adding a new class of children at the next earliest available age until an entire child population is being served to as high an age as available resources permit.

Advantages:

- Lesions of dental caries are treated before there has been a chance for pulpal involvement.
- Periodontal disease is intercepted at or near the beginning.
- Topical and other preventive measures are maintained on a periodic basis.
- Bills for dental services are equalized and regularly spaced.
- The program avoids the high expenditure of late dental care.
- It confines dental disease to small early increments, thus reducing loss of teeth.
- It inculcates a habit of periodic return to the dental office in subsequent years.

Disadvantages:

1. Time consuming:

   Restorative dentistry is more time consuming on a piecemeal basis than upon a wholesale basis. A large operative program can be handled on a quadrant basis under local anesthesia. This makes for rapid cavity preparation and easy isolation of teeth for filling procedures. Five or six tooth surfaces can thus be filled in the time required for only two or three surfaces if these are scattered in various parts of the mouth

2. Attention to deciduous teeth:

   Much laborious restorative work may be performed upon deciduous molars at a time when permanent successors have already started calcification and are controlling factors in mandibular growth. Financial resources may be exhausted even before the elementary school population has been cared for and the permanent teeth might receive no care at all.

3. Increasing likelihood of interruption in children's dental health programs:

   Mobility of the children along with their families tends to interrupt programs for dental or maintenance care. There is also a segment of the population where systemic recall habits will be difficult or impossible to induce.

COMPREHENSIVE DENTAL CARE

Comprehensive dental care is the meeting of accumulated dental needs at the time a population group is taken into the program (initial care) and the detection and correction of new increments of dental disease on a semiannual or other periodic basis (maintenance care). Preventive measures aimed to minimize disease are a part of comprehensive dental care.

Services are provided not only to eliminate pain and infection but also to

- Restore serviceable teeth to good functional form,
- Replace missing teeth,
- Provide maintenance care for the control of early lesions of dental disease
- Provide preventive measures, educational and otherwise, so that the population may experience a lower prevalence of disease.

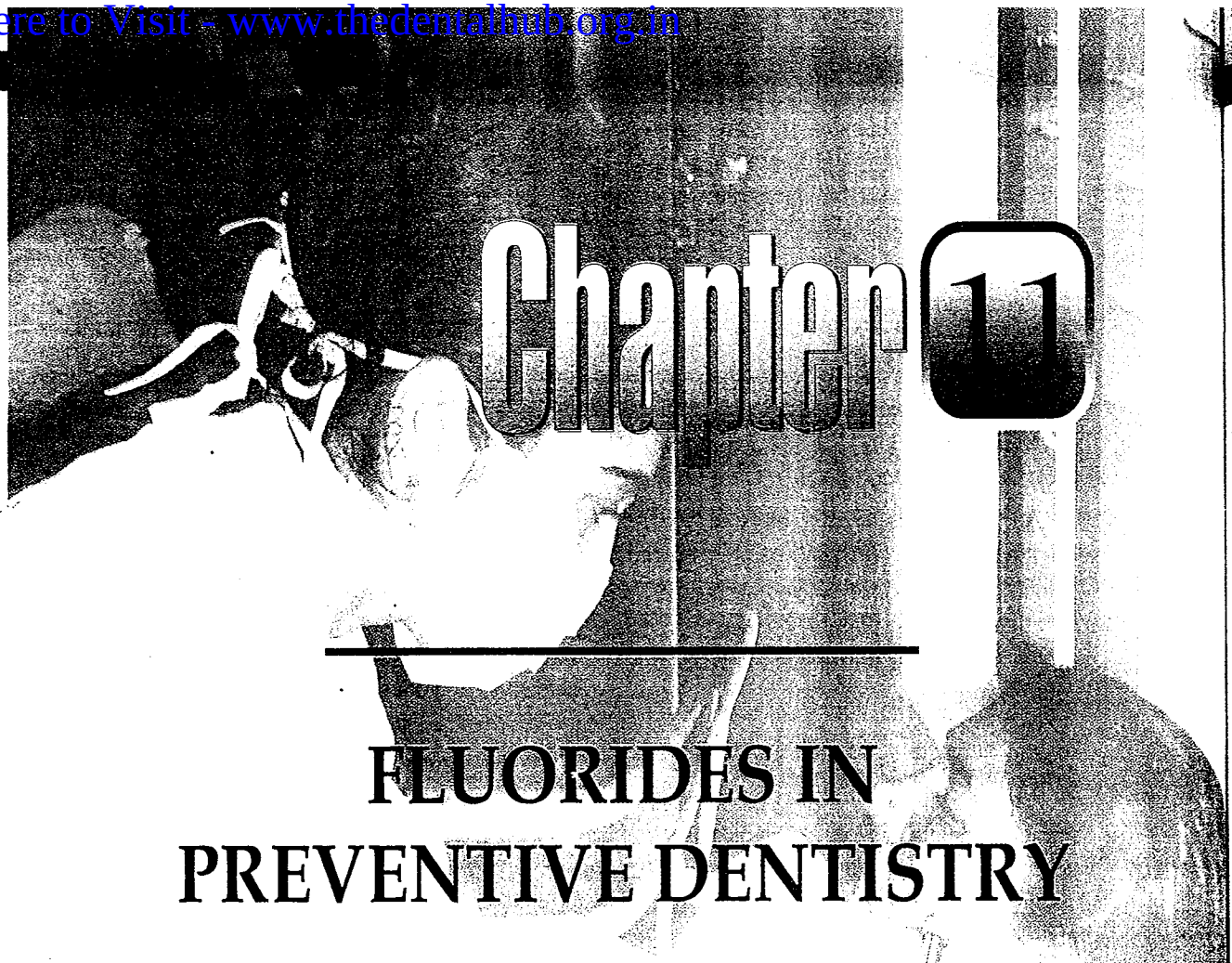
Dental care from WOMB to TOMB, this is comprehensive dental care in the true sense.

CONCLUSION

A school dental health program should not impose an excess or unusual teaching burden on the teachers, it should be cost effective in manpower, money, and material and it should produce observable results.

Since children are often the most important victims of dental diseases, programs aimed at dental health of the school children are of great importance in promoting oral health of the community.

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Chapter 11

FLUORIDES IN PREVENTIVE DENTISTRY

INTRODUCTION

THE ELEMENT FLUORIDE

HISTORICAL EVOLUTION OF FLUORIDES

FLUORIDE IN THE ENVIRONMENT

SOURCES OF FLUORIDE

METABOLISM OF FLUORIDE

- ABSORPTION OF FLUORIDE
- DISTRIBUTION OF FLUORIDE IN THE BODY
- EXCRETION OF FLUORIDES

ESTIMATION OF FLUORIDE CONCENTRATION

MECHANISM OF ACTION OF FLUORIDES

FLUORIDE DELIVERY METHODS

- TOPICAL FLUORIDES
- SYSTEMIC FLUORIDES

TOXICITY OF FLUORIDES

CONCLUSION

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INTRODUCTION

Dental caries is a major dental disease affecting a large proportion of the inhabitants of the world. It impairs the quality of life for many people causing pain and discomfort. In addition, it places a heavy financial burden on public health services. Its very high morbidity potential has brought this disease into the main focus of dental health professionals. Scientific research, technologic advances and a better understanding of the disease process have contributed to dentistry's emergence from a purely reparable art towards a preventive-oriented science. The cariostatic efficacy of fluorides has been convincingly demonstrated and the recent decline in caries prevalence is primarily attributed to the increased use of fluoride agents.

THE ELEMENT FLUORINE

Fluorine is a member of the halogen family with a relative atomic weight of 19 and an atomic number of 9. The word fluorine is derived from the Latin term "fluore", meaning, "to flow". At room temperature, fluorine is a pale, yellow-green gas. It is the most electronegative and reactive of all elements and thus, in nature, is rarely found in its elemental state. Fluorine combines directly at ordinary or elevated temperatures with all elements other than oxygen and nitrogen and therefore reacts vigorously with most organic compounds.

The Federal Register of United States Food and Drug Administration describes fluoride as an essential nutrient. The WHO expert committee on trace elements has included fluorine as one among the 14 physiologically essential elements required for the normal growth and development of the body.

Combined chemically in the form of fluorides, fluorine is the seventeenth in the order of frequency of occurrence of the elements, representing about 0.06% to 0.09% of the earth's crust. In rock and soil, fluorine may occur in combined form in a wide variety of minerals, such as Fluorspar [fluorite CaF_2], Fluorapatite ($Ca_{10}F_2(PO_4)_6$) and Cryolite (Na_3AlF_6). Fluorspar is the principal fluoride containing mineral and the theoretical fluoride content is 49%. Fluorapatite is a constituent of rock phosphate and has a theoretical fluoride content of only 3.4%. Cryolite is a relatively rare mineral that is an essential raw material in the aluminium industry and has a theoretical fluoride content of 54%. Volcanic and hypabyssal rocks, as well as salt deposits of marine origin also contain significant amounts of fluoride.

Fluoride ions have a strong tendency to form complexes with heavy metal ions in aqueous solutions. The range of fluoride levels in water varies in different parts of the world. Additionally fluorides are widely distributed in the atmosphere, originating from the dusts of fluoride - containing soils, from gaseous industrial wastes and from gases emitted in areas of volcanic activity.

HISTORICAL EVOLUTION OF FLUORIDES

In 1529, Georigius Agricola described the use of fluorspar as a flux and Ferdinand Frederic Henri Moissan, a French chemist, was the first to successfully isolate fluorine in 1886. He also completely isolated the fluorine gas from the hydrogen gas and his work was so impressive that he was awarded the Nobel Prize for chemistry in 1906.

The history of fluoridation started with the arrival of Dr. Fredrick McKay in Colorado Springs, Colorado, USA, in 1901, the year following his graduation from the University of Pennsylvania Dental School. He noticed that many of his patients, particularly those who had lived in the area all their lives, had an apparently permanent stain on their teeth, which was known to the local inhabitants as 'Colorado Stain'. McKay checked the notes he had saved from dental school but found nothing to describe such markings, nor could

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he find any reference to them in any of the available scientific literature. He called the stain 'mottled enamel' and said that it was characterized by minute white flecks or yellow or brown spots or areas, scattered irregularly or streaked over the surface of a tooth or it may be a condition where the entire tooth surface is of a dead paper-white like the color of a china dish.

The first systematic endeavor to investigate this lesion was made by the Colorado Springs Dental Society in 1902.

At that time it was generally supposed that a limited area of territory, measured by a comparatively short radius of miles, was the only area affected, and as a first step toward defining its limits, a series of letters were addressed to dentists practicing in various portions of the Rocky Mountain region. The answers received brought very little information of value and the matter of further investigation was allowed to rest for the next few years.

In 1905, McKay moved to St. Louis to practice orthodontics. He stayed there for three years, during which time he never saw a case of mottled enamel, whereas in Colorado springs he saw cases every day. He returned to Colorado in 1908 and the stain problem struck him with more force than ever. At the May 1908 meeting of the El Paso County Odontological Society, McKay revived the question. After hearing his talk, the society sent him, together with a patient whose teeth bore the markings of the stain, to the annual meeting, in June, of the State Dental Association in Boulder. McKay exhibited the patient and, though dentists showed a passing interest in the problem, he learned of similar conditions in several other towns. The dentists in these towns, unimpressed by an almost universal condition, had not bothered to report the stain.

By showing an actual case of Colorado Stain to dentists from all over the State, McKay sowed the seeds of interest beyond the borders of his recently adopted home. As a result of the meeting in Boulder, McKay decided that, firstly, he needed help from a recognized dental research worker and, secondly, he needed to define the exact geographical area of the stain - the endemic area. To attain his first objective he approached one of America's foremost authorities on dental enamel, Dr. Greene Vardiman Black, Dean of the Northwestern University Dental School in Chicago. Black could scarcely believe that there could be a dental lesion affecting so many people which had remained unmentioned in the dental literature. Black asked that some of the mottled teeth be sent to him for examination. He agreed to attend the Colorado State Dental Association meeting in July 1909, and promised to spend some weeks in Colorado Springs before the annual meeting.

In preparation for this visit, and as a first step in mapping out the entire endemic area, McKay, Isaac Burton and A. Fleming, examined 2945 children in the public schools of Colorado Springs and discovered to their complete astonishment that 87.5 per cent of the children native to the area had mottled teeth. For the first time investigators had statistical data detailing the prevalence of the lesion in the community. This new information was given to Black when he arrived in Denver, in June 1909. At the State Dental association meeting, Black described the histological examination of the lesion and recounted his personal observations noted during the several weeks he had been touring the Rocky Mountain area. His interest together with his authority and prestige, raised the study of the problem from the status of a local curiosity to that of an investigation meriting the earnest concern of all dental research workers. Black's histological findings were published in a paper entitled, 'An endemic imperfection of the enamel of the teeth heretofore unknown in the literature of dentistry'.

In 1912, McKay found an article written by Dr. J. M. Eager in 1902 reporting the unusual

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occurrence of brownish colored stains among majority of the residents in Naples. Eager had termed these brownish discolorations as "denti di chiaie". This further broadened McKay's curiosity about mottled enamel he discovered in the Colorado springs.

In the year 1916, McKay along with Dr. G. V. Black conducted studies on individuals living in 26 different communities in various parts of USA and they concluded that an unidentified factor was responsible for the mottling of enamel. They assumed that this unknown factor might have been present in the water consumed by the individuals during the period of tooth calcification. McKay and Black established their assumption when they came across similar enamel mottling among the residents of Britton. The water supply of Britton was changed from shallow wells to deep wells after 1898 and those people who were born prior to 1898 had normal appearance of teeth while those born after 1898 had enamel mottling. In 1918, McKay confirmed the presence of an unknown element in the water supply to be the definite causative factor for enamel mottling. Similar findings were reported in Bauxite with regard to the change in water supply from shallow wells to deep wells. The children born in Bauxite after 1909, when the water supply was changed to deep wells from shallow wells, exhibited enamel mottling.

In the year 1931, Churchill H. V., a chemist employed with an aluminium company, Alcoa (Aluminium Corporation of America) in New Kensington, Pennsylvania identified the presence of fluoride in excessive amounts in water samples from Bauxite, through spectrographic analysis. Churchill identified fluoride levels ranging from 13 ppm to 17 ppm in Bauxite water. McKay asked Churchill to analyse water samples collected from other areas with enamel mottling. The analysis on the samples indicated a high level of fluoride content in the water. Thus after thirty years in 1931, the element fluoride was identified as the "mysterious factor" responsible for mottled enamel. Fluoride was established as the causative factor for mottling of enamel through the historical studies conducted by Trendley H. Dean, known as the "Shoe Leather Survey".

In 1931, U. S Public Health Service appointed Dr. Trendley H Dean to continue the work of McKay in determining the extent and severity of mottled enamel. Dean conducted a survey among 22 cities in ten states of USA on a total population sample of 5,824 children and gave the following report on mottling of enamel at various concentrations of fluoride.

1. A high concentration of fluoride in water is directly related to the severity of enamel mottling.
2. Enamel mottling was widespread in areas with water having fluoride content of 3 ppm.
3. Mottling with discrete pitting of enamel was noticed at fluoride levels of 4 ppm.
4. Mottling was less in case of fluoride levels of 2.5 ppm to 3 ppm, with a dull chalky white appearance of teeth.
5. No mottling or any other enamel changes were observed in areas with water containing 1 ppm fluoride.

Dr. Trendley H. Dean made a thorough documentation of the degree of mottled enamel and degree of caries at different concentrations of fluoride in order to permit reliable statistical analysis. The surveys conducted by Dean took him all over the United States, and it became obvious that large reductions in caries incidence were associated with the occasional appearance of enamel opacities that were in no way disfiguring. The term mottled enamel gave way to the more exact term dental fluorosis. Thus in 1934, Dean developed a standard system for classification of dental fluorosis the "mottling index" (Dean's Index for fluorosis).

Another characteristic feature observed was

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that mottled enamel did not develop dental caries compared to normal enamel, which was highly susceptible to caries.

In 1942, the important milestone discovery was made by Dean et al that at 1 ppm F in drinking water, a 60% reduction in caries experience was observed.

In 1945, the world's first artificial fluoridation plant was started at Grand Rapids, U.S.A.

In 1969, WHO advocated that 1 ppm of fluoride in community water supplies was a practical and effective public health measure.

Thus, fluoride was identified as the essential element for reducing dental caries and this led to the introduction of various methods of topical application of fluorides for individuals and water fluoridation projects for communities.

Fluoride level in India

In India, areas with high fluoride minerals are extensive. The main fluoride bearing areas are Gujarat, Rajasthan and Andhra Pradesh where about 50-100% of the districts are affected. Only about 10-30% districts are affected in the states of Jammu & Kashmir, Kerala, Chhatisgarh and eastern India. Besides these areas, fluoride is also found in some areas of Karnataka, Bihar, West Bengal, Punjab and North West Himalayas.

According to the National Epidemiological Oral Health Survey & Fluoride Mapping of the Dental Council of India (2002-2003), the overall fluorosis prevalence in the country was found to be very low. The `moderate' and `severe' form of fluorosis was present in less than one per cent of the population in all the age groups. Even `very mild' or `mild' forms of fluorosis did not appear in more than 5.1 per cent of the population in 12 and 15 year age-groups and was even lower in adults.

FLUORIDE IN THE ENVIRONMENT

Fluoride enters the atmosphere by volcanic action and by the entrapment of soil and water particles due to action of wind on these surfaces. It is returned to the Earth's surface by deposition as dust or in rain, snow and fog. Fluoride enters the hydrosphere by leaching from soil and mineral into ground water and by entry into surface water. Fluoride enters vegetation by uptake from soil and water, by absorption from air and by deposition from atmosphere. It returns to soil through plant wastes or may enter the food chain. Fluoride may enter these pathways directly or indirectly from a variety of industrial processes including grinding, drying and calcining of fluoride containing mineral. The principal industries with a potential for appreciable fluoride release include coal burning, power generation plants, the production of aluminium, steel, phosphate fertilizers and phosphoric acid and the manufacture of glass, ceramic and brick products.

Lithosphere

Fluorine rarely occurs as such in nature but is present as inorganic fluoride. Concentrations are increased in highly siliceous igneous rocks, alkalic rocks in geothermal waters and hot springs and in volcanic gases and fumaroles. There are more than 50 fluoride containing minerals, many of which are silicates.

Fluoride is widely distributed in the Earth's crust where it averages 300 ppm and constitutes about 0.087% of its weight.

Average fluoride concentrations in several types of rock are,

Felsic	800 ppm
Intermediate	500 ppm
Mafic	370 ppm
Shale	590 ppm
Sand stone	290 ppm
Carbonate	330 ppm

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Fluoride concentration in the first several inches of soil ranges from 20 to 500 ppm; in deeper soil, the level increases. Some soil as in Idaho or Tennessee USA, contain high concentrations of fluoride in the 3,800 to 8,300 ppm range.

Heavier soils tend to have substantially higher concentrations of fluoride than sandy soils. Fluoride enters the soil through weathering of rocks, precipitation and impure water, mainly from waste run off and fertilizers.

Biosphere

The normal level of fluoride in plants is about 2-20 mg/g of dry weight. Leafy vegetables such as cabbages, lettuce and brussels sprouts contain about 11-26 mg fluoride on a dry weight basis. About 90% of the weight of vegetables is water. Washing leafy vegetables reduces the intake of fluoride by about 1/3 to 1/2. Plants grown in acidic soils have a higher fluoride content than those grown in lime- containing, basic soils.

A few species of plants actively accumulate high concentration of fluoride like tea plants, for which concentrations of several hundred ppm have been reported. Vegetation growing in the vicinity of industrial releases of fluoride may show elevated fluoride concentration, as in the case of aluminium smelters.

The concentration of fluoride in various animal food products is approximately in the same range as that in plants, with the exception of dried fish. Sardines, Salmon, Mackerel and other fish contain about 20-40 ppm of fluoride on a dry weight basis. The high fluoride level in fish is attributed to the fluoride in the skins and in bones.

Hydrosphere

Due to the universal presence of fluorides in the earth's crust, all water contains fluorides in varying concentrations. Fluorides are present in trace quantities in all surface and underground waters.

Concentration of fluoride in water varies not only from place to place but also within the same locality. Water with high fluoride content are found at the foot of high mountains and in areas with geological deposits of marine origin.

Typical examples are geographical belt from the Arab republic through Jordan, Egypt, the Libyan Arab Jamahiraiya, Algeria, Morocco and Rift valley. Another belt stretches from Turkey through Iraq, the Islamic Republican of Iran and Afghanistan to India, Northern Thailand and China.

The concentration of fluorides is negligible in rainwater. Rain water contributes fluoride to the ocean as well as the land and fresh water because it absorbs the halogen from the atmosphere. In India, relatively high concentrations of fluoride have been reported in the rain water over the industrial area of Calcutta.

In general, the concentration of fluoride in uncontaminated surface water hardly exceeds 1 ppm, but rivers receiving effluents from industries have much higher values. The industrial effluents containing fluoride are smelting operations, fertilizers, aluminium, plastic, steel, etc.

The fluoride content of water obtained from rivers, lakes, or artesian wells is for the most part below 0.5 mg/kg even though concentrations as high as 95 mg/kg have been reported as found in Tanzania. In lake water, the highest fluoride value ever recorded is 2800 ppm in lake Nakuru, in the rift valley located in volcanic areas of Kenya. The soil at the lake shore contained up to 5600 mg of fluoride per kg, and the dust in the huts of local inhabitants contained 150 mg/kg.

Sea water contains 1.2 to 1.4 mg/kg of fluoride. Concentration of fluoride may be enhanced locally by undersea volcanic activity as in the Pacific Ocean. The total oceanic reservoir of fluoride was estimated to be 1.781×10^{12} metric tons and is chiefly removed by incorporation into phosphates

3289

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and carbonates by life forms. The average residence time for oceanic fluoride was calculated to be 2 to 3 x 10^6 yrs.

Atmosphere

Fluoride emissions are heaviest in the vicinity of industries involved in the production of aluminium from cryolite, phosphate fertilizers, fluorinated hydrocarbons, plastics, uranium and other heavy metals and hydrogen fluoride.

Ordinarily, in large cities, 1 cubic meter of air on an average, contains less than 0.05 mg of fluoride but significantly high values have been recorded in some industrialized areas. Eg: It has been found that 1 cubic meter of air near an Italian aluminium factory surrounded by lofty mountains contains 15-18 mg of fluoride where a person normally inhales up to 0.8 mg fluoride per day.

SOURCES OF FLUORIDE

It is estimated that the intake of fluoride from fish by populations where fish represents a significant portion of the diet is about 0.5 mg/day. Fish products, in particular canned fish such as salmon and sardines have a fluoride content of up to 20-40 mg/kg. The meat of fish is relatively low in fluoride content (2-5 mg/kg) as compared with fish protein concentrates, which may contain up to 370 mg/kg.

Jowar, banana, potatoes also contain substantial quantities of fluoride. Certain plants, such as taro, yams, and cassava, have been found to contain relatively high fluoride levels.

The fluoride content of rock salt ranges between 40 and 200 ppm. Under the severe climate of India, this form of salt may be consumed at maximum intakes of 20g daily. This could supply between 1 and 4 mg fluoride to the daily diet in India, which could contribute to the endemic fluorosis, seen in some parts of India.

The dried tea leaves contain 100-400 ppm fluoride, depending on the brand. Fluoride is rapidly released into tea infusions, most of it within 5-10 minutes. The ingestion of fluoride by tea drinkers is in the range from 0.04 to 2.7 mg/day. Tea made from instant tea powder results in almost twice as much fluoride in the extract as in regular brewed tea. If fluoridated water is used for brewing, the fluoride concentration of the beverage, consequently will be higher.

Fluoride is also present in organic combination in certain compounds used as drugs and general anesthetics, which in vivo may release ionic fluoride. These include fluorine containing Benzothiadiazines used as diuretics, fluorosteroids and Phenothiazines and Fluorobutyrophenones used as tranquillizers; methoxyflurane, enflurane and halothane used as anesthetics.

The fluoride concentration in various foods reflects the fluoride concentrations in the water used in food processing. Mineral water usually contains considerably higher concentration, from 1.5-7 ppm, depending on the geological location of the source. Water, naturally or artificially fluoridated, is the most important single source of fluoride. When 1 litre of fluoridated water containing 1 ppm F is consumed, most of the fluoride is absorbed, whereas only about 1/3 to 1/2 of fluoride in foods is assimilated.

Estimated daily intake of fluoride

Although the daily intake of fluoride in individuals vary from country to country, an average daily intake of fluoride from dry food substances is in the range of 0.2 to 1.8 mg and the average daily intake from water containing 1 ppm fluoride is about 1.5 mg, the total daily intake for adults being in the 1.7 - 3.3 mg range. The total fluoride intake in children is about 0.7 mg/day for the younger, bottle fed group of children and about 1.3 mg fluoride/day for the 12 year old group.

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In infants, the feeding pattern i.e.; breast milk or formula feeding determines the daily fluoride intake. Fluoride concentration of human milk ranges from 5-10 µg/L. These levels are found in nursing mothers living both in non-fluoridated and fluoridated areas. Assuming that the infant consumes 0.15 lt/ kg/ day of human milk, he will obtain about 1µg/ kg/ day from this source. The fluoride intake in formula fed infants is mainly determined by the fluoride concentration of the water used. Cow's milk contains 30-60 µg/L of fluoride.

METABOLISM Of FLUORIDE

The metabolism of fluoride is through absorption, distribution and elimination. Blood plasma is considered the central compartment into which fluoride must pass for its subsequent distribution and elimination. Approximately 50% of the ingested fluoride will be excreted in the urine and most of the remaining will be taken up by mineralized tissues. Fluoride is reversibly bound in these tissues and released during normal remodeling of bone or following changes in daily fluoride exposure. In soft tissues, there is a steady state distribution between the intra and extracellular fluids because of which, when the plasma fluoride level changes, there is a proportional and parallel change in the intracellular fluids. The major route of fluoride elimination is the kidney.

Absorption

The absorption of most water-soluble fluoride compounds is rapid and almost complete and occurs mainly in the stomach. It is also absorbed via lungs and intestine. Absorption is passive in nature and no active transport mechanism is found to be involved. There is a detectable rise in the plasma fluoride concentration within minutes after fluoride is swallowed. The maximum plasma concentration of fluoride following the oral intake of fluoride on a fasting stomach is reached within 30 minutes. When fluoride is taken in conjunction with food, the degree and rate of absorption will decrease.

The main factors influencing absorption are

- Species variation
- Concentration of fluorides ingested
- Solubility and degree of ionization of the compounds (rate of absorption is inversely related to gastric acidity)
- Other dietary constituents such as calcium which may form insoluble salts with fluoride.

In the intestine, there is enormous reserve capacity for absorption due to the larger surface area which is increased by folding, finger like villi and each epithelial cell is covered by innumerable microvilli which increases the surface area considerably.

Absorption from dental preparations

The fluoride for topical application, is almost completely absorbed when swallowed. The bioavailability of fluoride from Sodium fluoride (NaF) or Stannous fluoride (SnF2) dentifrices is close to 100%. Fluoride from Acidulated Phosphate Fluoride (APF) is also well absorbed. Calcium containing abrasive system would reduce the rate and the degree of absorption.

Fluoride varnish remains on the tooth surface for upto 12 hours. Some of the fluoride diffuses into saliva and is swallowed and a very modest increase in plasma fluoride concentration is observed.

Small children may swallow various amounts of toothpaste during brushing, with ingested fluoride ranging from a tenth of a milligram upto 2 milligrams. Since most of the fluoride from a dentifrice is absorbed and distributed to the blood, the ingestion of fluoride dentifrice among small children should be kept to a minimum.

Fluoride in blood plasma

Since plasma is the biological fluid into which

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and from which fluoride must pass for its distribution and elimination, it is called the central compartment. Central compartment comprises of plasma, bone and well perfused tissues such as heart, kidney and liver. The peripheral compartment is formed by poorly perfused tissues like the skeletal muscle and adipose tissue.

Fluoride in plasma exists in the form of,

- Ionic fluoride (inorganic or free fluoride)
- Non-ionic fluoride (bound fluoride)

They are together called total plasma fluoride.

The ionic fluoride is of public health significance. It varies according to the concentration of fluoride in the drinking water. Its plasma concentration is approximately twice as high as that associated with the blood cells. Since plasma fluoride levels are not homeostatically regulated, there is no normal physiologic concentration. Plasma fluoride level expected in a healthy, fasting, long-term resident of a community with a water fluoride level of 1 ppm is approximately 1 μM (0.019 ppm). There is evidence that plasma fluoride levels increase slightly with age.

Pharmacokinetics of fluoride

A pharmacokinetic analysis of the plasma fluoride concentration curve, after intake of a single dose of fluoride will quantitatively describe the cumulative influence of the various metabolic processes and give important information about the kinetics of fluoride in the human body.

By plotting the plasma concentration of fluoride as a function of time on a semi logarithmic scale, three exponential phases can be distinguished:

- An initial increase,
- Followed by a rapid fall for about 1 hour (The early phase/distribution phase-α phase)
- Thereafter a slower decline (Representing the elimination phase - β phase)

The initial increase represents the absorption of fluoride from the gastro intestinal tract into the blood. When the plasma peak is reached, the absorption decreases and distribution from the blood to the tissues increases.

During the α phase, distribution to soft tissues primarily determines the rapid decline in plasma fluoride concentration. Fluoride is rapidly distributed to well perfused tissue such as heart, kidney, liver and because fluoride is a mineralized tissue seeker, to bone. It is more slowly distributed to poorly perfused tissues such as skeletal muscle and adipose tissue. The fluoride concentration increases in the peripheral compartment until a steady state is achieved. Since fluoride is continuously eliminated from the central compartment , there is a flux of fluoride from the peripheral to the central compartment.

The curve then enters the β phase, in which the curve is monotonic, but with a less pronounced slope compared to α phase. This decline reflects the plasma half life of fluoride (4-10 hrs) which is the time required for the plasma fluoride concentration to fall by one - half .

DISTRIBUTION

Fluoride in soft tissues

Distribution rate is generally determined by the blood flow to the tissue. Steady rate fluoride concentrations are achieved more rapidly between plasma and well perfused tissues such as heart, lungs and liver.

Plasma fluoride concentration ratio falls between 0.4 and 0.9 regardless of the rate at which the steady state level is achieved. Some exception to this range include the kidney, brain and adipose tissue. Fluoride is concentrated to high levels within the kidney tubules, so that taken as a whole, kidney has a higher concentration than that of plasma. The blood brain barrier is effective in restricting the passage of fluoride in the Central Nervous System, where the fluoride concentration is only 20% that of plasma. The

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amount of fluoride in the pulp is 100-650ppm.

Fluoride in bone

Fluoride is a mineralized tissue seeker. Approximately 99% of all the fluoride in the human body is found in calcified tissues. During active bone formation, when crystals are growing, the overall rate of fluoride uptake is high. There is also a correlation in individual bones between metabolic activity and fluoride uptake. Thus the metabolically active metaphyseal cortex and periosteal bone take up more fluoride than the mid cortical compact bone. In general, cancellous bone incorporates more fluoride than the cortical compact bone.

Fluoride is reversibly bound to bone. Not all the fluoride absorbed by bone is firmly held and loss may occur partly due to back exchange between fluoride of the surface of the apatite crystal and ions in the hydration shell or tissue fluids and due to physiological resorption of bone during the periods of development, remodelling and senile osteoporosis.

There are 2 phases of fluoride removal from the skeleton.

1. A rapid process of the order of weeks, probably involving ionic exchange.
2. Slow removal, taking years, due to osteoclastic resorption of bone.

Accretion: is a process where most of the fluoride is buried within the mineral crystallites during the period of crystal growth. Being built onto the crystal as it forms, such fluoride is quickly buried and will remain locked in the lattice interior for as long as the crystal exists. A decrease in carbonate content is generally found in highly fluoridated bone and tooth mineral, due to direct substitution of carbonates by fluoride.

Fluoride in saliva

There are 2 major sources of salivary fluoride.

1. Secretion from salivary glands

   The level of fluoride secreted by the glands is very low and in the range of 0.007 to 0.05 ppm. Adults seem to have slightly higher levels than children. Resting saliva has slightly more fluoride than stimulated saliva.

2. Introduction into the mouth from food, water and fluoride preparations such as dentifrices and topical application procedures such as fluoride rinses, dentifrices and chewing fluoride tablets, all have been found to increase the fluoride concentration of saliva, more than the ingested fluoride.

Eg. A 10 mg dose of fluoride will increase parotid fluoride levels from a normal value of 0.02 ppm F to about 0.28 ppm F. Five minutes after the application of APF solution whole saliva was found to contain approximately 100 ppm F.

Fluoride in enamel

(Amount of fluoride in the outer enamel is 2,200 - 3,200 ppm)

Developing enamel:

During early stages of development, there is a small but detectable background level of fluorides and if relatively high concentrations of fluoride are administered in diet or drinking water, the small crystallites in this region take up fluoride readily. The enamel is porous. The porous enamel appears to absorb fluoride preferentially and a fluoride peak or at least a zone of relatively high fluoride enamel is usually found just before the enamel begins to mineralize rapidly.

Erupted enamel :

Fluoride distribution is not uniform across the thickness of enamel. Even in the incompletely mineralized state, the accumulation of fluoride by enamel seems largely restricted to the surface region and the fluoride concentration is therefore always relatively

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high at the enamel surface compared with the interior.

Fluoride concentration also varies systematically from place to place in the tooth surface and the pattern changes with age. In newly erupted teeth, the surface fluoride concentrations were found to be the highest in the first formed enamel near the incisal edge and decreased steeply towards the more recently formed cervical region. In older teeth, this pattern is inverted due to wear. Acquisition of fluoride by the enamel surface appears to continue at a perceptible rate as long as the tissue remains porous. Fluoride interferes with the process of maturation, thus prolonging the length of time during which the enamel is porous and therefore will extend the period of rapid fluoride uptake.

Penetration of fluoride into fully mineralized enamel is very slow. Fully mineralized enamel has a density of 2.98 gm/ml with a porosity as low as 0.1% space by volume. In fully matured enamel, the creation of porosity or destruction of the apatite lattice is necessary before the concentration of fluoride in highly mineralized enamel can be significantly increased. This happens when the solutions, gels or pastes, containing concentration of fluoride from 1000-10,000 ppm are applied to the tooth surface at low pH. Enamel defects such as open carious lesions, incipient caries (white spots), microcracks, hypomineralized areas, and the margins of some restorations acquire larger amounts of fluoride than sound enamel because of their greater porosity and surface.

Fluoride in dentin

(Amount of fluoride in the dentin is 200-300 ppm)

Dentin and cementum have collagenous matrices. The apatite crystallites are considerably smaller than those of enamel and their surface area and their capacity to take up fluoride is consequently much larger. The fluoride concentration is more in dentin than in enamel.

In permanent teeth, the average concentrations of fluoride in dentin, appear to increase upto the age of 40. The concentration is highest at or near the surface limits of the tissue in the pulpal surface. Fluoride concentration tends to be low in secondary dentin, although, the newly formed tissue avidly absorbs fluoride, it has relatively little time to accumulate the element.

The distribution pattern of fluoride in the primary dentition is complicated by the process of physiological resorption, which occurs at the pulpal surface prior to exfoliation. Deciduous exfoliation is brought about by the osteoclasts which preferentially remove the high fluoride dentin near the pulpal surface and this continues until the tooth exfoliates. The fluoride concentration in the pulpal surface of deciduous dentin rises during the period of root formation and falls during the period of resorption. The greatest rise and fall in fluoride concentration is found in the pulpal surfaces of multirooted teeth.

Fluoride in cementum

(Amount of fluoride in the cementum is 4,500ppm)

The concentration of fluoride in cementum is higher than that of any skeletal or dental tissue. This is because, the tissue is very thin and all of it is therefore, near to the tissue surface and so accessible to the fluoride present in blood. Fluoride concentration generally decreases from surface to interior. Total fluoride content in cementum increases with age.

A detailed study of fluoride variation in the cementum shows that maximum fluoride concentration does not always occur in the most superficial outer layer, because as with dentin, the most superficial cementum has not had time to accumulate significant

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amounts of the element, having been recently and perhaps rapidly deposited.

Fluoride and dental plaque

Fluoride content in plaque ranges from 15 - 64 ppm. The ionic fluoride activity of neutral plaque is between 0.08 and 0.8 ppm and is too low to inhibit the metabolism of plaque bacteria.

However, when the plaque is acidified, either by adding acid in vitro or resulting from bacterial metabolism in vivo, fluoride ions are liberated from bound forms and about 30% or more of the total may be free (ionized). It seems likely, therefore that plaque fluoride acts as a reservoir for the ionized form, as the pH drops and favors remineralization as well as inhibits bacteria.

Plaque fluoride originates from prolonged day to day contact with the low levels of fluoride in the saliva and gingival fluid. Plaque fluoride is also higher in persons consuming fluoridated water. Firmly bound fluoride in plaque is more stable than fluorhydroxyapatite. Plaque matrix may be involved in the concentration of fluoride in plaque. This matrix contains numerous charged groups both on the bacterial surfaces and in the intermicrobial matrix and these represent an ion exchange system, with very high capacity, lending itself to concentrating and binding of fluoride from saliva diffusing through plaque.

When plaque is exposed to high concentration of fluoride, calcium fluoride is formed. It is slightly soluble in water and in buffers and in 0.5m perchloric acid but dissolves in strong mineral acids. The fact that calcium fluoride can be easily formed in the plaque matrix during topical use of fluoride and that the fluoride deposited in plaque has the solubility properties of calcium fluoride , indicates that calcium fluoride may be a major source of fluoride in dental plaque. The solubility of calcium fluoride in saliva was calculated to be about 12-15mg/litre. A rapid loss of calcium fluoride formed on the tooth surface may occur considering that 1 litre of saliva flows continuously through the oral cavity.

At a neutral pH, a solubility resistant layer is formed on the calcium fluoride particles. The loss of calcium or fluoride from such particles is low. When pH drops, the solubility reducing layer is lost and fluoride and calcium are released in a normal way. When pH rises, a solubility reducing layer is again formed. Plaque contains higher levels of fluoride than saliva, showing that it is capable of concentrating and retaining it by means of combination with inorganic or organic materials. Although, only a small amount of fluoride in the aqueous phase of plaque is in a free ionic state (0.1-1 ppm), much more is released (1-5 ppm) when the pH is lowered to levels found during caries formation.

Distribution to the foetus

There are different views regarding the passage of fluoride across the placenta. Some authors have said that placenta acts as a complete barrier to fluoride, others have said that it is only partial. Some have said that the placenta only acts as a barrier when there is a sudden increase in the maternal plasma fluoride level.

EXCRETION OF FLUORIDES

Fluoride is excreted in urine, lost through sweat, and excreted in the faeces. It also occurs in traces in breast milk, saliva, hair and tears. About 10 - 25 % of the daily intake of fluoride is not absorbed and is excreted in the faeces.

Renal clearance of fluorides

The chief organ of excretion of fluoride is the kidney, which performs this task in an efficient manner. The net mechanism of fluoride excretion in the kidney is through glomerular

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filtration and the rather limited ability of renal tubules to reabsorb it. The mechanism involved is simple passive diffusion.

The renal clearance rate of fluoride ranges from 30 - 50 ml per minute. The renal clearance of fluoride is directly related to urinary pH and, under certain conditions, to urinary flow rate. High urinary flow and an alkaline urine will result in a rapid clearance of fluoride from plasma while a low urinary flow and an acidic urine will result in a slower renal elimination rate of fluoride. In case of chronic renal failure, there will be increased plasma and bone fluoride levels. The normal kidney will eliminate about 50% of the fluoride which is presented to it by glomerular filtration.

About 30% of fluoride is excreted in 6 hours and in 24 hours, 60% of the fluoride is excreted.

Excretion via breast milk and saliva

Fluoride concentration of colostrum and mature breast milk is reported to be the same, about 0.4 µM. There is no diurnal variation in the fluoride concentration.

Excretion via faeces and sweat

These routes of excretion of fluorides are of less quantitative importance. Fluorides with a low solubility and therefore low absorption are excreted via the gut. Under conditions in which intake of fluorides was 0.4 - 0.6 mg in food and water per day, the fecal excretion was about 8% in relation to total intake and about 10% of the urinary output.

The concentration of fluoride in sweat is in the range of 0.067 - 0.5 ppm under normal conditions of intake. Excretion of about 15-50% of ingested fluoride in perspiration at elevated temperatures has been recorded.

ESTIMATION OF FLUORIDE CONCENTRATION

Collection of sample

Both stimulated and unstimulated saliva only should be collected for analysis, since most constituents of saliva vary with flow rate. The stimulus used may be mechanical (Eg: chewing inert wax) or use of citric acid. The flow rate of saliva also exhibits circadian rhythm. If the concentration of fluoride in saliva derived only from the systemic source is to be estimated, then the salivary secretions must be collected directly from the gland ducts. This is done using Carlsson - Crittend or Lashy device or by direct canulation. If the concentration of fluoride in saliva after enhancement from locally dissolved dietary or therapeutic sources is to be estimated, then whole saliva must be collected. Microorganisms and desquamated epithelial cells contaminate whole saliva. Separation by centrifugation of these cellular components is customary before analysis.

Fluoride analysis

Ionic fluoride : commonly used method for estimation is the fluoride - specific ion electrode. Ionic fluoride has also been measured by isotachophoresis and ion chromatography at about the same level of sensitivity as the micro methods, using the ion selective electrode.

Bound fluoride : The bound fluoride should be made free to ionic state before final measurement. Various analytical procedures, including distillation, wet and dry ashing and acid extraction have been used.

Method of fluoride analysis in food

The method for analyzing fluoride in water and beverages is performed by potentiometric measurements with the aid of a fluoride ion specific electrode. Measurements of fluoride in solutions can usually be made directly by adding an acetate buffer. This method can also be used in connection with analysis of fluoride in biological samples such as bone, teeth and urine.

Fluoride analysis of food has been a difficult

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problem for many years. During the 60's and early 70's, colorimetric methods were routinely used, but resulted in great over estimations of the fluoride content, which was due to interfering substances during the analytical procedure.

Other methods used are perchloric acid diffusion or similar diffusion, but from ashed samples. Silanol extraction after ashing in a closed oxygen bomb is also being used. These methods have given conflicting results for the fluoride concentration in certain food items.

At present the most reliable method for fluoride analysis in foods, seems to be the microdiffusion technique described by Taves(1983). It involves one day diffusion at 25°C with hexamethyl-di-siloxane (HMDS) into 0.1 ml of 0.65 M sodium hydroxide, which then is dried down and added to 0.5 ml of 0.66 M acetic acid. This solution is then applied to the fluoride electrode.

MECHANISM OF ACTION OF FLUORIDES

The benefits of fluoride in the reduction of dental caries have been known for years, but its exact mechanism of action is not completely understood. The mechanisms by which fluoride increases caries resistance may arise from both systemic and topical applications of fluoride. A number of proposed mechanisms have been identified which are assumed to work simultaneously and can be grouped as follows;

1. Increase enamel resistance (or) Reduction in enamel solubility
2. Increased rate of posteruptive maturation
3. Remineralization of incipient lesions
4. Interference with plaque microorganisms
5. Modification in tooth morphology

1.Increased enamel resistance / Reduction in enamel solubility

It has been well established that dental caries involves dissolution of enamel by acids from bacterial plaque and that dissolution is inhibited by the presence of fluoride. Because fluoride forms fluorapatite, which is a less soluble mineral, it has been thought that the anticaries effect of fluoride is the result of reduced solubility.

The dissolution of enamel during a caries attack is a complicated process. When enamel is exposed to a pH of about 5.5 or lower, it will dissolve. This ordinarily occurs beneath a bacterial plaque. The concentration of calcium, phosphate and other ions in the solution will increase. When the plaque stops producing acid, the pH rises and the dissolved minerals get precipitated. Thus, carious dissolution of enamel is a cyclic phenomenon consisting of phases of demineralization and re-precipitation. The presence of fluoride reduces the solubility of enamel by promoting the precipitation of hydroxyapatite and phosphate mineral.

When hydroxyapatite is exposed to low fluoride concentrations (about 1 ppm) a layer of fluorapatite forms on the hydroxyapatite crystals. This thin layer governs the rate of dissolution.

Fluoride inhibits demineralization in several ways,

- by reducing bacterial acid production and acidurance
- by reducing the equilibrium solubility of apatite
- by the fluoridation of apatite crystal surfaces reducing the dissolution rate whether or not there is reduced solubility of the bulk mineral.

On available evidence the last seems to be the most important effect.

2.Increased rate of posteruptive maturation

The greatest importance of fluoride to the maturation process lies in its ability to increase the rate of mineralization of hypomineralized areas. Newly erupted teeth often have hypomineralized areas that are

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prone to dental caries. In addition, the entire enamel surface is at its maximum degree of susceptibility to caries as soon as it appears in the mouth. Fluoride increases the rate of mineralization, or post eruptive maturation of these areas. Organic material is also deposited into the enamel surface to further increase its resistance to dental caries. Both mineral ions and organic material are deposited from the saliva. A less soluble tooth that is more resistant to acid attack and less prone to caries is formed.

Posteruptive maturation and remineralization are similar but they differ in one way. Posteruptive maturation involves deposition of minerals into hypomineralized areas, while remineralization involves deposition of minerals into demineralized areas. Remineralization does not occur without demineralization

3.Remineralization of incipient lesions

Fluoride also plays a critical role in reducing dental caries by enhancing remineralization. Remineralization, the deposition of minerals into previously damaged areas of the tooth is a dynamic process that results in reduced enamel solubility. This increase in enamel resistance is achieved through the growth of crystals which become larger than those in either demineralized or sound enamel. These larger crystals are more resistant to acid attack.

The most effective remineralizing solution contains fluoride in combination with calcium and phosphate ions. In the mouth, these calcium and phosphate ions come from two sources, the saliva and the tooth mineral dissolved during demineralization.

The composition of remineralized enamel is different from normal enamel and may vary according to conditions employed to produce the remineralization. In the case where stannous fluoride is used, tin compounds may be deposited in the lesion.

Fluoride enhances the rate of remineralization from calcium phosphate solutions. Remineralization of white spots is increased two-fold. However, very large amounts of fluoride in calcium phosphate solutions may actually inhibit remineralization, by formation of calcium fluoride, which prevents hydroxyapatite crystal growth.

4. Interference with microorganisms

Fluoride has been known to inhibit bacterial enzymatic processes involved in carbohydrate metabolism. Fluoride interferes with oral bacteria in two ways.

- In high concentrations, fluoride is bactericidal. This is probably how fluoride helps reduce plaque.
- In lower concentrations, fluoride is bacteriostatic. It helps control the growth of bacteria without destroying them. Fluoride lodges in plaque and inhibits bacterial enzymes responsible for acid metabolism.

Pertinent to the uptake of fluoride into bacterial cells is the difference in pH between the external medium and the intracellular cytoplasm -"Fluoride pH effect". When the external pH becomes more acidic, the pH gradient will increase. As fluoride diffuses into cells as hydrofluoric acid, its concentration also increases as the pH falls and consequently more hydrofluoric acid is available for cellular uptake. Hydrofluoric acid uptake will continue until the hydrofluoric acid concentration in the external and internal compartment is equal. The greater the difference in pH, the more fluoride will be taken up by the cells.

In vitro effects of fluoride on oral bacteria:

Studies done on streptococcus mutans indicate that the following are inhibited by fluoride:

- Enolase and therefore the transport of glucose involving the PEP (Phospo-Enol-

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Pyruvic acid) phospo transferase system. Enolase is highly sensitive to fluoride inhibition and may be partially inhibited by 0.5-1 ppm fluoride.

- Bacterial phosphatases which are involved in degradation of sugar phosphates.
- Cation (potassium) transport which is closely associated with carbohydrate metabolism.

These inhibitory mechanisms are affected by the hydrogen ion concentration of the plaque fluid. A decrease in pH, results in a greater inhibitory action on bacterial carbohydrate metabolism.

Saliva can serve as a source of fluoride for the plaque and therefore may affect both salivary and plaque organisms.

5. Modification in tooth morphology

There is a direct relationship between the amount of fluoride ingested during tooth development and the incidence of dental caries. If fluoride is ingested during tooth development, there is some evidence to suggest the formation of a more caries resistant tooth slightly smaller with shallow fissures.

The diameters and cusp depths of teeth are smaller if fluoride is present during tooth development. Such changes in morphology would tend to decrease the caries susceptibility of teeth by making them more self cleansing. The reduced level of occlusal caries found in fluoridated areas may be partly attributed to the improved morphology of the occlusal surface.

FLUORIDE DELIVERY METHODS

Fluoride can be delivered either as,

1. Topical fluorides

Topical fluorides are placed directly on the teeth. Some preparations provide a high concentration of fluoride over a short period of time. Other preparations, such as dentifrices provide continuous low concentration of fluoride to the teeth. Topical fluoride allows for the interaction of fluoride with minerals in the teeth.

2. Systemic fluorides

They circulate through the blood stream and are incorporated into developing teeth. They provide a low concentration of fluoride over a long period of time.

Some fluoride preparations provide both systemic and topical effects. For example when fluoride oral rinse supplements are used, they are swished for a topical effect and swallowed to provide a systemic effect.

TOPICAL FLUORIDES

By definition the term "topically applied fluorides" is used to describe those delivery systems which provide fluoride for a local chemical reaction to exposed surfaces of the erupted dentition. The delivery systems include measures designed for professional application in the dental office, such as fluoride - containing prophylactic pastes, solutions, gels and varnishes, as well as systems designed for unsupervised home use, such as fluoride dentifrices and rinses.

Indications for topical fluoride use,

1. Caries - active individuals (defined as those with past caries experience or those who develop new carious lesions on smooth tooth surfaces).
2. Children shortly after periods of tooth eruption, especially those who are not caries free.
3. Those who take medication that decrease salivary flow or have received radiation to head and neck.
4. After periodontal surgery when roots of teeth have been exposed.
5. Patients with fixed or removable prosthesis and after placement or replacement of restorations.
6. Patients with an eating disorder or who are

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undergoing a change in life style which may affect eating or oral hygiene habits conducive to good oral health.

7. Mentally and physically challenged individuals.

The choice of topical fluoride for each patient should depend on age, education, oral health habits and physical dexterity.

Topical fluoride products can be divided into 2 broad categories.

1. Professionally applied products

   Professionally applied fluoride products are those medicaments typically dispensed by dental professionals in the dental office and usually involve the use of high fluoride concentration products, ranging from 5000 and 19000 ppm, which is equivalent to 5-19 mg F/ml.

2. Self applied products

   Self-applied fluoride products are usually bought and dispensed by the individual patient but at the recommendation of a dental personnel. These products include fluoride dentifrices, mouthrinses and gels and typically are low fluoride concentration products ranging from 200 to 1000 ppm or 0.2 - 1.0 mg fluoride/ ml.

PROFESSIONALLY APPLIED TOPICAL FLUORIDES

Bibby in 1942 was the first to demonstrate that the repeated application of sodium or potassium fluoride to teeth of children significantly reduced their caries prevalence. This finding was the forerunner of numerous studies designed to test the effectiveness of various topical agents and the best mode of applying them to teeth.

Topical fluoride application by a dentist, hygienist or other dental auxiliary has become an established caries - preventive procedure in the dental office. The three agents currently in use are neutral Sodium Fluoride (NaF), Acidulated Phosphate Fluoride (APF) and Stannous Fluoride (SnF2).

The fluoride may be used in an aqueous solution, a viscous gel, a prophylaxis paste or as a dental varnish and can be applied using the paint on technique or the tray technique.

Rationale for using topical fluoride agents

The rationale for using topical - fluoride agents is to speed the rate and increase the concentration of fluoride acquisition above the level, which occurs naturally. If an individual's only exposure to fluoride post-eruptively is in drinking water, it may take years before surface enamel acquires an effective concentration. Topical fluoride hastens this process. Since immature and porous enamel acquires fluoride rapidly and since the enamel surface of newly erupted teeth undergoes rapid maturation, it follows that the best time to apply topical fluoride is soon after eruption. Also, the initial caries lesion, characterized by a white spot, is porous and accumulates fluoride at a much higher concentration than adjacent sound enamel. Pre-treating enamel with 0.05 M phosphoric acid, in order to increase enamel surface area, greatly enhances the uptake and retention of fluoride. Lengthening the time interval between the applications of a solution also increases fluoride uptake. This implies that periodic application of fluoride would enable vulnerable enamel sites that are partially demineralized to accumulate fluoride.

FLUORIDE VEHICLES

Aqueous solutions and gels

The gel adheres to teeth for a considerable amount of time and eliminates the continuous wetting of enamel surfaces required when solutions are used. When trays are used for applying the gel solutions, it is possible to treat two or four quadrants simultaneously and this results in a substantial saving of time. Since each application may be loaded by

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FLUORIDE DELIVERY METHODS

SYSTEMIC

WATER FLUORIDATION



COMMUNITY



SCHOOL

SALT & MILK FLUORIDATION



DIETARY SUPPLEMENTS



FLOURIDE DROPS



FLOURIDE TABLETS

TOPICAL

PROFESSIONALLY APPLIED



TOPICAL SOLUTIONS AND GEL

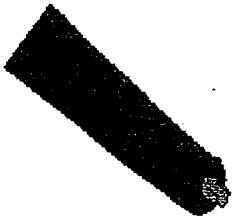


FLUORIDE CONTAINING PROPHYLAXIS PASTE

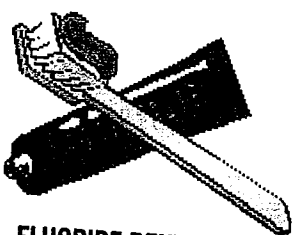
SELF APPLIED FLUORIDE



FLOURIDE RINSE



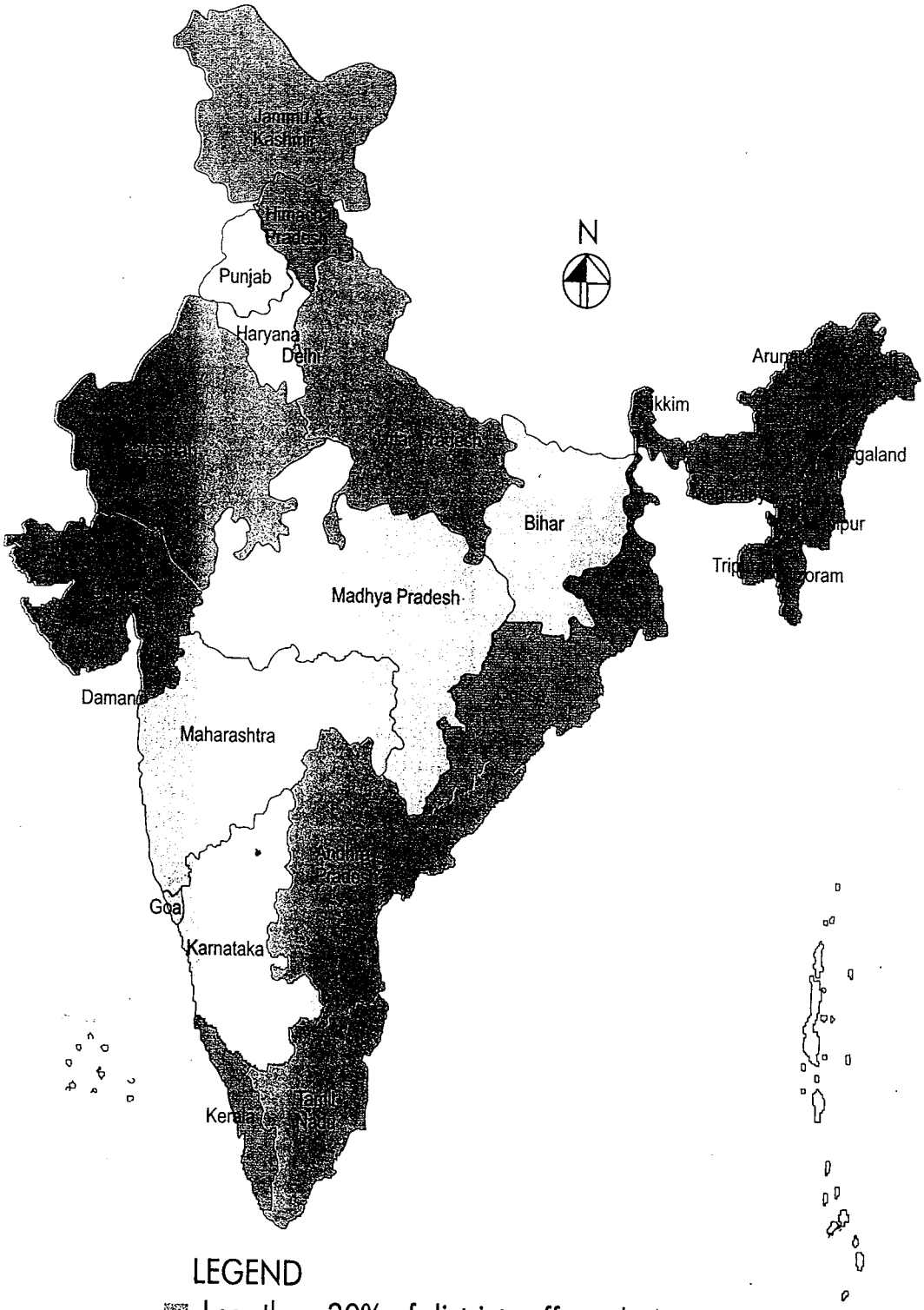
FLUORIDE GELS



FLUORIDE DENTIFRICES

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FLUORIDE BELTS IN INDIA



LEGEND

- Less than 30% of districts affected: 4 states
- 30 - 50% districts affected: 5 states
- 50 - 100% districts affected: 5 states
- Disease not detected

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coating it with a thin layer of gel (usually less than 0.5 ml), the hazard of accidentally ingesting a large quantity of fluoride is minimized. Application of aqueous fluoride using the two-step prophylaxis and topical fluoride method is a time-consuming procedure. Professional topical fluoride solutions and gels are available as sodium fluoride, stannous fluoride, and acidulated phosphate fluoride.

Thixotropic solutions are not gels, but have a high viscosity under storage conditions and become fluid under conditions of high stress or shearing force. Thixotropic gels are more stable at lower pH and do not run off the tray as readily as conventional gels.

Fluoridated prophylactic pastes

Surface enamel contains higher levels of fluoride than the internal layers. A prophylaxis, therefore, removes the fluoride - rich layer. If prophylaxis pastes containing fluoride are used, the lost fluoride is replenished and there is a small, but significant net gain in the concentration of fluoride.

Even though fluoride pastes offer less benefit than solutions or gels, it would seem prudent to use a compatibly formulated paste rather than a non-fluoride paste to obtain whatever additional benefit it may provide. The paste, however, should not be used as a substitute for a regular topical application.

Foam

Foam based agents were developed in an attempt to minimize the risk of fluoride over dosage as well as to maintain the efficacy of topical fluoride treatment. The advantages of foam - based APF agents are

1. It is much lighter than a conventional gel and therefore only a small amount of the agent is needed for topical application. [4gm of gel/mouth while less than 1 gm of foam / mouth]
2. The surfactant in the foaming agent has a cleansing action by lowering the surface tension. This also may facilitate the penetration of the material into interproximal surfaces where its action is most needed.
3. Since APF foam does not require suctioning, it offers advantages for home use as well as for the treatment of young children and disabled persons where saliva evacuation may not be feasible.

Fluoride varnish

With all currently used topical fluoride reagents, about two-thirds of the fluoride acquired after treatment is lost within days. Increasing the time of contact between the enamel surface and topical fluoride agents favors the deposition of more permanently bound fluorapatite and fluorhydroxyapatite. This is possible by incorporating the fluoride compound directly into varnish-like coating material. Fluoride varnish was first developed in Europe (1964) by Schimdt.

Duraphat

Duraphat, the first fluoride varnish developed in Germany, is a viscous yellowish material, containing 22,600 ppm fluoride as sodium fluoride in a neutral colophonium base (NaF varnish containing 2.26% fluoride in organic lacquer). Duraphat has shown caries reductions of between 30% and 40% in the permanent dentition and in between 7% and 44% in the primary dentition.

Fluorprotector

Fluoroprotector is a clear polyurethane based product containing 7000 ppm fluoride from an organic compound, difluorosilane (Silane fluoride with 0.7% F in a polyurethane - based lacquer).

Fluorprotector contains polyurethane lacquer dissolved in chloroform and difluorosilane at a concentration of 2% by

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weight, equivalent to 0.32% fluoride in the liquid. It is dispensed in 1 ml ampules, each ampule containing about 6.21 mg of fluoride. A steep concentration gradient from the surface to the interior has been observed for both fluoride and silicon. This may imply an association between uptake of fluoride and silicon and has led to the suggestion that silanes are an effective medium of transport of fluoride into enamel.

Fluorprotector has a range of efficacy between 1% and 17% but its clinical effectiveness is questionable.

Carex

Carex is another fluoride varnish and contains a lower fluoride concentration than Duraphat (1.8% fluoride) and has efficacy equivalent to that of Duraphat as a caries - preventive agent.

Technique of varnish application

- After prophylaxis, teeth are dried, but not isolated with cotton rolls since varnish sticks to cotton.
- A total of 0.3 - 0.5 ml of varnish equivalent to 6.9-11.5 mg F is required to cover the full dentition.
- Application is done first on the lower arch and then on the upper arch, using a single tufted small brush, starting with the proximal surfaces.
- After application, the patient is made to sit with the mouth open for 4 minutes before spitting to let Duraphat set on teeth which is further enhanced by saliva. (Fluorprotector sets faster than Duraphat).
- Patient is asked not to rinse or drink anything at all for one hour and not to eat anything solid but take liquids and semisolids only till the next morning, so that contact between varnish and tooth surfaces for about 18 hours is maintained for prolonged interaction between fluoride and enamel.

TOPICAL FLUORIDE COMPOUNDS USED IN PREVENTIVE DENTISTRY

NEUTRAL SODIUM FLUORIDE (NaF)

Sodium fluoride (NaF) was the first fluoride compound to be used for topical application. A minimum of four applications with a 2% sodium fluoride solution gives a caries reduction of about 30%.

Method of preparation of 2% neutral sodium fluoride

It is prepared by dissolving 20 grams of sodium fluoride powder in one liter (1000 ml) of distilled water in a plastic bottle. It is essential to store fluoride in plastic bottles because if stored in glass containers, the fluoride ion of solution can react with silica of glass forming silicon fluoride, thus reducing the availability of free active fluorides for anticaries action.

Method of application of neutral sodium fluoride according to Knutsons technique

If the sodium fluoride reagent is pure and uncontaminated, this solution has a pH of 7. Treatments are given in a series of four appointments.

- At the initial appointment, the teeth are first cleaned with aqueous pumice slurry and then isolated with cotton rolls and dried with compressed air. Teeth can either be isolated by quadrant or by half mouth.
- Using cotton-tipped applicator sticks, the 2% sodium fluoride solution is painted on the air-dried teeth so that all surfaces are visibly wet. Then with the teeth still isolated, the solution is allowed to dry for 3 to 4 minutes.
- This procedure is repeated for each of the isolated segments until all of the teeth are treated.
- A second, third and fourth fluoride

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application, each not preceded by a prophylaxis, is scheduled at intervals of approximately one week.

- The four-visit procedure is recommended for ages 3, 7, 11 and 13 years, coinciding with the eruption of different groups of primary and permanent teeth. Thus, most of the teeth would be treated soon after their eruption, maximizing the protection afforded by topical application.

Mechanism of action of sodium fluoride

When sodium fluoride solution is applied on the tooth surface as a topical agent, it reacts with the hydroxyapatite crystals in enamel to form calcium fluoride which is the main end product of the reaction. As a thick layer of calcium fluoride gets formed, it interferes with the further diffusion of fluoride from the topical fluoride solution to react with hydroxyapatite and blocks further entry of fluoride ions. This sudden stop of the entry of fluoride is termed as "Chocking off effect". Fluoride then slowly leaches from the calcium fluoride. Thus calcium fluoride acts as a reservoir for fluoride release (It is for this reason that after each application of sodium fluoride on to the tooth surface, it is left to dry for 4 minutes).

The calcium fluoride formed reacts with the hydroxyapatite crystals to form fluoridated hydroxyapatite. The hydroxyapatite thus formed increases the concentration of fluoride on enamel surface, which in turn makes the tooth surface resistant against caries attack through the action of fluoride.

Advantages of neutral sodium fluoride solution

1. It is relatively stable when kept in a plastic container and there is no need to prepare a fresh solution for each patient.
2. The taste is well accepted by patients.
3. The solution is non-irritating to the gingiva.
4. It does not cause discoloration of tooth structure.
5. Once applied to the teeth, the solution is allowed to dry for 3 minutes. Thus the clinician in public health programs can pursue a multiple-chair procedure.
6. The series of treatments must be repeated only four times in the general age range of 3 to 13, rather than at annual or semiannual intervals, therefore in a public health program, other groups of children can be treated in the intervening years.

Disadvantage of neutral sodium fluoride solution

The major disadvantage of the use of sodium fluoride is that the patient must make four visits to the dentist within a relatively short period of time.

STANNOUS FLUORIDE (SnF2)

Stannous fluoride has been used at 8% and 10% concentrations in solutions equivalent to 2 and 2.5% fluoride. Although the 10% solution is usually used for adults and the 8% for children, there is no evidence of an actual clinical difference between the two. However, the most commonly used is 8% stannous fluoride preparation.

Method of preparation of stannous fluoride solution

Solutions of stannous fluoride are not stable. Soon after mixing they become cloudy due to the formation of tin hydroxide. Since the stannous is believed to contribute to the anticaries benefit of stannous fluoride, aged solutions are considered to be clinically less effective. Muhler et al recommended that a fresh solution of stannous fluoride be prepared for each patient.

To prepare 8% stannous fluoride solution, the content of one capsule which is 0.8 grams ('0' No. gelation capsule) is dissolved in 10ml of distilled water in a plastic container and the solution is shaken briefly.

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Technique of application (Muhler's technique)

- Each tooth surface is cleaned with pumice or other dental cleaning agent for 5 to 10 seconds
- Unwaxed dental floss is passed between the interproximal areas (unwaxed floss has been recommended and continues to be used because it is believed that waxed floss may coat the tooth surface and adversely affect fluoride uptake.
- Teeth are isolated and dried with air
- Stannous fluoride is applied using the paint-on technique and the solution is kept for 4 minutes. Repeat applications are made every 6 months or more frequently if the patient is susceptible to caries.

Mechanism of action of stannous fluoride

When stannous fluoride is applied in low concentration, tin hydroxyphosphate is formed which gets dissolved in oral fluids and is responsible for the metallic taste after topical application of stannous fluoride. At very high concentrations, calcium tri-fluoro stannate gets formed along with tin tri-fluorophosphate. The tin-tri-fluorophosphate is responsible for making the tooth structure more stable and less susceptible to decay. Calcium fluoride is also the end product both at low and high concentrations. The calcium fluoride so formed further reacts with hydroxyapatite and a small fraction of fluorhydroxyapatite also gets formed.

Advantages of stannous fluoride

- Using an 8% stannous fluoride solution at 6 to 12 months intervals conforms to the practicing dentist's usual patient - recall system.
- Administrative difficulties, particularly in public health programs, created by the need to arrange four appointments (as for sodium fluoride applications) are avoided.

Disadvantages of stannous fluoride

- In aqueous solution the material is not stable. It undergoes fairly rapid hydrolysis and oxidation and forms stannous hydroxide and stannic ion, reducing the agent's effectiveness.
- Since 8% solution is quite astringent and disagreeable in taste, its application is unpleasant.
- The solution occasionally causes a reversible tissue irritation manifested by gingival blanching. The reaction usually occurs in individuals with poor gingival health.
- It occasionally causes pigmentation of teeth which has a characteristic light brown color. Staining usually appears in association with carious lesions, hypocalcified regions of the teeth and around the margins of restorations.

ACIDULATED PHOSPHATE FLUORIDE (APF)

Acidulated phosphate fluoride was introduced in the 1960's by Brudevold and his co-workers at the Forsyth Dental Center, Boston, Massachusetts.

Method of preparation of acidulated phosphate fluoride

An aqueous solution of acidulated phosphate fluoride is prepared by dissolving 20 grams of sodium fluoride in 1 liter of 0.1 M phosphoric acid and to this is added 50% hydrofluoric acid to adjust the pH at 3.0 and fluoride ion concentration at 1.23%. It is also called as Brudevold's solution.

For the preparation of acidulated phosphate fluoride gel, a gelling agent methylcellulose or hydroxyethyl cellulose is added to the solution and the pH is adjusted between 4-5.

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Technique of application

The preferred method of application using aqueous preparation of acidulated phosphate fluoride is the paint-on-technique and for gel preparation the tray technique. Acidulated phosphate fluoride is recommended for application at 6 or 12 month intervals.

- The patient should sit upright in the chair.
- Oral prophylaxis is done.
- The teeth to be treated are completely isolated and thoroughly dried with air.
- Clinical application of APF gels should be done using trays that fit the patient's upper and lower dental arches. A disposable foam-lined tray is preferred.
- To reduce ingestion of fluoride, a minimum amount of fluoride gel that will permit complete coverage of the tooth surfaces should be dispensed. Usually, the amount is less than 5 ml.
- After the trays have been properly positioned, saliva ejector is used to evacuate the stimulated saliva and excess fluoride.
- It is reapplied every 15-30 seconds so as to keep the teeth moist with the fluoride solution throughout the four-minute period.
- The patient should be told not to swallow the gel but to exert slight pressure using the cheeks and tongue as well as light biting forces in order to cause the gel to flow interproximally. The fluoride gel should be in the mouth for 4 minutes and then the remaining oral fluid should be expectorated.
- The patient is instructed not to eat, drink or rinse his mouth for at least 30 minutes.

Mechanism of action of acidulated - phosphate - fluoride

When APF is applied on the teeth, it initially leads to dehydration and shrinkage in the volume of hydroxypatite crystals which further on hydrolysis forms an intermediate product called dicalcium phosphate dihydrate (DCPD). This DCPD is highly reactive with fluoride ion and starts forming immediately when APF is applied. Fluoride penetrates into the crystals more deeply through the openings produced by shrinkage and leads to formation of fluorapatite.

The amount and depth of fluoride deposited as fluorapatite is dependent on the amount and depth at which DCPD gets formed. For the conversion of whole of DCPD so formed into fluorapatite, deeper penetration and continuous supply of fluoride is required. Because of this reason, APF is applied every 30 seconds and the teeth has to be kept wet for 4 minutes.

Because high fluoride concentration and low pH favor fluoride deposition, acidification of the fluoride solution with phosphoric acid was found to suppress the dissolution of enamel, as well as the formation of calcium fluoride and provide a more effective treatment. The intermediate product formed is the dicalcium phosphate dihydrate and calcium fluoride is the principal reaction product.

Calcium fluoride that forms is partly lost by dissolution in the saliva, but there is evidence that a substantial amount is retained, probably by transformation to fluorapatite.

Advantages of acidulated phosphate fluoride

- Requires only 2 applications in a year and is thus suited for most dental office routines.
- The gel preparation can be self applied and thus the cost of application also gets reduced.
- It has the ability to deposit fluoride in enamel to a deeper depth than neutral sodium fluoride or stannous fluoride
- APF is stable and need not be freshly prepared for each patient.

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Characteristics	Sodium fluoride	Stannous fluoride	APF
Percentage	2%	8%	1.23%
Fluoride concentration (ppm)	9,200	19,500	12,300
pH	Neutral	2.4-2.8	3.0
Frequency of application	4 at weekly intervals 3,7,11 &13 years	Biannually	Biannually
Adverse effects	No	Tooth pigmentation Gingival irritation	No
Caries reduction	30%	32%	28%

Disadvantages of acidulated phosphate fluoride

- Practical difficulties like the teeth should be kept wet for 4 minutes. So repeated applications necessitates the use of suction thereby minimizing its use in the field. This also increases the chair side time making this method more expensive.
- It is acidic, sour and bitter in taste.
- It cannot be stored in glass containers.
- Repeated or prolonged exposure of porcelain or composite restorations to APF can result in the loss of materials, surface roughening and possible cosmetic changes.

AMINE FLUORIDE

In 1957, Muhlemann and co-workers of the University of Zurich, first studied the effects of amine fluoride on enamel solubility in vitro. They found that, under the conditions of their study, certain organic fluorides were superior to inorganic fluorides in reducing enamel solubility. They attributed the improved effect to a combination of chemical protection afforded by the fluoride and physicochemical protection due to the organic portion of the molecule.

- In addition to their ability to reduce enamel solubility, the amine fluorides have other properties that enhance their potential as cariostatic agents.
- Some of them are surface active, that is, they have an affinity for enamel and thus will hold the fluoride for a longer time against the tooth.
- They also have antibacterial properties. Their antibacterial effects appear to be greater than those that can be accounted for by the presence of fluoride alone and have been attributed to the organic portion of the molecule. Reduced plaque formation and antiglycolytic activity have both been reported with these compounds, although not all studies have been positive.

For the prevention of dental caries in humans, amine fluorides have been tested in dentifrices, mouthrinses and topical gels, where they have been either brushed on the teeth or applied with a tray. While the caries inhibiting potential of amine fluoride preparations appears to be good, despite their surfactant and antibacterial properties, it is not known if they are superior to the other currently available fluoride agents.

Recommendations for topical application

According to Lecompte (1987), the following are the recommendations for topical application of high potency fluoride products:

1. No more than 2 g of gel per tray or

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approximately 40 % of tray capacity should be dispensed. Even more conservative amounts should be considered for small children.

2. Because patient may have the need to swallow during a 4 minute topical application procedure, the use of a saliva ejector during the procedure is recommended.
3. Following the 4 minutes application procedure, the patient should be instructed to expectorate thoroughly for from 30 sec to one minute, regardless of whether high speed suction is utilized or not. Expectoration is probably the single most effective way of reducing orally retained fluoride.
4. When utilizing custom individually fitted trays for patients requiring daily or weekly application of a high fluoride concentration product, utilize only 5-10 drops of products per tray.

SELF APPLIED TOPICAL FLUORIDES

The control of dental caries rests largely in the personal life style of the individual and that the sensible use of fluoride at home is an important part of this behavior. Self-applied topical systems presently include fluoride dentifrices, gels and rinses. All of these systems are intended for daily use and contain generally comparable amounts of fluoride. Depending on the manner of usage, these preparations expose the dentition to about 0.5-3.4 mg fluoride each time they are used.

DENTIFRICES

The first clinical trial of a fluoride dentifrice was initiated by Bibby in 1942. The active agent was sodium fluoride which had been added to a conventional dentifrice containing dicalcium phosphate as the abrasive.

In 1954, Muhler et al reported a clinical trial that tested stannous fluoride in a paste with a new calcium pyrophosphate abrasive system.

In 1955, the stannous fluoride dentifrice became the first dentifrice recognized by the Food and Drug Administration (FDA) as an effective tooth decay preventive product. The first fluoride dentifrice was accepted by American Dental Association (ADA) in 1964.

It has been demonstrated that subjects who brush twice per day or more with either 1000 ppm fluoride, 1500 ppm fluoride, or 2500 ppm fluoride, have significantly less caries than subjects using the same formulations who brush once per day or less.

Fluoride dentifrices may play a more significant caries prevention role since it requires active participation by the patient to have any effect.

Fluoride compounds in dentifrices

1. Sodium fluoride dentifrices

Because of the success of the topical application of sodium fluoride in preventing caries formation, dentifrices containing this agent were formulated and tested. However results from early clinical trials failed to show significant caries inhibition. The reason for failure was that probably one or more of the components of the dentifrice formulation was incompatible with sodium fluoride.

The Food and Drug Administration (in 1973) approved a sodium fluoride dentifrice formulated with calcium pyrophosphate abrasive system. Food and Drug Administration proposed rules for sodium fluoride dentifrice are 0.188 to 0.254% with available fluoride ion concentration of 650 ppm.

2. Stannous fluoride dentifrices

Most of the early work with stannous fluoride dentifrices was conducted in the early 1950s by Muhler and his associates of Indiana University in conjunction with the manufacturer of the commercial product, Crest.

Stannous fluoride dentifrice is not used

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because it causes staining of teeth, pigmentation of hypoplastic areas and the margins of restoration and it has a metallic, astringent taste.

3. Monofluorophosphate

In 1981, this compound became the most widely used agent for the formulation of caries preventive dentifrices in the world.

Monofluorophosphate does not occur in nature. It was produced during the 1940's in the research laboratories of the Ozark Mahoning Company in Tulsa, Oklahoma. On the basis of fluoride content the acute toxicity was found to be half that of fluoride as sodium fluoride. It did not cause staining of teeth as occurs with stannous fluoride. The mechanism of action of mono-fluorophosphate in the prevention of dental caries is not absolutely established.

Food and Drug Administration proposed rules for monfluorophosphate dentifrice is 0.564- 0.88.4% with available fluoride ion concentration of more than or equal to 800 ppm.

4. Amine fluoride dentifrice

Amine fluorides were first tested for their cariostatic potential in Zurich, Switzerland. An Amine fluoride dentifrice, Elmex (GABA Int Basel, Switzerland) was first marketed in Switzerland in 1963.

Insoluble metaphosphate is the abrasive and polishing agent whose minimal abrasiveness favorably influences the dentifrices fluoridating potential. The amine fluoride dentifrice foams less than mono-fluorophosphate dentifrices. The dentifrice has markedly superior properties concerning enamel dissolution rate reduction, fluoride uptake by enamel, and antiglycolytic activity in plaque, compared to sodium fluoride and monofluorophosphate alone or in combination. A concern has been expressed about the taste characteristics and the long-range toxic effects of this dentifrice.

Adverse effects of dentifrices

A single brushing with a full ribbon of paste on a brush head provides about one gram (equivalent to 1ml) of toothpaste and will expose an individual to approximately 1 mg F. It is only when substantial quantities of paste are eaten by children, who may experience the phenomenon of pica, that the acute toxicity of fluoride dentifrices must be considered.

The largest container of toothpaste manufactured, a nine ounce (270 gm) "family size" tube consists of about 270 mg F (1mg F x 270gm). This amount of fluoride is below the Certainly Lethal Dose (CLD) of 320 mg F for a hypothetical two year old but exceeds the Safely Tolerated Dose (STD) of 80 mg F. Detergents and flavoring oils in dentifrices, however irritate the stomach when ingested in large amounts and cause vomiting. Also, abrasives may interfere with complete intestinal absorption of fluoride from toothpastes. Thus, a child is unlikely to receive a highly toxic amount of fluoride from eating a family sized tube of dentifrice. The Food and Drug Administration advisory review panel on over-the-counter (OTC) anticaries drugs has recommended that fluoride content of dentifrice containers be limited to 260mg of fluoride.

Rather than acute systemic illness, the main concern associated with the use of fluoride toothpastes is the risk of producing dental fluorosis from the regular ingestion of small amounts by children under six years of age. Parents should therefore make sure that only a pea size portion of fluoride paste is on the child's toothbrush and remind the child frequently to rinse and spit out thoroughly after brushing.

For children six years of age and older, the amount and frequency of use of fluoride dentifrices pose neither health nor cosmetic risks.

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FLUORIDE MOUTHRINSES

The use of a fluoride mouthrinse was first described by Bibby et al in 1946. Over the past several decades, fluoride mouthrinsing has become one of the most widely used caries preventive public health methods. In 1975 the Council on Dental Therapeutics of the American Dental Association accepted neutral sodium fluoride and acidulated phosphate fluoride mouthrinses as effective caries preventive agents. Later a stannous fluoride mouthrinse was also accepted by the American Dental Association.

Sodium fluoride mouthrinses

Sodium fluoride mouthrinses are usually formulated at concentrations of either 0.2% (900 ppm F) for weekly use or 0.05% (225 ppm F) for daily use. They have been tested in both neutral and acidified forms in a water vehicle. These rinses are intended to be used by forcefully swishing 10ml of the liquid around the mouth for 60 seconds before expectorating it.

Preparation of sodium fluoride mouthrinse

Home use:

It can be prepared by dissolving 200mg sodium fluoride tablet (10mg sodium fluoride and the rest lactose as a filler) in 5 teaspoons of fresh clean water (approximately 25ml). This quantity is sufficient for daily mouthrinse of a family of about 4 members (2 adults and 2 children) providing approximately 0.04% sodium fluoride. Use of lactose is essential as this does not react with fluoride. For weekly use, 2 gm of sodium fluoride powder is dissolved in 1000ml of water.

In schools:

The authorities can buy packets of sodium fluoride powder (2 grams powder in each packet) and dissolve this powder in 100ml of water to make a 0.2% solution.

Other fluoride mouthrinses

Various other fluoride compounds have been tested as mouthrinses, but none have shown sufficient cariostatic activity, compared to sodium fluoride, to warrant their recommended use.

- The anticaries effect of stannous fluoride rinses is roughly the same as that of sodium fluoride rinse.
- A clinical trial of an amine fluoride rinse showed no superiority over a neutral sodium fluoride rinse when used according to the same regimen.
- An ammonium fluoride mouthrinse was no more effective than a sodium fluoride rinse when both were used daily in a acidulated form.

Mechanism of action of fluoride mouth rinses

- Fluoride changes the enamel structure of teeth from predominantly hydroxyapatite to fluorapatite.
- Fluoride may act by inhibition of bacterial metabolism and plaque acid formation. This is however, unlikely to be the main mechanism of action of fluoride mouthrinse's cariostatic effect, since very high concentration of fluoride is required.

Recommendations for fluoride mouthrinses

1. The rinse and expectorate technique can be used for patients in fluoride-deficient communities or for those in optimally fluoridated communities who nevertheless exhibit a high susceptibility.
2. A teaspoonful of 0.05% sodium fluoride solution will, if swallowed deliver 1 mg of sodium fluoride. A swish and swallow technique as opposed to a swish and expectorate technique should be recommended if the concentration of fluoride in the drinking water is 0.3 ppm or less and if the patient is not already

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taking a systemic supplement. Dentists must be aware however that the over the counter product as well as many of the other commercial rinses are not meant to be swallowed.

3. It is especially beneficial for patients with increased caries risk, for example those undergoing orthodontic treatment as well as patients undergoing radiotherapy.
4. Whether school based fluoride mouthrinsing programs should continue in fluoride deficient communities must be determined by the individual program based upon the caries activity of the participants and the cost to reduce the disease level to an anticipated 30%. However because of the low absolute caries reduction associated with mouthrinsing in optimally fluoridated communities, school based programs are impractical under such circumstances.

Advantages of daily rinsing

1. If the patient misses several sessions it is probably less critical than if he was on a weekly schedule.
2. Advantage of the 0.05% sodium fluoride concentration is that it can be used to provide both a topical and systemic benefit when indicated for the individual patient.

Because of practical considerations, the low potency, high frequency (0.05% sodium fluoride daily) rinsing regimen is recommended for home use.

FLUORIDE GELS

Fluoride gel products for self application include neutral sodium fluoride and acidulated phosphate fluoride with a fluoride concentration of 5,000 ppm and stannous fluoride which has a concentration of 1,000 ppm. The stannous fluoride products are conventionally called gels, but actually are glycerin-based solutions.

- The gels are either applied in trays or brushed on the teeth.
- Professionally applied topical fluoride treatment are given twice a year, whereas self applied fluoride gels can be applied once a day or more.
- Patients brush their teeth for 1 minute with the gel or if trays are used several drops are placed in each tray and held in contact with the teeth for 5 minutes. Patients should be cautioned to expectorate excess gel and not to swallow it. Also patients should rinse with tap water after brushing or tray application. Because of the potential risk that young children with developing teeth might swallow some of the gel, home fluoride gels are not recommended for children 6 yrs and younger.

Limitations of fluoride gels

- They violate the principle of delivering low concentration of fluoride at regular intervals. High concentration of fluoride deposit calcium fluoride on the tooth surface rather than encouraging the formation of hydroxyapatite.
- They present a toxicity hazard as relatively large amounts of fluoride are given in an uncontrolled manner to people of varying intelligence.
- They are tedious to use on a daily basis over a long period of time. However they may be of value when prescribed professionally for use at home especially for high risk subjects.

SYSTEMIC FLUORIDES

Systemic fluoride provides a low concentration of fluoride to the teeth over a long period of time. It circulates through the blood stream and is incorporated into developing teeth. After teeth erupt, fluoride contacts teeth directly through salivary secretions. Most systemic fluorides have a topical effect but their primary effect is

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systemic. The different types of systemic fluorides are,

- Community water fluoridation
- Salt fluoridation
- Milk fluoridation
- Fluoride tablets/drops/lozenges

COMMUNITY WATER FLUORIDATION

The most common form of systemic fluoride administration is - the addition of fluoride to public water supplies. The optimal level of fluoride in water for protection against dental caries is approximately 1 part per million (ppm).

Water fluoridation is defined as "controlled adjustment of the concentration of fluoride in a communal water supply so as to achieve maximum caries reduction and a clinically insignificant level of fluorosis".

Water fluoridation may also be defined as "the upward adjustment of the concentration of fluoride ion in a public water supply in such a way that the concentration of fluoride ion in the water may be consistently maintained at one part per million (ppm) by weight to prevent dental caries with minimum possibility of causing dental fluorosis".

Fluoridation is the adjustment of water supply to a fluoride content such that reductions of 50 to 70 % in dental caries would occur without damage to teeth or other structures.

In 1958, WHO produced the first report by an expert committee on water fluoridation (TRS 146) and concluded that drinking water containing about 1 ppm fluoride had a marked caries - preventive action and that controlled fluoridation of drinking water was a practicable and effective public health measure.

1 mg fluoride in 1 litre
1 mg fluoride in 1 kilogram

CONTROLLED WATER FLUORIDATION STUDIES

Grand Rapids-Muskegon study

On January 25th, 1945, sodium fluoride was added to the Grand Rapids water supply. Muskegon was the control. This was a historic occasion, because for the first time a permissible quantity of a beneficial dietary nutrient was added to the community drinking water. The effects of 6½ years of fluoridation in Grand Rapids were reported by Arnold et al in 1953. The results showed that the caries experience of 6-yr-old Grand Rapids children was almost half that of six year old Muskegon children.

Newburgh - Kingston study

On May 2nd 1945, sodium fluoride was added to the drinking water of Newburg on the Hudson river. Kingston town was the control. After ten years of fluoridation, Ast et al (1956) reported that the DMF rate had fallen from 23.5% to 13.9%, thus confirming the caries inhibitory property of fluoride in drinking water.

The Brantford- Sarnia - Stratford fluoridation caries study

In Canada, a project was undertaken in Brantford, Ontario, where fluoride was added to the water supply in June 1945. The community of Sarnia was established as the control town. In addition, the community of Stratford, where fluoride was naturally present in the drinking water at a level of 1.3 ppm was used as an auxiliary control. After 17 years of fluoridation in Brantford, caries experience was similar to that occurring in the natural fluoride area of Stratford and was 55% lower than in the control town of Sarnia (Hutton et al 1951; Brown & Poplove, 1965).

Evanston- Oak Park study

In January 1946, a fluoridation experiment

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began in Evanston, Illinois and the nearby community of Oak Park acted as the control town. After 14 years of fluoridation in Evanston, there was a reduction of 49% in DMF values. The Evanston-Oak Park study presented the most detailed data of all the fluoridation studies.

Tiel - Culemborg fluoridation study

In March 1953 the drinking water in Tiel was fluoridated to a level of 1.1 ppm. Culemborg with water fluoride level of 0.1 ppm was the control. After 13 years of fluoridation, the number of anatomical sites of teeth affected by dental caries was 58% lower in Tiel than in Culemborg.

Optimal water fluoride concentration

In order to determine the amount of fluoride that should be added to water, Galagan & Vermillion (1957) developed an empiric formula for estimating the amount of daily fluoride intake based on body weight & climatic conditions, as follows,

ppm F = 0.34/E where, E = - 0.038 + 0.0062 X T (Temperature of the area in ^{0}F)

In the above formula, 'E' is the estimated daily water intake of children in oz / lb of body weight; 'T' is the mean maximum daily air temperature in degree Fahrenheit of the area.

METHODOLOGY OF ESTIMATION OF FLUORIDE CONCENTRATION IN DRINKING WATER

The knowledge about the methods of estimation of fluoride in drinking water is important for the dental profession so as to know whether the people of a particular area are getting only the cariostatic levels of 1 ppm of fluoride through drinking water. This also helps to know whether the water of the particular area can be accordingly fluoridated / defluoridated and also for prescribing additional fluoride in the form of supplements in a fluoride deficient area where fluoridation of drinking water is not feasible.

Sample collection for fluoride estimation

500ml of water to be tested is collected from its source in a clean dry polythene container. 2 CC of 6N HCl is added to inhibit microbial growth or enzymatic changes and stored at 4^{0}C for analysis (preferably within 2-3 months).

Fluoride concentration in the water can be estimated by

1. Fluoride electrode coupled with standard pH meter.
2. Scot - Sanchis method.

1. Fluoride electrode coupled with standard pH meter

It is the most recent and universally accepted method. This method allows fluoride in aqueous solution to be measured quickly, simply, economically and accurately. When a pH meter is used in conjunction with a fluoride electrode, the readings observed are the electrode potentials of the standard /sample solutions from which the concentration of fluoride is calculated. Two pH meters, namely the Orion 901 microprocessor ion analyzer and Orion 407 are used. A specific ion meter is the one that has inbuilt facility of converting the electrode potential into concentration of fluoride in ppm. The unknown concentration of fluoride in the sample can be calculated by one of the following,

a) Typical calibration curve
b) By applying electrode potential difference equation
c) Direct ppm reading.

2. Scot - Sanchis method

The test is based on the reaction between fluoride and the red Zirconium Alizarin lake.

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Fluoride forms a colorless complex ion and liberates free alizarin sulphuric acid, which is yellow in acid solution. As the amount of fluoride increases, the color produced varies from yellow to red. The fluoride level in the test material is determined by comparing the color thus produced with the standard. This method was commonly used in the past but with the advent of standard pH meters coupled with fluoride electrodes and other sophisticated instruments this method is no longer used.

LIMITATIONS OF COMMUNITY WATER FLUORIDATION

- The crucial requirement for community water fluoridation is a well-established, centralized piped water distribution system. Unfortunately, in most developing countries, where caries is increasing sharply, centralized water distribution system, which is the crucial requirement for community water fluoridation, is often lacking even in densely populated urban areas and they are rarely found in rural areas.
- The introduction of a water fluoridation program requires the support of the top health authorities and of the government in the form of laws, decrees, regulations, budget allocations etc.

CHOICE OF EQUIPMENT AND CHEMICALS FOR WATER FLUORIDATION

When planning a fluoridation system, the selection of the chemical product to be used as the source of the fluoride ion will have an important bearing on the final decision as to the type of distribution equipment to be installed. Thus, a saturator is used with granular sodium fluoride, a dry distributor with silicofluoride or sodium fluoride, and a liquid distributor with hydrofluosilicic acid.

The general characteristics of the system to be considered are,

- The equipment for fluoridation must be adapted to local conditions and needs of the water network. The choice of distributor should be based on the quantity and type of fluoride-bearing product used.
- It should be of standard type, recognized as satisfactory and for which maintenance is easily provided.
- The equipment should have well-defined precision limits i.e., not more than 5% error in the whole system whatever the variation in the quantity of water treated.
- The equipment must be safe. In order to avoid over dosage, it should be provided with a safety mechanism that automatically stops the addition of fluoride if the flow of water through the treatment plant is suddenly diminished.
- Adjustment of the distribution must be sufficiently easy and rapid.
- The apparatus should operate between 20% and 80% of its total capacity. This is a security measure that assures a maximum fluoride dosage of 5 times the optimum level in case of serious malfunction, a fluoride level which is considered for a short period.
- In each fluoridation system, an anti-siphon mechanism should be installed in the pipes that distribute fluoride solution into the water, to avoid a concentrated solution of fluoride entering the distribution system.

Fluoride compounds used in water fluoridation

The principal forms in which fluorides are added to public water supplies will vary from place to place so that final choice must be based on a more or less detailed study of the advantages and disadvantages of each compound.

a) Fluorspar:

It is a mineral containing varying amount of calcium fluoride. Commercial grades of

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fluorspar usually contain from 85 to over 98% calcium fluoride.

b) Sodium fluoride :

It is a white, odorless, free flowing material available either as a powder or as a mixture of various sized crystals. It is manufactured from hydrofluoric acid, a by-product of fluorspar. It is usually available in 45 kg bags. It is the most expensive source of fluorides.

c)Silicofluorides:

Most of the commercially available silicofluorides are obtained as byproducts of the purification of phosphate rocks. The primary products are superphosphates, phosphoric acid, elemental phosphorous, and triple superphosphates.

d)Sodium silicofluoride:

Hydrofluosilicic acid is the basic raw material used in the manufacture of silicofluoride salts. It is by far the most popular, because of its low cost. Solutions of this compound are corrosive and the materials for piping, valves, pumps and fittings should be chosen with this in mind.

e)Hydrofluosilicic acid:

It is slightly more expensive than silicofluoride on account of the cost of transporting liquids. It can be delivered by tanker lorry with a capacity of up to 19,000 litres.

f) Ammonium silicofluoride:

This compound is produced by neutralizing fluosilicic acid with either aqueous ammonia or ammonia in gaseous form. The use of this material is particularly desirable at those places where ammonia is used to form chloramines with the chlorine added to the water for disinfection purposes. The use of ammonium silicofluoride provides part or all the ammonium required for producing chloramine.

Types of equipment for water fluoridation

The 3 types of fluoridation equipment commonly used for fluoridation of water supplies are,

a. The saturator system.

b. The dry-feeder system.

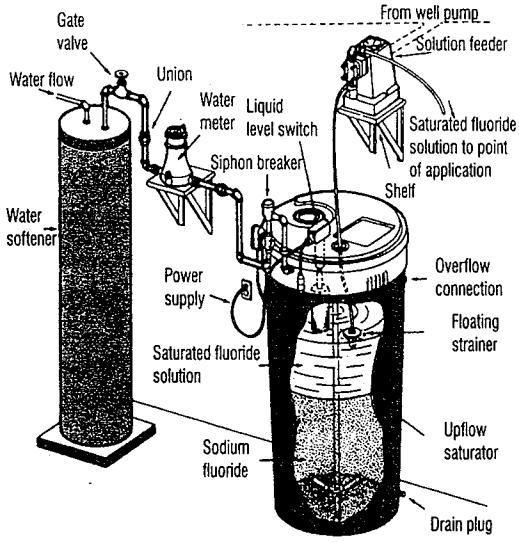
c. The solution-feeder system.

a. Saturator System

Principle: A 4% saturated solution of sodium fluoride is produced and injected at the desired concentration at the water distribution source with the aid of a pump.

Factors limiting utilization: A high hard water level (total hardness of over 75mg/litre), the need to clean the gravel bed used for water filtration.

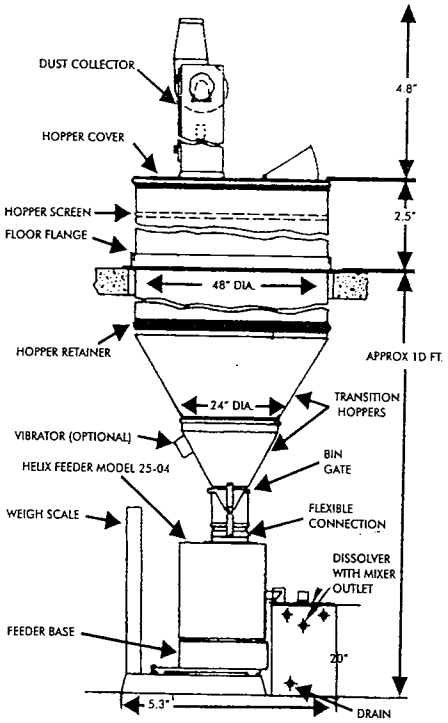
Recommendation : Suitable for small towns with a total requirement of less than 3.8 million liters per day.



b. Dry feeder

Principle: Sodium fluoride or silicofluoride in the form of powder is introduced into a dissolving basin with the aid of an automatic mechanism to ensure maintenance of the correct supply of fluoride according to the amount of water to be delivered.

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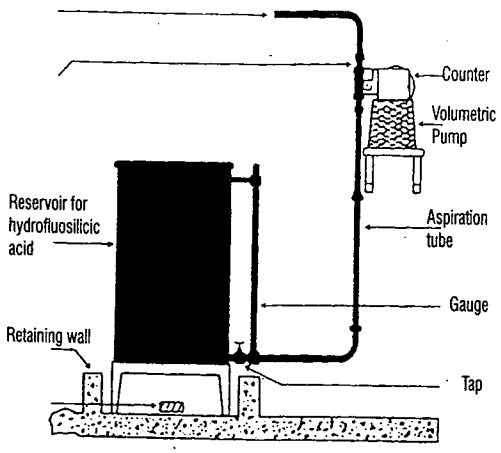
Factors limiting utilization: The need for care in the handling of fluoride, obstruction of pipes, compacting of fluoride while stocked in a humid atmosphere.

Recommendation: Suitable for medium-sized towns with a total requirement of 19 million liters per day.

c. Solution feeder

Principle: Volumetric pump permitting the addition of a given quantity of hydrofluosilicic acid in proportion to the amount of water treated.

Factors limiting utilization: All the equipment must be resistant to attack by hydrofluosilicic acid, necessitating construction using polyvinyl chloride or any other plastic.



Recommendation: Suitable for medium-sized and large towns, with a total requirement of more than 7.6 million liters per day.

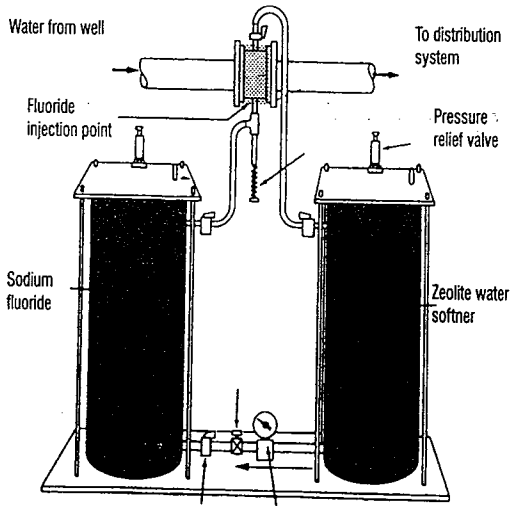
The conventional system described above incorporate electrical and mechanical devices that require maintenance by capable operators. The Venturi fluoridator system and the Saturation-suspension cone are the two systems which do not suffer from these drawbacks.

Venturi fluoridator system

It is a non-electrical system which was developed by J. N. Leo. It is activated by the flow of water in the main water line. The tank containing the fluoride is made of a clear acrylic thermoplastic (e.g. plexiglass) and this enables the operator to make a visual inspection of the level of chemical, in order to replenish it.

Advantages

- It is simple to install
- The cost of this unit is approximately two-thirds of the cost of the conventional equipments although the amount of chemicals used is the same as for other



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equipments.

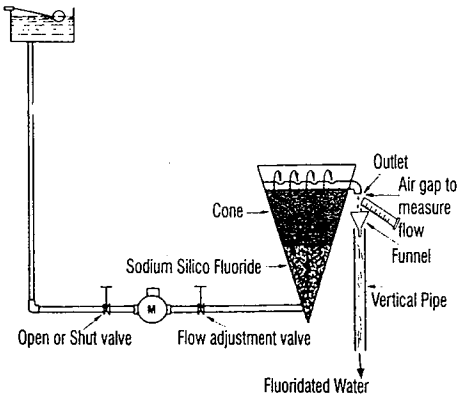
- There is no possibility of accidental over dosage by surges of fluoride being introduced into the distribution system when the main water pump stops

Saturation - suspension cone

The system was developed by the water and sewage authority of the state of Rio Grande do Sul, Brazil. It consists of an upside down cone charged with a bag of sodium silicofluoride through which a constant flow of water percolates. The solution is collected at the top by a horizontal perforated plastic pipe, which forms the outlet.

The parts of the installation are,

a) A cone 0.91m in height and 0.91m in



diameter, mounted upside down on a tripod made of 2 cm diameter rod or galvanized iron tubing.

b) An elevated constant head tank (7-10 m head) for feeding water to prepare a constant volume of solution.

c) A 2 cm diameter connecting pipe connecting the constant head tank to the lower end of the cone. A shutoff valve is inserted in the line, along with a water meter or flow meter to measure the instant flow of water and the accumulative flow in a given period of time. The 2 cm diameter inlet is reduced in diameter at the lower end of the cone to 1.2 cm.

d) A surface collector consisting of a horizontal perforated 2.5 cm diameter pipe collects the solution and discharges it into a wide - mouth funnel, which is connected to a 3.75 cm diameter pipe. This pipe feeds the solution to the point of application.

The cone must be built of a corrosion resistant material such as stainless steel, fibre glass or standard steel with a polyvinyl chloride lining. The cone is charged with a 45-kg bag of sodium silicofluoride. It is recommended that the quantity of salt in the cone be never less than 25 kg. If the consumption of chemical is 20 kg/day, this amount must be added daily.

TECHNICAL CONSIDERATIONS FOR WATER FLUORIDATION

Since fluoridation can be easily integrated into general water treatment plants, the principal cost of fluoridation is that of the fluoride used. To avoid problems such as obstruction of pipes and the hazard of toxic dusts, it is appropriate to use a liquid fluosilicic acid rather than fluoride in powder form.

a) Maintenance and control:

The fluoridation system must be carefully maintained so as to ensure maximum efficiency at all times. A sufficient quantity of spare parts should also be available for the smooth functioning of the equipment.

b) Control at the water treatment plants:

Analytical control at the plant consists of determination of the fluoride content of water as it leaves the treatment plant using a specific ion electrode. This analysis is vital in order to determine whether fluoridation of water is being implemented at the optimum concentration. Any variation is to be noted and the operator should make an immediate correction.

Regular monitoring of water supplies is essential even at the smallest installation. The following methods for monitoring are available,

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- Hourly check of the weight of the chemical fed into the hopper. Dry feeders, if well maintained and adjusted, should be accurate well within 5%.
- Colorimetric chemical testing through addition of a zirconium alizarin reagent, the result to be compared with standard color samples. Accuracy is within approximately 0.1- 0.2 ppm of fluoride. Testing is usually done once or twice daily upon the effluent water.

Uniform concentration of fluoride ions should be maintained at all times and in all parts of the network, by taking samples. The analysis should be made several times a day in the treatment plant. These determinations should be noted on an official recording sheet and means of the daily determination included in a register, a copy of which should be sent each month to the responsible authority.

c) Control of the quality of analysis:

The responding authority should send three "blind" samples each month for analysis at the water treatment plant which should be returned within 48 hours to the responsible authority. If any difference from the known content exists, technical assistance should be sought to correct the analysis technique.

d)Control of the quality of water in the network:

Personnel from the water plant should take samples from the distribution network once a week and send them for analysis. This will enable the validity of the monthly reports to be checked and also indicate any inherent anomalies in the distribution network. These determinations should be noted in a register and used as a record of the period of application of fluoridation in the region and the fluctuations in concentration during that period.

e) Control of the quality of fluorides used:

Each time the delivery of fluorides is received, the samples should be analyzed to verify whether they correspond to the criteria of quality approved by the responsible authorities. If not, the consignment should be replaced.

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Evaluation and safety of water fluoridation:

Water fluoridation has been in operation for more than 60 years and has been implemented in more than 20 countries in different parts of the world. It has been found to be the least expensive and most effective way of providing fluoride to large groups of people of all ages.

Medical investigations have shown that optimal concentration of fluoride is safe and does not impair general health. Longitudinal studies comparing children living in fluoride rich and poor areas have not shown any systemic effects on development, growth and health as well as any significant difference in the incidence of congenital anomalies, cardiovascular, allergic or other diseases. Likewise, in studies on adults, there was no difference in the incidence of cancer or in the death rate of old people. These reports have considered the adjustment of the water fluoride content to about 1 mg of fluoride / litre to be safe.

Fluoridation can be considered only if,

1. there is a municipal water supply reaching a reasonable number of homes.
2. people drink this water rather than water from individual wells or tanks.
3. suitable equipment is available in a treatment plant or pumping station.
4. a supply of a suitable fluoride chemical is assured.
5. there are workers in the water treatment plant able to maintain the system and keep adequate records
6. there is sufficient money available for the

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initial installation and running costs.

Cost of water fluoridation

Based on the current knowledge of increasing prevalence of dental caries, developing economy of our country, an insufficient dental manpower, community water fluoridation appears to be the most effective, practical and economical public health measure for the prevention of dental caries as this measure extends its benefits to all the residents of the community without necessitating any conscious effort on the part of the residents.

In India, the approximate per capita cost shall be about Rs 0.25 per individual per year and a caries reduction of 50%. If one assumes a caries increment of 1 DMFS per year and the cost of restoring a tooth surface at Rs 40/-, the cost to benefit ratio works out to be 1:160 i.e. for every Rs 0.25 spent on water fluoridation, each person shall save Rs 40/-.

In the U.S.A., fluoridation was assessed in 1981 by the U.S. Public Health Service as costing an average of US $0.35 per person per year. The per capita cost was seen to decrease as the size of the community increased. The cost of chemicals alone is low. When equipment costs are included, the larger the population size, the economical fluoridation is.

School water fluoridation programs

Where community water fluoridation is not feasible, school water fluoridation is a suitable alternative because children would consume it during school days, thus making it one of the several effective alternatives for prevention of dental caries in children. The concentration of fluoride in the school water system has to be adjusted upward to compensate for the reduced water intake since the school day and year, in terms of water consumption, is 'shorter' than in communities with fluoridated water supplies. The currently recommended level is 4.5 - 6.3 ppm of fluoride in the school water supply. Simple fluoridators, particularly that which employ the Venturi system are most suitable, because they require almost no maintenance & can be utilized effectively in small installations of small or medium-sized schools.

Advantages:

- Effective public health measure
- Target population - school children
- Quite economical

Limitations:

- Need for co-operation from school authorities
- Children may not attend all school days
- There is intermittent fluoride exposure
- Limited pre-eruptive benefits to primary teeth

LEGAL ASPECTS OF WATER FLUORIDATION

Fluoridation is not simply a health issue, it is a political one. The decision to implement fluoridation must ultimately come from public authorities, who are usually responsive to political pressures. Legislation providing for water fluoridation is of two types. It may be "mandatory law" or "permissive or enabling legislation".

Mandatory laws:

Makes fluoridation of public water supplies compulsory. These laws have been enacted in Brazil, Bulgaria, Greece, Ireland and six states of the USA.

Permissive or enabling legislation:

This legislation empowers the ministry of health or a local government to institute community water fluoridation. While such legislation does not automatically lead to water fluoridation, it opens the way for national or local health officials to act on the matter.

Australia and the German Democratic

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Republic have enabling legislations authorizing fluoridation. In Israel authority to introduce community water fluoridation rests with the health officials.

Referenda on water fluoridation:

In the 1960's, fluoridation was introduced in many places by resorting to popular referenda to decide the issue, but in recent years, the opponents of fluoridation have become better organized and have succeeded in defeating proposals to introduce this measure.

The reasons for rejecting a measure proven to be good for health when the public votes against its own interest is explained by a number of factors:

1. Ignorance and confusion on the part of the public about the dental health benefits of fluoridation.
2. Ambivalence of the public towards science and its by-products, with greater reservation about scientific findings concerning the human body than about those that are external to the individual.
3. Misrepresentation of the scientist and technical information involved, enabling the opposition to distort the issues and frighten the public.

It has been pointed out that opponents of fluoridation need only sow a seed of doubt to ensure a "no" vote, whereas supporters need to prove beyond all question that fluoridation is safe and desirable in order to obtain a "yes" vote.

Water fluoridation is not only safe but is by far the most effective and efficient method of bringing the benefits of a continuous low concentration of fluoride to a whole community.

DEFLUORIDATION OF WATER

Defluoridation is the process of removing excess naturally occurring fluoride from drinking water in order to reduce the prevalence and severity of dental fluorosis

The most obvious way of reducing exposure to water-borne fluorides is to change the water supply to one containing acceptable levels of fluoride. Other methods involve chemical or physicochemical removal of fluoride.

Several methods have been suggested from time to time for defluoridation. These may be divided into two basic types:

i) based upon ion exchange process or adsorption and

ii) based upon addition of chemicals to water during treatment (Nalgonda Technique).

Ion exchange resins

These are commercially produced resins which are expensive and uneconomical in most circumstances.

a) Carbion : It is a cation exchange resin of good durability and can be used on sodium and hydrogen cycles.

b) Defluoron 1: a sulphonated saw dust impregnated with 2% alum solution.

c) Defluoron - 2 : This was developed in 1968 to overcome the problem of Defluoron - 1. It is a sulphonated coal using aluminium solution as regenerant. Although it was successful in removing fluorides, regeneration and maintenance of the plant required skilled operation.

Nalgonda Technique of defluoridation

The Nalgonda Technique was developed by the National Environmental Engineering Research Institute (NEERI) at Nagpur in 1974 and reported by Bulusu in 1988. The process comprises addition in sequence of sodium aluminate (filter alum), lime and bleaching powder to the fluoride water followed by flocculation, sedimentation and filtration. The technique is extremely useful both for domestic as well as for community water supplies.

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Mechanism:

The unit holds 22 litres of water, which is filled into the upper chamber.

Rapid mix : Rapid mixing is an operation by which the coagulant is rapidly and uniformly dispersed through out a single or multiple phase system. It is rapidly mixed for a period of 30 to 60 seconds with a speed of 10 to 20 rpm so that the coagulant is rapidly and uniformly dispersed. This helps in the formation of microflocs and results in proper utilization of the chemical coagulant, preventing localization of concentration and premature formation of hydroxides which leads to reduced utilization of coagulants.

Flocculation: Flocculation is the second stage of the formation of settleable particles (flocs) from destabilized colloidal sized particles and is achieved by gentle and prolonged mixing for a period of 10-15 minutes with a speed of 2 - 4 rpm.

Sedimentation : It is the separation from the water by gravitational setting of suspended particles that are heavier than water.

Factors that influence sedimentation are:

a) Size, shape, density, and nature of the particles.
b) Viscosity, density and temperature of water.
c) Surface over flow rate.
d) Velocity of flow.
e) Effective depth of settling zone.

Filtration : Filtration is the process of separating suspended and colloidal impurities from water by passage through a porous media. The flocculated water is allowed to settle and filter through fullers earth candles overnight. Treated water will be available for drinking and cooking with desired level of fluoride 1 ppm or less.

Maintenance of Nalgonda filters

The package plant installed on hand pump schemes costing Rs. 1.6 lakhs to serve 250 population requires a skilled operator and chemicals for treatment. To serve a population of 250, 50 stainless steel filters are required and the total cost of the 50 filters is approximately Rs. 35,000.00. The main advantages will be its low cost of investment and low cost of maintenance.

Salient features of Nalgonda technique

- No regeneration of media
- No handling of caustic acids and alkalies
- Only readily available chemicals used in conventional municipal water treatment are required.
- Adaptable for domestic use
- Simplicity of design, construction, operation and maintenance.
- Highly efficient removal of fluoride to desirable levels.
- It is effective even when dissolved solids are above 1500 mg/l and hardness above 600 mg/litre.
- Little wastage of water and least disposal problem
- Needs minimum of mechanical and electrical equipment
- No energy except muscle power for domestic equipment

Indications for adopting Nalgonda Technique

- Absence of acceptable, alternate low fluoride source within transportable distance.
- Total dissolved solids are below 1500 mg/l. Desalination may be necessary when the total dissolved solids exceed 1500mg/l.
- Raw water fluoride ranging from 1.5 mg to 20 mg F/l.

Domestic defluoridation filters

These are stainless steel candle filters adopting the Nalgonda technique. The equipment consists of water filter of any size

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and make, fitted with candle filters and an additional mixing device which can be used as domestic defluoridation filters.

Nalgonda technique is a simple and economical process which can be adopted by the common man. It can be adopted both at the domestic as well as at the community level. Both fill-and-draw and continuous operation system can be installed for defluoridation of water for community water supply.

SALT FLUORIDATION

Salt fluoridation is the controlled addition of fluoride, usually sodium or potassium fluoride, during the manufacture of salt for human consumption.

Fluoridation of salt is suggested as an alternative method of preventing dental caries on a mass scale. It was introduced by Wespi in 1948 in Switzerland. It has been on sale in Switzerland since 1955 and by 1967 more than three-quarters of domestic salt sold in Switzerland were fluoridated at 90 mg of fluoride per kg salt.

Ideal fluoride concentration in salt

The concentration of fluoride in salt is largely based on average salt consumption. Recent investigations have shown that the level of fluoride can be kept at 200, 250 and 350 mg of fluoride per kg salt.

Production of fluoridated salt

For effective caries prevention, fluoride must be present in ionic form when salt (sodium chloride) is dissolved in water. There are essentially two different salt production processes:

- Batch processing
- Continuous processing.

Batch processing

A fixed amount of a fluoride compound (mostly sodium or potassium fluoride) is added to a fixed amount of refined salt.

Example: 765g of potassium fluoride are added to one ton (999,235g or roughly one million grams) of refined salt (765g F salt contains 250mg of fluoride). In the resulting mixture of one ton, the fluoride concentration is then 250ppm F. Correspondingly, 552 g of sodium fluoride are needed to produce one ton of salt containing 250 ppm fluoride.

For batch processing, sodium fluoride can be used, this fluoride salt being much cheaper. Powder mixing refutes the assumption that the longer the mixing time, the better the homogeneity. It has been found that the best mixture - i.e. the most homogeneous distribution of fluoride in a ton of salt - was obtained after 20 minutes of mixing. Beyond this point the fluoride tended to accumulate selectively at the bottom of the mixing cone.

Continuous processing of salt

In large production plants where continuous processing of salt is common, the procedure is often to spray a dosed concentrated fluoride solution through a nozzle onto the salt passing on a conveyor belt below. The amount of salt passing under the nozzle must be continually assessed and this determines the amount of fluoride solution to be sprayed, according to the fluoride concentration specified by law or decree.

Example: in one second, one kilogram of already refined and dried salt passes under the nozzle from which the concentrated solution is sprayed (1 kg salt per second corresponds to an annual production of 10,000 to 20,000 tons). The solution must therefore spray 0.25g of fluoride per second. If a concentrated solution of 15% potassium fluoride is used for spraying (15% potassium fluoride solution is equivalent to 5% F), 5g of the solution (containing 250mg of fluoride) must be sprayed on the salt passing below. It must be considered that this adds about 0.4% humidity to the salt.

In continuous production facilities, potassium

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fluoride is the preferred compound because of its high solubility in water. While the cost of potassium fluoride is negligible in affluent countries, developing countries may find the cost of potassium fluoride prohibitive and its very strong hygroscopic properties are likely to pose storage problems.

Evaluation and safety

The use of salt as a vehicle for fluoride is attractive, but would benefit from further long-term studies. Fluoride ingestion should be studied by monitoring urinary output. There is no problem of acute toxicity with fluoridated salt because renal clearance of fluoride is more rapid than it is for either sodium or chlorine.

It is found that calcium fluoride and sodium fluoride in salt result in similar preventive effects.

Advantages

1. It does not require a community water supply as in the case of water fluoridation.
2. It permits individuals to accept or reject it.
3. Non-fluoridated salt, like non-iodized salt, can be made available to the population.

Limitations

1. There may be large variations in salt intake in different groups of people. Fluoridated salt consumption is lowest when the need for fluorides is greatest - in the early years of life.
2. The amount of fluoridated salt ingested may decrease with increasing consumption of processed foods if the processors do not use fluoridated salt.
3. Difficulties arise when there are multiple drinking water sources which have a naturally optimal or excessive fluoride concentration
4. It requires refined salt produced with modern technology and a high level of technical expertise
5. The current view that a high salt intake may contribute to hypertension.

Among the countries that have used salt as a vehicle for fluorides are Columbia, Hungary, Mexico and Switzerland. The experience of salt fluoridation has been longest and most widespread in Switzerland.

MILK FLUORIDATION

Milk fluoridation is the addition of a measured quantity of fluoride to bottled or packaged milk to be drunk by children.

It was introduced by Zeigler, a pediatrician, who started the first project with fluoridated milk in the Swiss city of Winterthur in 1953 (Reported in 1956). In 1971, Dr Edgar Borrow established the Borrow Foundation (formerly the Borrow Dental Milk Foundation) in England, with the aim of promoting the use of milk as a vehicle for fluoride for the benefit of children's oral health. The first community based milk fluoridation scheme was introduced in 1988, in Bulgaria, under the International Milk Fluoridation program started by the Borrow Foundation in collaboration with the World Health Organization.

Rationale of milk fluoridation

- The nutritional value of milk has been well documented.
- Milk is often available to children through school and nutritional programs and the use of such distribution systems can provide a convenient and cost-efficient vehicle.
- Virtually all forms of milk products are suitable for fluoridation and the process is relatively simple.
- Milk fluoridation can be targeted at those communities in greatest need.
- Research has demonstrated the effectiveness of fluoridated milk in preventing dental disease
- The bioavailability of fluoride is not

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reduced by milk

- Fluoridated milk keeps a permanently low level of ionized fluoride within the oral cavity, promoting remineralization. This topical mechanism contributes to the caries-preventive effect of fluoridated milk.
- Studies have confirmed fluoride's dual mode of action i.e. topical and systemic.
- The preventive effect of fluoridated milk was greater, the earlier in the child's life the consumption commenced.

Planning a milk fluoridation program

There are a number of points, which have to be considered when deciding whether milk fluoridation is necessary for any given community

1.Dental health status:

The oral health status within the community, especially that of the children, must be determined properly. If the DMFT among the children is moderate to very high, then there is a clear indication for caries preventive programs.

2. Other fluoride sources:

The levels of fluoride in the drinking water of the community and whether fluoride tooth pastes are being used should be considered before the fluoride dose to be delivered in the milk is estimated.

3. Urine analysis:

When a decision has been taken to implement a milk fluoridation scheme, urinary fluoride monitoring procedure is mandatory with respect to safety and compliance of the program.

4. Milk distribution:

Fluoridated milk distribution to children is best done through an established or existing system, like school milk or milk for kindergartens and nursery schools. Persons at schools who would supervise milk distribution and consumption should be identified.

5. Fluoridating the milk

Fluoridated milk may be produced in a number of different forms,

- liquid (pasteurized and sterilized) and
- powder,

each containing a variety of fluoridating agents so as to provide them with the optimum amount in line with the recommendations of the WHO Expert Committee (1994), i.e. ranging from zero to 1.0 mg fluoride per day according to the age of the child and the fluoride concentration in the local water supply.

Sodium fluoride is by far the commonly used agent for large scale production of fluoridated milk, currently being used in Bulgaria, China, Russia and Britain. The other agents are calcium fluoride, disodium monofluorophosphate (used in Chile) and disodium silicofluoride. Except in Chile where the fluoridated milk was in powder form, the rest of the schemes mentioned used liquid milk.

To calculate the fluoride concentration, it is necessary to consider the volume of fluoridated milk consumed daily by each child. If 200 - 250 ml of milk is consumed daily and the fluoride requirement is 1 mg per day, the concentration of fluoride in milk is set at 5 ppm.

Sodium fluoride is generally added to milk in the form of a concentrated aqueous solution using a fixed volume ratio to obtain the required product. Usually one litre of the concentration of aqueous solution of sodium fluoride is added to 1000 litres of milk. In this way the water added to the milk is small (0.1%). Fluoridated milk is produced with different concentrations of fluorides but a typical value may be 5 ppm fluoride. Sodium fluoride may be added pre or post

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pasteurization for pasteurized milk. It is best that the solution of sodium fluoride is sterilized at the time of manufacture and maintained sterile. Sterilization is achieved by autoclaving at 121° C for 15 min. In the preparation of sterilized milk the fluoride solution is added before the heat treatment of the milk. Fluoridated powdered milk is made by fluoridating the liquid milk first to get a homogeneous product and then the water is removed in stages to create the powder. All of the products have been shown to have relatively high fluoride availabilities remaining throughout their complete shelf-lives

FLUORIDE TABLETS / DROPS / LOZENGES

Fluoride tablets / drops / lozenges may be prescribed to individual patients or may be part of a school or home based public health preventive dentistry program. They are prescribed by the dentist or pediatrician and are not available over the counter.

Fluoride compounds used

Sodium fluoride is the most commonly used. The other compounds used are acidulated phosphate fluoride, potassium fluoride or calcium fluoride. Supplements contain a measured amount of fluoride typically 0.25mg, 0.5mg or 1.0mg . Fluoride drops are dispensed with a measured dropper and are convenient for infants. Tablets and lozenges should be chewed, swished and swallowed.

Frequency of use and dosage

They should be taken on a daily basis according to the prescribed dosage schedule. The Council on Dental Therapeutics of the American Dental Association recommends the dosage schedule for dietary fluoride supplements as shown in the table

Age	Fluoride concentration of drinking water (in ppm) (WHO 1994)		
	0.3	0.3 - 0.6	0.6
0-6 months	-	-	-
6 mon-3 yrs	0.25gms	-	-
3-6 yrs	0.5 gms	0.25gms	-
6-16 yrs	1gms	0.5 gms	-

Correct dosage is based on the concentration of fluoride in drinking water, age and weight of the child, and other available fluoride. Not more than 1 milligram of fluoride should be ingested each day from all available systemic sources.

Indications for use

a) In areas where there are no central water supplies, where the fluoride concentrations of well-water is low and where parental motivation is very high.
b) As an interim measure in these communities with a central water system that have not yet implemented community water fluoridation.
c) In areas where water fluoridation or salt fluoridation schemes cannot be implemented.
d) In families where there is a high degree of mobility involving frequent changes in the place of work and residence and where parents wish to ensure daily fluoride supplementation themselves.

Benefits

The use of dietary fluoride supplements from birth to age 13 or 16 years provides caries reductions from 60% to 65%. Supplements provide systemic and topical benefits for primary and permanent teeth.

Precautions

Accidental ingestion of fluoride supplements can cause stomach upset. No more than 120, 2.2 mg sodium fluoride tablets should be dispensed at one time. There is no risk of

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dental fluorosis if the proper regimen is followed. However, fluoride supplements when ingested prior to tooth eruption are a risk factor for dental fluorosis.

TOXICITY OF FLUORIDES

Fluoride is often called as a double-edged sword as an expression for anything that can simultaneously help and hinder. This is because inadequate ingestion of fluoride is associated with dental caries and an excessive intake of fluoride can lead to dental and skeletal fluorosis.

Prior to the introduction of water fluoridation as a public health measure, the principal use of fluoride known to the layman was that of a pesticide. Most fatalities associated with fluoride toxicity have resulted from industrial accidents. The toxic effects of fluoride can be classified as acute, due to a single ingestion of a large amount of fluoride, or chronic, due to long-term, ingestion of smaller amounts.

ACUTE TOXICITY OF FLUORIDES

Acute fluoride toxicity results from rapid excessive ingestion of fluoride at one time. The speed and severity of the response are dependent on the amount of fluoride ingested and the weight and age of the individual.

The most frequently encountered adverse effect of topical fluoride therapy is nausea. This is caused by fluoride combining with hydrogen in the gastric juices to form hydrofluoric acid a stomach irritant. Other symptoms of fluoride toxicity include

- abdominal cramps,
- vomiting,
- diarrhea,
- increased salivation,
- dehydration and thirst.

MANAGEMENT OF ACUTE FLUORIDE TOXICITY

Less than 5 mg/kg	1. Give calcium orally (milk) to relieve gastro-intestinal symptoms. Observe for few hours 2. Induce vomiting (not necessary).
More than 15mg/kg	1. Admit to hospital immediately 2. Induce vomiting 3. Begin cardiac monitoring. 4. Slowly administer intravenously 10 ml of 10% calcium gluconate solution. Additional doses may be given if clinical signs of tetany develops. Electrolytes, especially calcium and potassium, should be monitored. 5. Adequate urine output should be maintained using diuretics if necessary. 6. General supportive measures for shock.

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After two to four hours, fatality is possible if first aid is not administered. In acute poisoning, fluoride causes death by blocking normal cellular metabolism. Death usually results from either cardiac failure or respiratory paralysis. Generally, serious symptoms develop within an hour or two and death occurs from two to four hours after ingestion. If death has not occurred after 24 hours the prognosis for recovery is good.

To prevent accidental poisoning of an infant weighing as little as 10 Kgs (22 lbs), the Council on Dental Therapeutics of the American Dental Association (ADA) recommended that no more than 264 mg of fluoride (120 mg) be dispensed at any one time.

CERTAINLY LETHAL DOSE (CLD)
32 to 64 mg of fluoride / kg body wt.
SAFELY TOLERATED DOSE (STD)
8 - 16 mg of fluoride / kg body wt.

CHRONIC FLUORIDE TOXICITY

Chronic fluoride toxicity results from long term ingestion of small amounts of fluoride. The effect of chronic fluoride toxicity on enamel is dental fluorosis. Other problems such as skeletal fluorosis may occur.

Dental Fluorosis	>2 times optimal	Until 5 years
Skeletal Fluorosis	10-25 mg/day	10-20 years

DENTAL FLUOROSIS

Dental fluorosis is caused by excessive intake of fluoride during tooth development. Ingestion of water with a fluoride concentration two or three times greater than the recommended amount causes white flecks and chalky opaque areas on the tooth enamel (mild fluorosis). Consumption of water containing four times the recommended amount of fluoride causes a brown pitted corroded appearance on the enamel surface. However although these teeth represent cosmetic problems they are highly resistant to carious attack.

Clinical features of dental fluorosis are varied:

- Lustreless, opaque white patches in the enamel which may become mottled, striated or pitted
- Mottled areas may become stained yellow or brown
- Hypoplastic areas may also be present to such an extent in severe cases that normal tooth form is lost

Enamel fluorosis is a developmental phenomenon due to excessive fluoride ingestion during amelogenesis. Once the crowns of the teeth are formed, no further fluorosis can be induced by additional intake of fluoride or by posteruptive topical applications of fluoride. The hypocalcified areas of the mottled enamel are less soluble in acids, have a greater permeability to dyes and emit fluorescence of higher intensity than normal enamel. Fluorosis occurs symmetrically within the dental arches; the premolar is usually affected first, followed by second molar, maxillary incisor, canine, first molar and mandibular incisors.

SKELETAL FLUOROSIS

Skeletal fluorosis occurs from ingestion of very high amounts of fluorides for long periods of time.

In India, the disease was first reported by Vishwanathan (1935) to be prevalent in residents of Madras Presidency in 1933.

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However, Shortt (1937) was the first to identify the disease as "fluorosis" in individuals in Nellore district of Andhra Pradesh. At water fluoride levels over 8 ppm, skeletal fluorosis may develop.

Its symptoms are varied in nature,

- Severe pain in the back bones, joints, hips, stiffness in joints and spine.
- Outward bending of legs and hands is seen in advanced stages and these parts loose their shape and contours. This is called knock-knee syndrome.
- Pregnant lactating mothers and children are the most vulnerable group. Fluoride can also damage a foetus if the mother consumes excess fluoride during pregnancy. Calcium fluoride seemed to be more toxic to the foetus than sodium fluoride.
- Fluoride may lead to blocking and calcification of blood vessels causing cardiac problems.
- In its severest form, 'crippling fluorosis', the spine becomes rigid and the joints stiffen, virtually immobilizing the patient.

The fluoride dosage necessary to produce pathologic skeletal fluorosis is estimated at 20 to 80 mg fluoride / day for a period of 10 to 20 years. In India, it is most commonly seen in Punjab. The neurological manifestations of fluorosis occur only in very advanced cases where the ingestion of large quantities of fluorides has continued for at least 20 years and have been exclusively reported from India (Madras and Punjab).

CONCLUSION

When used appropriately, fluoride is a safe and effective agent that can be used to prevent and control dental caries. Fluoride has contributed profoundly to the improved dental health of persons all over the World. Fluoride is needed regularly throughout life to protect teeth against tooth decay. To ensure additional gains in oral health, water fluoridation should be extended to additional communities and fluoride toothpaste should be used widely.

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Chapter 12

SURVEY PROCEDURES IN DENTISTRY

INTRODUCTION

TYPES OF SURVEYS

USES OF SURVEYS

METHODS OF DATA COLLECTION

STEPS IN SURVEYING

- ESTABLISHING THE OBJECTIVES
- DESIGNING THE INVESTIGATION
- SELECTING THE SAMPLE
- CONDUCTING THE EXAMINATIONS
- ANALYZING THE DATA
- DRAWING THE CONCLUSIONS
- PUBLISHING THE RESULTS

ORAL HEALTH SURVEYS (PATHFINDER SURVEYS)

THE WHO ORAL HEALTH ASSESSMENT FORM (1997)

CONCLUSION

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INTRODUCTION

Survey is a non-experimental type of research that attempts to gather information about the status quo for a large number of people by describing present conditions without directly analyzing their causes.

A survey is most easily defined negatively as a 'non-experimental investigation'. It is an investigation in which information is systematically collected, but in which there is no active intervention by the investigators. The purpose of most surveys is to collect information that will provide a basis for action, whether immediately or in the long term.

TYPES OF SURVEYS

1. Descriptive or analytic
2. Cross - sectional or longitudinal

A descriptive survey sets out to describe a situation, e.g. the distribution of a disease in a population in relation to sex and age. An analytic (or explanatory) survey tries to explain the situation, i.e. to study the determinative process. This is done by formulating and testing hypothesis. The distinction between a descriptive and analytic survey is not always clear and a single survey can combine both purposes, e.g. A broad descriptive survey may be so planned, that it also provides information for the testing of a specific hypothesis.

Surveys, whether descriptive, analytic or mixed can be usefully categorized as cross-sectional or longitudinal, depending on the time period covered by the observations. A cross-sectional (instantaneous, simultaneous, prevalence) survey provides information about the situation that exists at a single time. A longitudinal (time span) survey provides data about events or changes during a period of time.

USES OF SURVEYS

1. Monitoring trends in oral health and disease
2. Policy development
3. Program evaluation
4. Assessment of dental needs
5. Providing visibility for dental issues

Monitoring trends in oral health and disease:

When national surveys are repeated periodically under general similar conditions, broad oral health trends over time can be estimated, provided the sampling design so permits. A single survey can show how oral health varies by geographic region, social class or by race or ethnic group. The WHO's pathfinder survey protocol when repeated periodically can assess trends in health and disease and it is assumed that the results are valid enough to support national policy decisions.

Policy development:

Survey data can be used to establish oral health strategies. Scotland has successfully used survey data to develop its oral health policy. A number of American States switched their primary preventive focus from fluoride mouth-rinsing to sealant application after statewide surveys showed most carious lesions to be in pits and fissures.

Program evaluation:

Survey data are often used to evaluate programs though the principle that association does not show cause-and-effect needs to be remembered. A survey is not a randomized controlled trial and inferences need to be made with caution. The success of particular programs can only be inferred from survey data, though the more localized the survey and the program, then the more plausible is the inference.

Assessment of dental needs:

Although surveys can be used for assessment of needs, there is a clear gap between the criteria used in surveys and those applied for

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individual patient care. e.g. criteria for caries in surveys usually are based on cavitation, but dentists generally intervene at an earlier stage in the carious process.

Providing visibility to dental issues:

The visibility that oral health acquires through the mere existence of data from a national survey may be the most important of all uses of survey data.

METHODS OF DATA COLLECTION

1. Health interview survey: (face-to-face survey)

It is an invaluable method of measuring subjective phenomena, such as perceived morbidity, disability and impairment; opinions, beliefs and attitudes and some behavioral characteristics. However, the data obtained, may not be reliable, because of the limitation of the interview method. That is why interviews are often combined with health examination surveys.

2. Health examination survey:

The information obtained through this method is more valid than health interview survey. This survey is carried out by teams consisting of doctors and auxiliaries.

Disadvantages:

- It is expensive and cannot be carried out on an extensive scale.
- The method also requires consideration of providing treatment to people found suffering from certain diseases.

3. Health records survey:

It involves the collection of data from health service records. This is obviously the most economical method of collecting data.

Disadvantages:

- The data obtained is not population-based.
- Reliability is open to question.
- Lack of uniform procedures and standardization in the recording of data.

4. Questionnaire survey:

The use of questionnaires and interviews is a standard method of data collection in clinical, epidemiological, psychosocial and demographic research. It is used for measuring subjective phenomena.

Taking a medical history is a form of questionnaire interview and is recorded either in a fixed protocol (medical record) or taken as an open-ended interview.

Types

- Mailed questionnaires require a literate respondent and, despite their low cost, usually result in a high rate of non-response.
- Telephone interviews are easy to conduct in urban areas, but miss those without a telephone or those at work. They are of little use in developing countries.
- Face-to-face interviews by a trained interviewer are the commonest type used in community surveys and clinical research.

The face-to-face format allows:

- clarification of questions
- probing for answers
- use of visual aids
- high response rate
- short time in filling out the questionnaire

However, it is expensive, requires training of interviewers and introduces interviewers' bias.

Advantages of questionnaire surveys:

- Simple
- Economical
- Standardization - Written instructions

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reduce biases from differences in administration)
- Anonymity - Privacy encourages candid and honest responses to sensitive questions.

Disadvantages:

- A certain level of education and skill is expected from the respondents.
- There is usually a high rate of non-response.

The questions may be of 2 types:

Open - ended questions (free response)

The subject answers in his own words. This may produce difficulties when interpreting the responses, e.g. How many cigarettes do you smoke per day?

Open-ended questionnaires are useful for anthropological and social enquiries. Some of the questions in medical surveys may be open-ended, but the fewer the better. Such questions allow the respondent to talk freely and at length, but he may deviate from the subject in question. They require special coding after the end of the study, thus lengthening the time for analysis.

Closed questions (fixed - alternative)

They are answered by choosing from a number of fixed alternative responses. They make for greater uniformity and simplify the analysis and are therefore preferred for most purposes, although they limit the variety and detail of responses.

Eg: How many cigarettes do you smoke per day?

a. Upto 10 b. 10-20
c. 20 30 d. More than 30

Advantages of closed questionnaires:

- focused and pertinent to the study objectives
- easy to administer
- uniform
- precoded and thus easy to analyze
- analyzed in a short time

They are preferred in medical studies.

The 2 types of scales most commonly used are the Likert and Guttman scales.

Likert Scale: (Summative)

Commonly used to quantify attitudes and behavior. Respondents are asked to select a response that best represents the rank or degree of their answer. E.g. The respondent may be asked to indicate whether he strongly agrees, agrees, neither, disagrees or strongly disagrees with the statement. Each response is assigned a number. The points of each item is added.

Guttman scale: (Cumulative) (Scalogram)

These contain a series of statements that express increasing intensity of a characteristic. The respondent is asked to agree or disagree with each statement. The respondents score is the total number of items with which he agrees or disagrees.

Language and wording style

The language of the questions should be pitched to the level of the respondent. A common, everyday, conversational style or vernacular should be used. In cross-cultural studies, questionnaires are translated from the original language into the local language or dialect. They are then translated back to the original language by an independent linguist to check and correct any possible misunderstanding. Avoid leading questions, e.g. 'Don't you think that eating sweets during meals is better than eating in between meals?' It would be better to ask: 'Which do you think is better, eating sweets during meals or in between meals?' Avoid professional jargon and abbreviations.

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Sequencing of questions

The questions should be asked in a proper sequence.

a. Introduction: A clear and concise but relevant introduction to the questionnaire is helpful. It should seek to identify the investigator or interviewer with a respected agency in the community. It should indicate the purpose of the questionnaire and should remove any hesitation on the part of the respondent.
b. Cover sheet or identification page. This page usually carries:
   - the name of the survey and the responsible organization
   - the code for the respondent or household
   - the name of the interviewer and date of the interview
c. Warm-up questions or statements should start the questionnaire. Do not start with threatening questions about income and other sensitive issues.
d. The transition from one section to the other should be smooth.
e. In the body of the questionnaire, appropriate use should be made of standard formats for instructions: boxes for instructions, and arrows for directions and which directions to skip (instructions for questions that should be bypassed for a particular respondent.
f. Requirements of questions:
   - Must have face validity
   - Respondents can be expected to know the answer
   - Must be clear and unambiguous
   - Must not be offensive
   - Must be fair (questions should not be suggestive)
g. Instructions:
   (i) a separate instruction manual may be used, or
   (ii) instructions may be included in the questionnaire itself.

Reliability of questionnaires

a. In-built reliability, which is achieved by repeating certain questions, rephrasing the second inquiry while maintaining the same or comparable response codes; and
b. Repeat reliability, which is achieved by repeating the interview with a small percentage of the respondents (chosen at random). Usually, factual questions are used to measure reliability; opinion questions do not provide a direct measure of reliability, because people change their minds from time to time.

Validity/consistency checks

Certain items in a questionnaire may be validated in special surveys. For example, clinical records can be checked against the responses of women who have been receiving preventive advice from the clinic regularly over the preceding 12 months.

Another type of validity check is the consistency or cross-check. If a man is 18 years old, he cannot possibly be consuming tobacco for 25 years. This tedious job can be done by a computer.

Auxiliary activities

1. Pretesting the questionnaire

A pretest is a try-out of the questionnaire. Pretesting is carried out on a small number of respondents who are comparable with the sample of correspondents but are not part of it. The results of pretesting are incorporated into the rewriting of the questionnaire. Even if a standardized questionnaire is used, it should be pretested in the population being studied, and a reliability coefficient calculated.

2. Training of interviewers

Interviewers must be carefully selected and properly trained. In survey research, they

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become the backbone of data collection. Instructions should be given about confidentiality of information, patience and perseverance, being pleasant, with a positive attitude, following instructions, etc. Interviewers should always be supervised (one supervisor to four to six interviewers).

3. Call-backs

Call-backs or repeat visits to non-respondents are most helpful in minimizing the non-response rate. The time of the call-back should coincide with the time that the respondent is most likely to be home. Persons who have refused to participate should also be revisited in the hope that they may cooperate. Call-backs add, however, to the cost of a survey and there must be a limit on how many can be done. Perhaps two or three call-backs to non-respondents are enough.

4. Editing and coding

Questionnaires should be checked by supervisors at the end of each day for omissions, incomplete answers, unclear statements or illegible writing. Interviewers may have to go back to collect missing or unclear information. Responses are then carefully coded, with verification.

STEPS IN SURVEYING

1. Establishing the objectives
2. Designing the investigation
3. Selecting the sample
4. Conducting the examinations
5. Analyzing the data
6. Drawing the conclusions
7. Publishing the results.

1. Establishing the objectives:

The investigator must be absolutely clear about the objective of the investigation before considering its design as the latter is entirely dependent on the former. The objectives can either be stated in the form of a hypothesis which is to be tested, or, the objective may be stated by describing what is to be measured. The starting point of a study is frequently an expression of a null hypothesis, which states that there is no difference between the groups.

Eg: There is no difference in the periodontal status of males and females aged 35-44 years in Mangalore. The objective of the study is then to test this hypothesis.

In other circumstances, particularly where there is to be no comparison between groups, the objective may be stated by describing what is to be measured. Eg: To determine the prevalence of dental caries among 12 year old school children in Mangalore.

Having determined the objectives, each subsequent stage of the investigation must be carried out in a way that will enable these objectives to be met.

2. Designing the investigation:

Survey protocol: It is important to prepare a written protocol for the survey, which should contain,

- Main objective and purpose of the survey,
- A description of the type of information to be collected and of the methods to be used.
- A description of the sampling methods to be used.
- Personnel and physical arrangements.
- Statistical methods to be used in analyzing the data.
- A provisional budget.
- A provisional time-table of main activities and responsible staff.

Obtaining approval from authorities:

Permission to examine population groups must usually be obtained from a local, regional or national authority. E.g. If school populations are to be examined, school

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authorities and the parents should be approached for obtaining permission. The health authorities should also be notified, since it may be necessary to time the survey to fit in with other health related activities.

Budgeting:

A budget for the survey should be prepared which should include all the resources required to carry out the survey.

Emergency care and referral:

All survey teams should be equipped for and ready to provide emergency care if required. It is also the responsibility of the examiner to ensure that referral to an appropriate care facility is made.

3. Selecting the sample:

While designing a study, it is usually impossible to examine every individual in the population under investigation. Resources in terms of time, manpower and money may not be available for the collection and analysis of vast amounts of data. For this reason, a sample must be chosen from the population. A sample is a part of a population called the "universe", "reference" or "parent" population. A sampling frame is a listing of the members of the universe from which the sample is to be drawn.

Sampling is the process or technique of selecting a sample of appropriate characteristics and adequate size.

Advantages of sampling:

- It reduces the cost of the investigation, the time required and the number of personnel involved.
- It allows thorough investigation of the units of observation.
- A sample can be covered more adequately and in more depth than can a total population.

Requisites for a reliable sample:

- Efficiency: The ability of the sample to yield the desired information.
- Representativeness: A sample should be representative of the parent population, so that the inferences drawn can be generalized to that population with precision.
- Measurability: The extent to which findings from the sample differ from that of the parent population should be able to be measured.
- Size: A sample should be large enough to minimize sample variability.
- Coverage: A sample should provide adequate coverage of the population.
- Feasibility: The design should be simple enough to be carried out in practice.
- Economy and cost efficiency: The sample should yield the desired information at a fixed low cost with least sampling error.

Sampling methods:

a. Random sampling: (simple random sampling). It is a technique whereby each sampling unit has the same probability of being selected.

Basic procedure:

- Prepare a sampling frame
- Decide on the size of the sample
- Select the required number of unit

Lottery method:

Here the population units are numbered on separate slips of paper of identical size and shape. These slips are then shuffled and blind fold selection of the number of slips is made to constitute the desired sample size. This cannot be used for large population.

Table of random numbers:

Random numbers are haphazard collection of certain numbers, arranged in a cunning manner to eliminate personal selection or the

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unconscious bias in taking out the sample. Here, each and very unit has equal chance of being drawn in the sample.

Eg: Selection made based on the numbers in the table either diagonally or vertically or in a haphazard manner where each unit is given a random number according to the table.

b. Systematic sampling:
The first unit is chosen at random and then, other units are chosen in a systematic way. E.g. Every third patient visiting the dentist.

c. Stratified sampling: The population is first divided into subgroups or strata according to certain common characteristics. Then random or systematic sampling is performed independently in each stratum:

- Stratified random sampling
- Stratified systematic sampling

Advantages:

It eliminates sampling variation with respect to the properties used in stratifying.

d. Cluster sampling:
Here, a simple random sampling is selected, not of individual subjects, but of groups or clusters of individuals. The sampling units are clusters and the sampling frame is a list of these clusters.

Advantages:

Administratively simple; Less expensive than random sampling.

Disadvantages:

If clusters contain similar persons, the findings cannot be generalized to the parent population.

Other types of sampling:

A. Multistage sampling: It is a sub-sampling within groups chosen as cluster samples. The first stage is to select the groups or clusters. Then sub-samples are taken in as many subsequent stages as necessary to obtain the desired sample size. E.g. 1st stage: choice of states within countries; 2nd stage: choice of towns within each state; 3rd stage: choice of neighborhoods within each town.

B. Multiphase sampling: This is used to take basic data from a large sample and details from a sub-sample.

C. Sequential sampling: Here, a small sample is tested in order to answer certain questions about the population. If the questions are not answered, the number of subjects or units in the sample is increased gradually until the conclusions may be drawn.

D. Panels: They are useful for studying trends. A sample is randomly selected and then data are collected from the sample on several occasions. E.g. Every person is interviewed every 6 months.

E. Area sampling: It is a type of random sampling in which maps rather than lists are used.

ERRORS:

Errors are induced in the data because of factors that can be controlled. Errors are of 3 types.

Observer error

It may be subjective or objective. An example of subjective error is the faulty interrogation of individuals by an untrained investigator who keeps on varying the method of asking questions or tries to suggest answers to them.

An example of objective error is the faulty recording of blood pressure by measuring the same without proper positioning of the patient.

Instrumental error

This error is due to faulty instruments, e.g. faulty weighing machine or a blood pressure cuff of inappropriate size.

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Sampling error

A sample must be representative of the whole population. A biased, non random sample or too small a sample cannot give reliable information about the total population.

The first and second are called non-sampling errors

4. Conducting the examinations:

Scheduling:

An orderly schedule should be prepared for data collection, to prevent the waste of valuable time. The schedule should allow for some flexibility so that unexpected delays do not cause major upsets in the survey time-table. Since fatigue contributes significantly to inaccuracy and inconsistency, it is unwise to make the schedule too demanding.

The length of time that it takes to examine each subject depends on the extent and detail of the examination and the habits and inclination of the examiner. Although extremes of thirty seconds to one and a half hours have been admitted, basic oral health examination of a child takes 5-10 minutes and of an adult takes 15 - 20 minutes. It is not advisable to schedule more than 15 children to be examined in an hour.

Although no rules can be laid down in this matter, two principles should be considered:

- The examination should be as automatic as possible to obviate excessive intrusion of subjective thought. Therefore it should be performed quickly.
- The object of epidemiological surveys is to examine subjects in fairly large numbers. Excessive time spent on each individual necessitates a reduction in the number of individuals seen.

Instruments and supplies :

- plane mouth mirrors - 30 per examiner
- periodontal probes - 30 per examiner
- several pair of tweezers
- containers and concentrated sterilizing solution.
- a wash basin
- cloth or paper hand towels
- gauze.

Infection control :

Current national recommendations and standards should be followed for both infection control and waste disposal. The use of disposable marks and gloves and the wearing of protective glasses are recommended.

Examination area :

The basic requirements for an oral examination are

- a chair, preferably with a head rest, on which to seat the patient. The most comfortable situation is for the subject to be on a table or bench, and the examiner to sit behind the subject's head. Some workers prefer to have the subject in a reclining position on a couch; the dentist can then remain seated at the head and no bending or chair adjustments are required to compensate for the varying size of the subjects.
- a source of illumination, which can either be a separate unit, a lamp attached to the head of the examiner or a fibre optic light source. Inflammatory and structural changes of the oral tissues are more difficult to detect under normal artificial yellow-red light than under natural or corrected artificial light. If electricity or battery operated lights are not available, natural light should be used at all locations.
- Some method of cleaning the teeth to remove loose debris where necessary.
- There should be an adequate supply of assessment forms. There should be avoidance of crowding and noise around

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the examiner or recorder. The flow of subjects through the examination unit needs careful regulation and should be discussed prior to arrival.

- A recorder, live or tape, is necessary for receiving the information called by the examiner. Even if a human recorder is available some workers use a tape recorder as well to check possible errors in the transcription.
- It is also desirable to have an organizing clerk at each examination site to maintain a constant flow of subjects to the examiners and to enter general descriptive information on the recorded forms. He should also be responsible for ensuring that the examiners have an adequate supply of sterile instruments. A log book can also be maintained in which are recorded the location of each day's examinations, the number of persons examined and information about each location.

Training and calibrating examiners:

When an epidemiological survey is undertaken by a team, it is essential that the participating examiners be trained to make consistent clinical judgements.

Objectives of standardization and calibration are :

- To ensure uniform interpretation, understanding and application by all examiners of the codes and criteria for the various diseases and conditions to be observed.
- To ensure that each examiner can examine consistently.

In order to measure intra examiner variability each examiner should carry out a reproducibility test (ability to reproduce the same diagnosis of the same condition on another occasion). If more than one examiner is involved in a study they must be carefully standardized in their diagnosis. They should undergo a training and calibration exercise in which inter examiner variability is measured. The following precautions are usually taken :

1. Keep the number of examiners to a minimum.
2. Discuss interpretation of borderline problems carefully in advance.
3. Use only one make and design of explorer, discard dull explorers.
4. Have all members of the team examine a few cases in sequence and then exchange cases until each examiner has examined each patient. Divergences of opinion or of observation can then be discussed and minimized.
5. Circulate among examiners any rules or systems which may seem pertinent.
6. The supervisor should recheck an occasional case throughout the entire survey.
7. Subtle changes in interpretation should be guarded against.

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Kappa statistic

It is used to calculate intra and inter examiner reproducibility. It is an index which compares the agreement against that which might be expected by chance. Kappa can be thought of as the chance-corrected proportional agreement, and possible values range from +1 (perfect agreement) via 0 (no agreement above that expected by chance) to -1 (complete disagreement).

Kappa value	Interpretation
1	total agreement
> 0.8	good agreement
0.6 - 0.8	substantial agreement
0.4 - 0.6	moderate agreement

Classification of types of inspection and examination:

The ADA has standardized four main types of examination and inspection.

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Type 1: Complete examination, using mouth mirror and explorer, adequate illumination, thorough roentgenographic survey and when indicated, percussion, pulp-vitality tests, trans-illumination, study models and laboratory tests. This method can seldom be used in public health work.

Type 2: Limited examination, using mouth mirror and explorer, adequate illumination, posterior bite-wing roentgenograms. This method is of great value where public health programs combine service to individual patients with population survey work and gives superior results for pure survey work where time and money permit.

Type 3: Inspection, using mouth mirror and explorer and adequate illumination. This is the most-used method in public health surveying.

Type 4: Screening, using tongue depressor and available illumination. This method identifies individuals in urgent need of treatment, but is too unreliable for most public health surveying.

The auxiliary and professional manpower available will usually determine the type of inspection to be used.

5. Analyzing the data:

Once the examination procedures of a survey have been completed, the work of assembling the material and interpreting it begins.

The analysis of findings has 2 components:

- Data processing (statistical analysis)
- Interpretation of results.

To derive full value from the study, it is not enough to 'make sense' of the findings. The investigator should also give thought to their broader "significance" i.e. the extent to which they may be generalized beyond this study population and their wider scientific implications.

6. Drawing the conclusions and publishing the report:

The conclusions are specifically related to the investigation that has been carried out and no extrapolation is made to the population as a whole unless the investigation was designed accordingly.

The final step in a survey procedure should be the construction of a report with or without a set of recommendations. Clearness and simplicity should be sought. For purposes of broad community action, the recommendations should deal only with major objectives.

The WHO outline for a formal written report is:

1. Statement of the purposes of the survey.
2. Material and methods.
   A) Description of area and population served.
   B) Types of information collected
   C) Methods of collecting data
   D) Sampling method
   E) Examiner personnel and equipment
   F) Statistical analysis and computational procedure
   G) Cost analysis
   H) Reliability and reproducibility of results.
3. Results: They should be tabulated and illustrated appropriately.
4. Discussion and conclusions: The investigations, its findings and its conclusions are discussed.
5. Summary.

ORAL HEALTH SURVEYS (PATHFINDER SURVEYS)

Basic oral health surveys are used to collect information about the oral health status and treatment needs of a population and subsequently, to monitor changes in levels and patterns of disease.

Thus, it is possible to assess the appropriateness and effectiveness of the

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services being provided and to plan or modify oral health services as needed.

There are special factors associated with the most common oral diseases which have enabled a practical, economic survey sampling methodology to be defined, called the "pathfinder" method.

The special considerations involving the two major oral diseases are:

1. The diseases are strongly age related.
2. The diseases exist in all populations, varying only in severity and prevalence.
3. Dental caries is irreversible and therefore information on previous disease experience can be got.
4. There is extensive documentation on variation of profiles of dental caries for population groups with different socioeconomic levels and environmental conditions.

The "pathfinder method" is a stratified cluster sampling technique, which aims to include the most important population subgroups likely to have differing disease levels. It also proposes appropriate numbers of subjects in specific index age groups in any one location. In this way, reliable and clinically relevant information for planning is obtained at minimum expense.

Classification:

Pathfinder surveys can be classified depending on the number and type of sampling sites and age groups included,

- Pilot Survey

is one that includes only the most important subgroups in the population and only one or two index ages, usually 12 years and one other age group. Such a survey provides the minimum amount of data needed to commence planning. Additional data should then be collected to provide a reliable baseline for the implementation and monitoring of services.

- National pathfinder survey

incorporates sufficient examination sites to cover all important subgroups of the population that may have differing disease levels or treatment needs and at least three of the age groups or index ages. This type of survey design is suitable for the collection of data for the planning and monitoring of services in all countries whatever the level of disease, availability of resources or complexity of services.

In a large country, a larger number of sampling sites is needed. However, the number and distribution of sampling sites depend upon the specific objectives of the study. Sampling sites are usually chosen so as to provide information on population groups likely to have different levels of oral disease, e.g. cities, small towns or ethnic groups. Once the different groups are decided upon, random sampling of subjects within the groups is done.

The recommended index ages and age groups are, 5, 12, 15, 35-44 and 65-74 years.

5 years:

Children should be examined between their 5th and 6th birthdays. This age is of interest in relation to levels of caries in the primary dentition which may exhibit changes over a shorter time span than the permanent dentition. In some countries, 5 years is also the age at which children begin primary school.

12 years:

This age is especially important as it is generally the age at which children leave primary school and is the last age at which a reliable sample may be obtained easily through the school system. Also, it is at this age, that all permanent teeth, except third molars, will have erupted. For these reasons, 12 years has been chosen as the global

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monitoring age for caries for international comparisons and monitoring of disease trends.

In countries where many children do not attend school, two or three groups of non-attenders should be surveyed from different areas, so as to compare their oral health status with that of the attenders

15 years:

At this age, the permanent teeth have been exposed to the oral environment for 3-9 years. The assessment of caries prevalence is therefore often more meaningful than at 12 years of age. This age is also important for the assessment of periodontal disease indicators in adolescents.

35-44 years: (mean 40 years)

This age group is the standard monitoring group for health conditions of adults. The full effect of dental caries, the level of severe periodontal involvement and the general effects of care provided can be monitored using data for this age group.

65-74 years: (mean 70 years)

This age group has become more important with the changes in age distribution and increases in life span that are now occurring. Data for this group are needed both for planning appropriate care for the elderly and for monitoring the overall effects of oral care services in a population.

Number of subjects:

The number of subjects in each index age group to be examined ranges from a minimum of 25 to 50 for each cluster or sampling site, depending on the expected prevalence and severity of oral disease.

Eg. Sample design for a national pathfinder survey (usually 10 to 15 sampling sites are selected)

Urban:

4 sites in the city (4 x 25 = 100)
2 sites in 2 towns (2 x 2 x 25 = 100)

Rural:

1 site in each of 4 villages (4 x 25 = 100) in different regions

Total: 12 sites x 25 subjects = 300.

If this cluster distribution is applied to four index ages in the population, the total sample is = 4 x 300 = 1200

A total of 25 subjects is sufficient only in populations where caries and periodontal disease levels are estimated to be low or very low. In populations where these disease levels are moderate or high, (e.g. caries prevalence among 12 year olds is 90-95%) the standard size for each sample should be 40-50 subjects.

Caries prevalence is considered 'low' - if >20% of children are caries free.

Caries prevalence is 'moderate' - if 5-20% are caries free.

Caries prevalence is 'high' - if <5% are caries free.

(If the level of dental caries in the population is unknown, it is necessary to estimate the level of disease before starting a survey, e.g. 2 or 3 classes of 12 year olds of different socio-economic levels, in two or three schools are examined.)

THE WHO ORAL HEALTH ASSESSMENT FORM (1997)

The WHO Oral Health Assessment Form 1997 is a universally accepted and used recording methodology for oral health surveys.

Standard codes are used for all sections of the form. If some of the oral health assessments are not carried out, or are not applicable to the age group being examined, the unused sections of the form should be canceled with a diagonal line, or by using code 9 in the

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appropriate box (= not recorded).

The forms are designed to facilitate computer processing of the results. Each box is given an identification number (the small number in parentheses), which represents a location in a computer file. Recording codes are shown near the appropriate boxes. To minimize the number of errors, all entries must be clear and unambiguous.

The two-digit numbers above or below some of the boxes indicate specific teeth, according to the system used by the International Dental Federation (FDI). The first digit specifies the quadrant of the mouth and the second the actual tooth.

In designating a tooth, the examiner should call the quadrant number, then the tooth number - for example, the upper right second incisor, 12 = "one -two" rather than "twelve"; the lower left third molar, 38 = "three eight" rather than "thirty-eight".

Oral health assessment form

The standard form for oral health assessment is designed for collection of all the information needed for planning oral care services and thorough monitoring and replanning of existing care services. The form includes the following sections :

1. Survey identification information
2. General information
3. Extra-oral examination
4. Temporomandibular joint assessment
5. Oral mucosa
6. Enamel opacities / hypoplasia
7. Dental fluorosis
8. CPI (periodontal status, formerly called Community Periodontal Index of Treatment Needs or CPITN)
9. Loss of attachment
10. Dentition status and treatment need
11. Prosthetic status
12. Prosthetic need
13. Dentofacial anomalies
14. Need for immediate care and referral
15. Notes

This form can be used for surveying children as well as adults. Where only children are examined, it would not usually be necessary to record the presence of oral mucosal lesions, root caries, or prosthetic status or need. Similarly, if adults only are examined, it may be of little use to record dentofacial anomalies. For certain communities where extrinsic staining or other deposits obscure observation of tooth surfaces, it might also be impossible to score enamel opacities / hypoplasia or dental fluorosis.

Identification and general information sections of the form

The investigator should write the name of the country in which the survey was conducted in capital letters on the original assessment form before making additional copies. Boxes 1 - 4 on the form are reserved for the WHO code for the country in which the survey is carried out and should not be filled in by the investigator.

During the planning of the survey, a list of examination sites should be made and a two-digit code assigned to each one. The appropriate code should then be recorded in boxes 26 and 27 of each form during the survey. Similarly, a list of the examiners who will be involved in the study should be made and a code assigned to each one. If there is information about ethnic groups and occupations, or if it is intended to record other information such as fluoride content of the water or use of fluoride tablets, then the codes for this information should also be included in the coding list. This information should be entered in boxes 24, 25, 29 and 30.

Date of examination: (boxes 5 - 10)

The year, month and day should be written on

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the form at the time of the examination. Only the year and month (recorded in boxes 5 - 8) will be entered into the computer data file. Recording the day enables an investigator to refer back to any one day's examinations that may need to be reviewed or checked.

Identification number:(boxes 11-14)

Each subject examined should be given an identification number. This number should always have the same number of digits as the total number of subjects to be examined. Thus, if it is intended to examine 1000 subjects, the first subject should be numbered 0001.

If possible, the identification numbers should be entered on the forms before the day's work starts. It is important to ensure that each identification number is used only once. Cross-checking is necessary when more than one examiner participates in a survey. If a total of 1000 subjects are to be surveyed by two examiners, examiner 1 should use numbers 0001 - 0500, and examiner 2, numbers 0501 - 1000.

Examiner: (box 15)

If more than one examiner is participating in the survey, each examiner should be assigned a specific code which should be entered in box 15. Similarly, if a validating examiner is participating in the survey, he or she should also be assigned a specific code.

Original / duplicate examinations: (box 16)

If the subjects are being re-examined to assess reproducibility, then the first (original) examination is scored "1" and any subsequent duplication examinations are coded 2,3,4 etc., in box 16. For all subjects for which duplicate examinations have been made, data from the first examination only are included in the survey analysis.

Name:

The name of the subject may be written in block letters, beginning with the family name. It should be noted that, in some countries, identification of survey subjects by name is not permitted, in which case this space should be left blank.

Date of birth: (boxes 17 - 20)

Where possible, the year and month of birth should be entered for cross checking purposes.

Age: (boxes 21 and 22)

Age should be recorded as age at last birthday (ie, a child in the 13th year of life is 12). If the age is less than 10 years, "0" should be entered in box 21 (ie, 6 years - 06). In communities where age is normally expressed in another way, a conversion must be made. If the age of the subjects is not known, it may be necessary to make an estimate on the basis of, for instance, stage of tooth eruption or, for adults, major events in the community. Where age has been estimated, the manner of estimation should be reported.

Sex: (box 23)

This information should be recorded at the time of examination because it is not always possible to tell a person's sex from name alone. The appropriate code (1 = male, 2 = female) should be entered in box 23.

Ethnic group: (box 24)

In different countries, ethnic and other groups are identified in different ways e.g., by area or country of origin, race, color, language, religion or tribal membership. Local health and education authorities should be consulted before any decision is made as to which ethnic groups should be recorded. When this decision has been reached, a coding system should be made.

Note : The codes 0 - 8 may be used to identify different subgroups. Since it is often not possible to identify a person's ethnic origin

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from name alone, ethnic group information must be recorded at the time of the examination and coded in box 24.

Occupation: (box 25)

A coding system should be devised according to local usage for recording occupation groups and the appropriate code entered in box 25.

Note : The codes 0 - 8 may be used to identify different occupations.

Geographical location: (boxes 26 and 27)

Boxes 26 and 27 should be used to record the site where the examination is conducted. This allows up to 99 geographical locations (villages, schools etc.) to be identified (00 - 98). A list relating each location to its code number should be prepared. Usually, only a few codes are needed. The code "99" should be entered if this information is not recorded.

Location type: (box 28)

Box 28 is provided for recording information about each survey site. The purpose of including these data is to obtain general information about the availability of services at each survey site. Three codes are used :

1- Urban site.
2- Periurban area ; this has been included in order to indicate areas surrounding major towns, which may have characteristics similar to those of rural areas, i.e., very few health facilities of any kind and usually no access to oral health care facilities.
3- Rural area or small village.

Other data : (boxes 29 and 30)

Two boxes - 29 and 30 - have been provided for recording other information about the subjects examined or the survey location. Information such as use of tobacco or a chew stick, refugee status, or the level of fluoride in the water can be recorded here; if sugar intake was of interest, a system could be designed by the investigator whereby the level and frequency of intake were given suitable codes. It would be possible to summarize the results of the survey according to the different codes placed in these boxes.

Note : The codes 0 - 8 may be used in these boxes.

Contraindication to examination: (box 31)

Local practices must be taken into consideration when establishing the presence of conditions contraindicating the conduct of any part of the examination which might place subjects at risk or cause them discomfort. Examiners should use their judgement in this matter.

The following codes are used ;

0 - No contrainidication
1 - Contraindication

Clinical assessment

In order to ensure that all conditions are detected and diagnosed, it is recommended that the clinical examination follows the order of the assessment form.

Exta -oral examination (box 32)

The extra-oral examination should be performed in the following sequence :

a) general overview of exposed skin areas (head, neck, limbs)
b) perioral skin areas (nose, cheeks, chin)
c) lymph nodes (head, neck)
d) cutaneous parts of upper and lower lips
e) vermilion border and commissures
f) temporomandibular joint (TMJ) and parotid gland region

The following codes and criteria are used;

0 Normal extra-oral appearance,
1 Ulceration, sores, eriosions, fissures -

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head, neck, limbs
2 Ulceration, sores, erosions, fissures - nose, cheeks, chin.
3 Ulceration, sores, erosions, fissures - commissures
4 Ulceration, sores, erosions, fissures - vermilion border.
5 Cancrum oris.
6 Abnormalities of upper and lower lips (e.g., clefts)
7 Enlarged lymph nodes - head, neck
8 Other swelling of the face and jaws.
9 Not recorded.

Temporomandibular joint assessment: (boxes 33 - 36)

Symptoms (box 33).

The following codes and criteria are used;

0 No symptoms
1 Occurrence of clicking, pain or difficulties in opening or closing the jaw once or more per week.
9 Not recorded.

Signs (boxes 34 - 36).

The following codes and criteria are used;

0 No signs
1 Occurrence of clicking, tenderness (on palpation) or reduced jaw mobility (opening < 30 mm).
9 Not recorded.

Clicking (box 34) of one or both temporomandibular joints. Clicking is evaluated directly by an audible sharp sound or by palpation of the temporomandibular joints.

Tenderness (on palpation) (box 35) of the anterior temporalis and/or masseter muscles on one or both sides. The tenderness should be evaluated by unilateral palpation with the firm pressure of two fingers, exerted twice on the most voluminous part of the muscle. Tenderness is recorded only if the palpation spontaneously provokes an avoidance reflex.

Reduced jaw mobility (box 36) - opening of < 30 mm, taken as the distance between the incisal tips of the central maxillary and mandibular incisors. As a general guide, in an adult jaw, mobility is considered to be reduced if the subject is unable to open his or her jaw to the width of two fingers.

Oral mucosa: (boxes 37 - 42)

An examination of the oral mucosa and soft tissues in and around the mouth should be made on every subject. The examination should be thorough and systematic and be performed in the following sequence :

a) Labial mucosa and labial sulci (upper and lower)
b) Labial part of the commissures and buccal mucosa (right and left).
c) Tongue (dorsal and ventral surfaces, margins)
d) Floor of the mouth
e) Hard and soft palate
f) Alveolar ridges/ gingiva (upper and lower).

Either two mouth mirrors or one mirror and the handle of the periodontal probe can be used to retract the tissues. Boxes 37 - 39 should be used to record the absence, presence, or suspected presence, of the conditions coded 1 to 7 for which examiners can make a tentative diagnosis and to which they should be alert during clinical examinations. Code 8 should be used to record a condition not mentioned in the precoded list; for example, Hairy leukoplakia or Kaposi's sarcoma. Whenever possible, the tentative diagnosis should be specified in the space provided.

The codes and criteria are :

0 No abnormal condition
1 Malignant tumor (oral cancer).
2 Leukoplakia
3 Lichen planus
4 Ulceration (aphthous, herpetic, traumatic)
5 Acute necrotizing gingivitis

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6 Candidiasis
7 Abscess.
8 Other condition (specify if possible)
9 Not recorded.

The main location of the oral mucosal lesion(s) should be recorded in boxes 40 - 42 as follows;

0 Vermilion border
1 Commissures
2 Lips
3 Sulci
4 Buccal mucosa
5 Floor of the mouth
6 Tongue
7 Hard and / or soft palate
8 Alveolar ridges / gingiva.
9 Not recorded.

Enamel opacities / hypoplasia: (boxes 43 - 52)

The modified developmental defects of enamel (DDE) index is used. Enamel abnormalities are classified into one of three types on the basis of their appearance. They vary in their extent, position on the tooth surface, and distribution within the dentition.

The codes and criteria are as follows;

0 - Normal
1 -Demarcated opacity. In enamel of normal thickness and with an intact surface, there is an alteration in the translucency of the enamel, variable in degree. It is demarcated from the adjacent normal enamel with a distinct and clear boundary and can be white, cream, yellow or brown in color.
2 -Diffuse opacity. Also an abnormality involving an alteration in the translucency of the enamel, variable in degree, and white in enamel and the opacity can be linear or patchy or have a confluent distribution.
3 - Hypoplasia. A defect involving the surface of the enamel and associated with a localized reduction in the thickness of the enamel. It can occur in the form of : a) pits - single or multiple, shallow or deep, scattered, or in rows arranged horizontally across the tooth surface; b) grooves - single or multiple, narrow or wide (max. 2 mm); or c) partial or complete absence of enamel over a considerable area of dentine. The affected enamel may be translucent or opaque.
4 - Other defects
5 - Demarcated and diffuse opacities
6 - Demarcated opacities and hypoplasia
7 - Diffuse opacity and hypoplasia
8 - All three conditions
9 - Not recorded

Clinical examination

Ten index teeth should be examined on the buccal surfaces only and coded in boxes 43 - 52. If any index teeth are missing, the relevant box(es) should be left blank.

Buccal surfaces, i.e., from the incisal edges or cuspal points to the gingiva and from the mesial to the distal embrasure, should be inspected visually for defects and, if there is any doubt, areas such as hypoplastic pits should be checked with the periodontal probe to confirm the diagnosis. Any gross plaque or food deposits should be removed and the teeth should be examined in a wet condition.

Specific areas of concern in differentiating between enamel opacities and other changes in dental enamel are ; a) white spot decay; and (b) white cuspal and marginal ridges on premolar and molar teeth and, occasionally, on lateral incisors.

If there is any doubt about the presence of an abnormality, the tooth surface should be scored "normal" (code 0). Similarly, a tooth surface with a single abnormality less than 1 mm in diameter should be scored "0". Any abnormality that cannot be readily classified into one of the three basic types should be scored "other defects" (code 4). A tooth

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should be regarded as present once any part of it has penetrated the mucosa and any abnormality present on the erupted portion should be recorded. If more than two-thirds of a tooth surface is heavily restored, badly decayed or fractured, it should not be examined (code 9).

Dental fluorosis: (box 53)

Fluorotic lesions are usually bilaterally symmetrical and tend to show a horizontal striated pattern across the tooth. The premolars and second molars are most frequently affected, followed by the upper incisors. The mandibular incisors are least affected.

The examiner should note the distribution pattern of any defects and decide if they are typical of fluorosis. The defects in the "questionable" to "mild" categories (the most likely to occur) may consist of fine white lines or patches, usually near the incisal edges or cusp tips. They are paper white or frosted in appearance like a snow-capped mountain and tend to fade into the surrounding enamel.

WHO recommends that Dean's index criteria be used. (See chapter 13 Indices in Dental Epidemiology)

Community Periodontal Index (CPI): (boxes 54 - 59)

This index is based on a modification of the earlier used Community Periodontal Index of Treatment Needs (CPITN)

(See chapter 13 Indices in Dental Epidemiology)

Dentition status and treatment need: (boxes 66-161)

The examination for dental caries should be conducted with a plane mouth mirror. Radiography for detection of proximal caries is not recommended because of the impracticability of using the equipment in all situations. Likewise, the use of fibre optics is not recommended. Although it is realized that both these diagnostic aids will reduce the underestimation of the need for restorative care, the extra complication and frequent objections to exposure to radiation outweigh the gains to be expected.

Examiners should adopt a systematic approach to the assessment of dentition status and treatment needs. The examination should proceed in an orderly manner form one tooth or tooth space to the adjacent tooth or tooth space. A tooth should be considered present in the mouth when any part of it is visible. If a permanent and primary tooth occupy the same tooth space, the status of the permanent tooth only should be recorded.

Dentition status:

Both letters and numbers are used for recording dentition status. Boxes 66-97 are used for upper teeth and boxes 114-145 for lower teeth. The same boxes are used for recording both primary teeth and their permanent successors. An entry must be made in every box pertaining to coronal and root status. In the case of children, where the root status is not assessed, a code "9" (not recorded) should be entered in the box pertaining to root status.

Note : Considerable care should be taken to diagnose tooth-colored fillings, which may be extremely difficult to detect.

0 (A) Sound crown. A crown is recorded as sound if it shows no evidence of treated or untreated clinical caries. The stages of caries that precede cavitation, as well as other conditions similar to the early stages of caries, are excluded because they cannot be reliably diagnosed. Thus, a crown with the following defects, in the absence of other positive criteria, should be coded as sound;

- white or chalky spots;
- discolored or rough spots that are not soft to touch with a metal CPI probe:

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- stained pits or fissures in the enamel that do not have visual signs of undermined enamel, or softening of the floor or walls detectable with a CPI probe;
- dark , shiny, hard, pitted areas of enamel in a tooth showing signs of moderate to severe fluorosis;
- lesions that, on the basis of their distribution or history, or visual/tactile examination, appear to be due to abrasion.

Sound root:

A root is recorded as sound when it is exposed and showed no evidence of treated clinical caries. (Unexposed roots are coded 8.)

1 (B) Decayed crown.

Caries is recorded as present when a lesion in a pit or fissure, or on a smooth tooth surface, has an unmistakable cavity, undermined enamel, or a detectably softened floor or wall. A tooth with a temporary filing or one which is sealed (code 6(F)) but also decayed, should also be included in this category. In cases where the crown has been destroyed by caries and only the root is left, the caries is judged to have originated on the crown and therefore scored as crown caries only. The CPI probe should be used to confirm visual evidence of caries on the occlusal, buccal and lingual surface. Where any doubt exists, caries should not be recorded as present.

Decayed root:

3289

Caries is recorded as present when a lesion feels soft or leathery to probing with the CPI probe. If the root caries is discrete from the crown and will require a separate treatment, it should be recorded as root caries. For single carious lesion affecting both the crown and the root, the likely site of origin of the lesion should be recorded as decayed. When it is not possible to judge the site of origin, both the crown and the root should be recorded as decayed.

2 (C) Filled crown, with decay.

A crown is considered filled, with decay, when it has one or more permanent restoration and one or more areas that are decayed. No distinction is made between primary and secondary caries (i.e. the same code applies whether or not the carious lesions are in physical association with the restoration).

Filled root, with decay:

A root is considered filled, with decay, when it has one or more permanent restorations and one or more areas that are decayed. No distinction is made between primary and secondary caries.

In the case of fillings involving both the crown and the root, judgement of the site of origin is more difficult. For any restoration involving both the crown and the root with secondary caries, the most likely site of the primary carious lesion is recorded as filled, with decay. When it is not possible to judge the site of origin of the primary carious lesion, both the crown and the root should be recorded as filled, with decay.

3 (D) Filled crown, with no decay.

A crown is considered filled, without decay, when one or more permanent restorations are present and there is no caries anywhere on the crown. A tooth that has been crowned because of previous decay is recorded in this category. (A tooth that has been crowned for reasons other than decay, e.g. a bridge abutment, is coded 7 (G).)

Filled root, with no decay:

A root is considered filled, without decay, when one or more permanent restorations are present and there is no caries anywhere on the root.

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In the case of fillings involving both the crown and the root, judgement of the site of the origin is more difficult. For any restoration involving both the crown and the root, the most likely site of the primary carious lesion is recorded as filled. When it is not possible to judge the site of origin, both the crown and the root should be recorded as filled.

4 (E) Missing tooth, as a result of caries.

This code is used for permanent or primary teeth that have been extracted because of caries and is recorded under coronal status. For missing primary teeth, this score should be used only if the subject is at an age when normal exfoliation would not be a sufficient explanation for absence.

Note: The root status of a tooth that has been scored as missing because of caries should be coded "7" or 9".

In some age groups, it may be difficult to distinguish between unerupted teeth (code 8) and missing teeth (code 4 or 5). Basic knowledge of tooth eruption patterns, the appearance of alveolar ridge in the area of the tooth space in question and the caries status of other teeth in the mouth may provide helpful clues in making a differential diagnosis between unerupted and detracted teeth. Code 4 should not be used for teeth judged to be missing for any reason other than caries. For convenience, in fully edentulous arches, a single " 4" should be placed in boxes 66 and 81 and/or 114 and 129, as appropriate, and the respective pairs of members linked with straight lines.

5 (-) Permanent tooth missing, for any other reason.

This code is used for permanent teeth judged to be absent congenitally, or extracted for orthodontic reasons or because of periodontal disease, trauma, etc. As for code 4, two entries of code 5 can be linked by a line in cases of fully edentulous arches.

Note; the root status of a tooth scored 5 should be coded '" 7" or " 9 "

6 (F) Fissure sealant.

This code is used for teeth in which a fissure sealant has been placed on the occlusal surface; or for teeth in which the occlusal fissure has been enlarged with a rounded or " flame shaped " bur, and a composite material placed. If a tooth with a sealant has decay, it should be coded as 1 or B.

7 (G) Bridge abutment, special crown or veneer.

This code is used under coronal status to indicate that a tooth forms part of a fixed bridge, i.e. is a bridge abutment. This code can also be used for crowns placed for reasons other than caries and for veneers or laminates covering the labial surface of a tooth on which there is no evidence of caries or a restoration.

Note: Missing teeth replaced by bridge pontics are coded 4 or 5 under coronal status, while root status is scored 9 .

Implant: This code is used under root status to indicate that an implant has been placed as an abutment.

8 (-) Unerupted crown.

This classification is restricted to permanent teeth and used only for a tooth space with an unerupted permanent tooth but without a primary tooth. Teeth scored as unerupted are excluded from all calculations concerning dental caries. This category does not include congenitally missing teeth, or teeth lost as a result of trauma, etc. For differential diagnosis between missing and unerupted teeth, see code 5.

Unexposed root:

This code indicates that the root surface is not exposed, i.e. there is no gingival recession

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beyond the CEJ.

T (T) Trauma (fracture).

A crown is scored as fractured when some of its surface is missing as a result of trauma and there is no evidence of caries.

9 (-) Not recorded.

This code is used for any unerupted permanent tooth that cannot be examined for any reason (e. g. Because of orthodontic bands, severe hypoplasia, etc.) .

This code is used under root status to indicate either that the tooth has been extracted or that calculus is present to such an extent that a root examination is not possible.

Treatment needs of individual teeth:

Treatment requirements should be assessed for the whole tooth, including both coronal and root caries. Immediately after the status of a tooth is recorded, and before proceeding to the next tooth or tooth space, the type of treatment required, if any should be recoded (boxes 98-113 and 146- 161). If no treatment is required, code "0" should be placed in the appropriate treatment box. (If this is not done, it will be impossible to determine later, when the data are processed, whether no treatment was necessary, or whether the examiner or recorder omitted to make an appropriate entry.)

The codes and criteria for treatment needs are:

0- None (no treatment). This code is recorded if a crown and a root are both sound, or if it is decided that a tooth should not receive any treatment.
P- Preventive, caries-arresting care.
F- Fissure sealant.
1- One surface filling.
2- Two or more surface fillings.
One of the codes P, F, 1 or 2 should be used to indicate the treatment required, to

- treat initial, primary or secondary caries;
- treat discoloration of a tooth, or a developmental defect ;
- treat lesions due to trauma, abrasion, erosion or attrition;
- replace unsatisfactory fillings or sealants.

A sealant is considered unsatisfactory if partial loss has extended to exposure of a fissure, pit, or junction or surface of the dentine which, in the examiners opinion, requires resealing.

A filling is considered unsatisfactory if one or more of the following conditions exist:

- A deficient margin to an existing restoration that has leaked or is likely to permit leakage into the dentine. The decision as to whether a margin is deficient should be based on the examiner's clinical judgement, on evidence gained from the insertion of a CPI probe at the margin, or on the presence of severe staining of the tooth structure.
- An overhanging margin of an existing restoration that causes obvious local irritation to the gingiva and cannot be removed by recontouring of the restoration.
- A fracture of an existing restoration that either causes it to be loose or permits leakage into the dentin.
- Discoloration.

3- Crown for any reason.
4- Veneer or laminate (may be recommended for esthetic purposes).
5- Pulp care and restoration. This code is used to indicate that a tooth probably needs care prior to restoration with a filling or crown because of deep and extensive caries, or because of tooth mutilation or trauma.

Note : A probe should never be inserted into the depth of a cavity to confirm the presence of a suspected pulp exposure.

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6- Extraction. A tooth is recorded as "indicated for extraction " depending on the treatment possibilities available, when:

- caries has so destroyed the tooth that it cannot be restored
- periodontal disease has progressed so far that the tooth is loose, painful or functionless and, in the clinical judgement of the examiner, cannot be restored to a functional state
- a tooth needs to be extracted to make way for a prosthesis or
- extraction is required for orthodontic or cosmetic reasons, or because of impaction.

7/8 - Need for other care. The examiner should specify the types of care for which codes 7 and 8 are used. The use of these two codes should be kept to a minimum.

9- Not recorded.

Prosthetic status : (boxes 162 and 163)

The presence of prostheses should be recorded for each jaw (box 162, upper jaw; box 163, lower jaw). The following codes are provided for this:

0- No prosthesis.
1- Bridge.
2- More than one bridge.
3- Partial denture.
4- Both bridge(s) and partial denture(s)
5- Full removable denture.
9- Not recorded.

Prosthetic need: (boxes 164 and 165)

A recording should be made for each jaw on the perceived need for prostheses (box 164, upper jaw; box 165, lower jaw), according to the following codes:

0- No prosthesis needed.
1- Need for one-unit prosthesis (one tooth replacement).
2- Need for multi-unit prosthesis (more than one tooth replacement).
3- Need for a combination of one-and /or multi-unit prosthesis.
4- Need for full prosthesis(replacement of all teeth).
5- Not recorded.

Dentofacial anomalies : (boxes 166-176)

Dental Aesthetic Index (DAI) criteria are used. It is recommended that this index be used for age groups in which there are no longer primary teeth, usually from 12 years . The codes and criteria are as follows.

Missing incisor, canine and premolar teeth (boxes 166 and 167):

The number of missing permanent incisor, canine and premolar teeth in the upper and lower arches should be counted. This should be done by counting the teeth present, starting at the right second premolar and moving forward to the left second premolar. There should be 10 teeth present in each arch. If there are less than 10, the difference is the number missing. The number of missing teeth in the upper and lower arches should be recorded in boxes 166 and 167 of the assessment form (box 166, upper arch; box 167, lower arch). A history of all missing anterior teeth should be obtained to determine whether extractions were performed for aesthetic reasons. Teeth should not be recorded as missing if spaces are closed, if a primary tooth is still in position and its successor has not yet erupted, or if a missing incisor, canine or premolar tooth has been replaced by a fixed prosthesis.

Crowding in the incisal segments (box 168): Both the upper and the lower incisal segments should be examined for crowding. Crowding in the incisal segment is the condition in which the available space between the right and left canine teeth is insufficient to accommodate all four incisors in normal alignment. Teeth

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may be rotated or displaced out of alignment in the arch. Crowding in the incisal segments is recorded as follows:

0- No crowding.
1- One segment crowded.
2- Two segments crowded.

If there is any doubt, the lower score should be assigned. Crowding should not be recorded if the four incisors are in proper alignment but either or both canines are displaced.

Spacing in the incisal segments (box 169): Both the upper and lower incisal segments should be examined for spacing. When measured in the incisal segments, spacing is the condition in which the amount of space available between the right and left canine teeth exceeds that required to accommodate all four incisors in normal alignment. If one or more incisor teeth have proximal surface without any interdental contact, the segment is recorded as having space. The space from a recently exfoliated primary tooth should not be recorded if it appears that the permanent replacement will soon erupt. Spacing in the incisal segments is recorded as follows:

0- No spacing.
1- One segment spaced.
2- Two segments spaced.

If there is any doubt, the lower scores should be assigned.

Diastema (box 170): A midline diastema is defined as the space, in millimetres, between the two permanent maxillary insicors at the normal position of the contact points. This measurement can be made at any level between the mesial surface of the central incisiors and should be recorded to the nearest whole millimetre.

Largest anterior maxillary irregularity (box 171): Irregularities may be either rotation out of, or displacement from, normal alignment. The four incisors in upper (maxillary) arch should be examined to locate the greatest irregularity. The site of the greatest irregularity between adjacent teeth is measured using the CPI probe. The tip of the probe is placed in contact with the labial surface of the most lingually displaced or rotated incisor while the probe is held parallel to the occlusal plane and at right angles to the normal line of the arch. The irregularity in millimetres can then be estimated from the marking on the probe. It should be recorded to the nearest whole millimetre.

Irregularities may occur with or without crowding. If there is sufficient space for all four incisors in normal alignment but some are rotated or displaced, the largest irregularity is recorded as described above. The segment should not be crowded. Irregularities on the distal surface of the lateral incisors should also be considered, if present.

Largest anterior mandibular irregularity (box 172): The measurement is the same as on the upper arch except that it is made on the lower (mandibular) arch. The greatest irregularity between adjacent teeth on the lower arch is located and measured as described above.

Anterior maxillary overjet (box 173): Measurement of the horizontal relation of the incisors is made with the teeth in centric occlusion. The distance from the labial-incisal edge of the most prominent upper incisor to the labial surface of the corresponding lower incisor is measured with the CPI probe parallel to the occlusal plane. The largest maxillary overjet is recorded to the nearest whole millimetre. Maxillary overjet should not be recorded if all the upper incisors are missing or in lingual crossbite. If the incisors occlude edge to edge, the score is zero.

Anterior mandibular overjet (box 174): Mandibular overjet is recorded when any lower incisor protrudes anteriorly or labially to the opposing upper incisor, i.e., in crossbite. The largest mandibular overjet is

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recorded to the nearest whole millimetre. It should not be recorded if a lower incisor is rotated so that one part of the incisal edge is in crossbite but another part of the incisal edge is not.

Vertical anterior openbite (box 175): If there is a lack of vertical overlap between any of the opposing pairs of incisors, the amount of openbite is estimated using a CPI probe. The largest openbite is recorded to the nearest whole millimetre.

Antero-posterior molar relation (box 176): This assessment is most often based on the relation of the permanent upper and lower first molars. If the assessment cannot be based on the first molars because one or both are absent, not fully erupted, or misshapen because of extensive decay or fillings, the relations of the permanent canines and premolars are assessed. The right and left sides are assessed with the teeth in occlusion and only the largest deviation from the normal relation is recorded. The following codes are used:

0 -Normal.
1 -Half cusp. The lower first molar is half a cusp mesial or distal to its normal relation.
2 -Full cusp. The lower first molar is one cusp or more mesial or distal to its normal relation.

Need for immediate care and referral: (boxes 177-180):

It is the responsibility of the examiner or team leader to ensure that referral to an appropriate care facility is made, if needed.

There is a need for immediate care if pain, infection or serious illness will result unless treatment is provided within a certain period of time. This period may vary from a few days to a month, depending on the availability of oral health services. Examples of conditions that require immediate attention include periapical abscess and acute necrotizing ulcerative gingivitis. Gross caries and chronic alveolar abscesses may also be recorded in box 178.

Three boxes are provided for the recording of the presence (code 1) of the following condition:

- a life threatening condition (oral cancer or precancerous lesion) or other severe condition with clear oral manifestation (box 177);
- pain or infection that needs immediate relief (box178);
- other conditions, specify (box 179).

If the subject is referred for care, a "1" should be recorded in box 180.

The items coded in boxes 177-180 are not mutually exclusive; several recordings may be made when more than one condition requiring immediate attention is present.

Space is provided at the bottom of the assessment form for the examiner/recorder to note, for his or her own reference, any additional information that might be pertinent to the subject being examined.

CONCLUSION

Surveying is far more than just a collecting and arraying of facts. It is a task through which many key people in a community become aware of the dental needs of the community and what can be done about them. These people are the ones who will subsequently rally popular support for the program. The real focus of any dental health survey involves the measurement of dental disease or morbidity. The teeth and their surrounding structures are so definite, easy to observe and carry with them so much of their previous disease history that the measurement of dental disease is easier than the measurement of many other forms of disease.

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WHO ORAL HEALTH ASSESSMENT FORM (1997)

Country .....

Leave blank (1)[ ](4) | Year Month (5)[ ](8) | Day (9)[ ](10) | Identification number (11)[ ](14) | Examiner [ ](15) | Original/duplicate [ ](16)

GENERAL INFORMATION

Name .....

Date of birth (Year Month) (17)[ ](20)

Age in years (21)[ ](22)

Sex (M=1, F=2) [ ](23)

Ethnic group [ ](24)

Occupation [ ](25)

Geographical location (26)[ ](27)

Location type [ ](28)
1 = Urban
2 = Periurban
3 = Rural

OTHER DATA (specify and provide codes)

..... [ ](29)

..... [ ](30)

CONTRAINDICATION TO EXAMINATION

Reason ..... [ ](31)

..... 0=No 1=Yes

CLINICAL ASSESSMENT

EXTRA-ORAL EXAMINATION
0=Normal extra-oral appearance
1=Ulceration, sores, erosions, fissures (head, neck, limbs)
2=Ulceration, sores, erosions, fissures (nose, cheeks, chin)
3=Ulceration, sores, erosions, fissures (commissures)
4=Ulceration, sores, erosions, fissures (vermilion border)
5=Cancrum oris
6=Abnormalities of upper and lower lips
7=Enlarged lymph nodes (head, neck)
8=Other swellings of face and jaws
9= Not recorded
[ ](32)

TEMPOROMANDIBULAR JOINT ASSESSMENT

SYMPTOMS
0=No
1=Yes
9=Not recorded
[ ](33)

SIGNS
0=No
1=Yes
9=Not recorded

Clicking [ ](34)
Tenderness (on palpation) [ ](35)
Reduced jaw mobility (<30mm opening) [ ](36)

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ORAL MUCOSA

CONDITION

0 = No abnormal condition
1 = Malignant tumour (oral cancer)
2 = Leukoplakia
3 = Lichen planus
4 = Ulceration (aphthous, herpetic, traumatic)
5 = Acute necrotizing gingivitis
6 = Candidiasis
7 = Abscess
8 = Other condition (specify if possible)
9 = Not recorded

(37) ☐ ☐ (40)
(38) ☐ ☐ (41)
(39) ☐ ☐ (42)

LOCATION

0 = Vermilion border
1 = Commissures
2 = Lips
3 = Sulci
4 = Buccal mucosa
5 = Floor of mouth
6 = Tongue
7 = Hard and/or soft palate
8 = Alveolar ridges/ gingiva
9 = Not recorded

ENAMEL OPACITIES / HYPOPLASIA

Permanent teeth

0 = Normal
1 = Demarcated opacity
2 = Diffuse opacity
3 = Hypoplasia
4 = Other defects
5 = Demarcated and diffuse opacities
6 = Demarcated opacity and hypoplasia
7 = Diffuse opacity and hypoplasia
8 = All three conditions
9 = Not recorded

14 13 12 11 21 22 23 24
(43) ☐☐☐☐☐☐☐☐ (50)
(51) ☐ ☐ (52)
46 36

DENTAL FLUOROSIS

0 = Normal
1 = Questionable
2 = Very mild
3 = Mild
4 = Moderate
5 = Severe
8 = Excluded
9 = Not recorded

☐ (53)

COMMUNITY PERIODONTAL INDEX (CPI)

0 = Healthy
1 = Bleeding
2 = Calculus
3*= Pocket 4-5 mm (Black band on probe partially visible)
4*=Pocket 6 mm or more (Black band on probe not visible)
X = Excluded sextant
9 = Not recorded
*Not recorded under 15 years of age

17/16 11 26/27
(54) ☐☐☐ (56)
(57) ☐☐☐ (59)
47/46 31 36/37

LOSS OF ATTACHMENT*

0 = 0-3 mm
1 = 4-5 mm (cementoenamel junction (CEJ) within black band)
2 = 6-8 mm (CEJ between upper limit of black band and 8.5mm ring)
3 = 9-11 mm (CEJ between 8.5- mm and 11.5-mm rings)
4 = 12 mm or more (CEJ beyond 11.5-mm ring)
X = Excluded sextant
9 = Not recorded
* Not recorded under 15 years of age

17/16 11 26/27
(60) ☐☐☐ (62)
(63) ☐☐☐ (65)
47/46 31 36/37

DENTITION STATUS AND TREATMENT NEED

Identification number _____

* Not recorded under 15 years of age

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DENTITION STATUS AND TREATMENT NEED

Identification number ☐☐☐☐

55 54 53 52 51 61 62 63 64 65
18 17 16 15 14 13 12 11 21 22 23 24 25 26 27 28

Crown (66) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ (81)
Root (82) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ (97)
Treatment (98) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ (113)

85 84 83 82 81 71 72 73 74 75
48 47 46 45 44 43 42 41 31 32 33 34 35 36 37 38

Crown (114) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ (129)
Root 130) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ (145)
Treatment (146) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ (161)

Primary teeth Crown	Permanent teeth Crown/ Root		STATUS	TREATMENT
A	0	0	Sound	0 = None
B	1	1	Decayed	P = Preventive, caries arresting care
C	2	2	Filled, with decay	F = Fissure sealant
D	3	3	Filled, no decay	1 = One surface filling
E	4	-	Missing, as a result of caries	2 = Two or more surface fillings
-	5	-	Missing any other reason	3 = Crown for any reason
F	6	-	Fissure sealant	4 = Veneer or laminate
G	7	7	Bridge abutment, Special crown or veneer/ implant	5 = Pulp care and restoration
-	8	8	Unerupted tooth, (crown)/unexposed root	6 = Extraction
				7 = Need for other care (specify).....
T	T	-	Trauma (Fracture)	8 = Need for other care (specify).....
-	9	9	Not recorded	9 = Not recorded

PROSTHETIC STATUS

0 = No prosthesis
1 = Bridge
2 = More than one bridge
3 = Partial denture
4 = Both bridge(s) and partial denture(s)
5 = Full removable denture
9 = Not recorded

Upper Lower
(162) ☐☐ (163)

PROSTHETIC NEED

0 = No prosthesis needed
1 = Need for one- unit prosthesis
2 = Need for a combination of one- and/ or multi- unit prostheses
4 = Need for full prosthesis (replacement of all teeth)
9 = Not recorded

Upper Lower
(164) ☐☐ (165)

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DENTOFACIAL ANOMALIES

DENTITION

(166) ☐☐ (167) Missing incisor, canine and premolar teeth --- maxillary and mandibular --- enter number of teeth

SPACE

☐ (168) Crowding in the incisal segments:

0 = No crowding
1 = One segment crowded
2 = Two segment crowded

☐ (169) Spacing in the incisal segments:

0 = No spacing
1 = One segment spaced
2 = Two segments spaced

☐ (170) Diastema in mm

☐ (171) Largest anterior maxillary irregularity in mm

☐ (172) Largest anterior mandibular irregularity in mm

OCCLUSION

☐ (173) Anterior maxillary overjet in mm

☐ (174) Anterior mandibular overjet in mm

☐ (175) Vertical anterior openbite in mm

☐ (176) Antero- posterior molar relation

0 = Normal
1 = Half cusp
2 = Full cusp

NEED FOR IMMEDIATE CARE AND REFERRAL

Life- threatening condition ☐ (177)

Pain or infection ☐ (178)

Other condition (Specify)..... ☐ (179)

0 = Absent
1 = Present
9 = Not recorded

Referral
0 = No
1 = Yes
9 = Not recorded

☐ (180)

NOTES

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Chapter 13

INDICES IN DENTAL EPIDEMIOLOGY

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INTRODUCTION
DEFINITIONS
TOOTH NUMBERING SYSTEMS
IDEAL REQUISITES OF AN INDEX
CRITERIA FOR SELECTING AN INDEX
CLASSIFICATION OF INDICES
USES OF AN INDEX
INDICES USED FOR ASSESSING ORAL HYGIENE AND PLAQUE
- ORAL HYGIENE INDEX (OHI)
- SIMPLIFIED ORAL HYGIENE INDEX (OHI-S)
- SILNESS AND LOE PLAQUE INDEX (PII)
- TURESKY - GILMORE - GLICKMAN MODIFICATION OF THE QUIGLEY - HEIN PLAQUE INDEX

INDICES USED FOR ASSESSING GINGIVAL AND PERIODONTAL DISEASE
- PMA INDEX
- LOE AND SILNESS GINGIVAL INDEX (GI)
- RUSSELL'S PERIODONTAL INDEX (PI)
- PERIODONTAL DISEASE INDEX (PDI)
- COMMUNITY PERIODONTAL INDEX OF TREATMENT NEEDS (CPITN)
- COMMUNITY PERIODONTAL INDEX AND LOSS OF ATTACHMENT (CPI & LoA)

INDICES USED FOR ASSESSING DENTAL CARIES
- DMFT INDEX
- DMFS INDEX
- deft/s INDEX
- SIGNIFICANT CARIES INDEX (SiC)
- ROOT CARIES INDEX (RCI)

INDICES USED FOR ASSESSING DENTAL FLUOROSIS
- DEAN'S FLUOROSIS INDEX
- COMMUNITY FLUOROSIS INDEX (C F I)

INDICES USED FOR ASSESSING MALOCCLUSION
- DENTAL AESTHETIC INDEX (DAI)
- INDEX OF ORTHODONTIC TREATMENT NEEDS (IOTN)

OTHER INDICES

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INTRODUCTION

Dental index or indices are devices to find out the incidence, prevalence and severity of the disease, based on which preventive programs can be adopted.

An index is an expression of the clinical observation in a numerical value. It helps to describe the status of the individual or group with respect to a condition being measured. An index score can be more consistent and less subjective than a word description of that condition.

DEFINITIONS

"A numerical value describing the relative status of a population on a graduated scale with definite upper and lower limits, which is designed to permit and facilitate comparison with other populations classified by the same criteria and methods".

- Russell A.L.

"Epidemiologic indices are attempts to quantitate clinical conditions on a graduated scale, thereby facilitating comparison among populations examined by the same criteria and methods.

- Irving Glickman

TOOTH NUMBERING SYSTEMS

The different methods of annotating teeth are,

1. Zsigmondy Palmer System

The first 'modern' system was developed by the Hungarian dentist, Adolf Zsigmondy (1861) in Vienna. It uses a quadrant plan in which each quadrant is symbolized by a 'corner' into which a number is placed to denote the teeth, from 1 to 8. An example is 6⌋ which is the upper right first permanent molar. This system is frequently used today despite the difficulty in typing the 'corner' symbol. It is the preferred method used in the United Kingdom. In the USA it is known as the Palmer system.

PERMANENT TEETH

RIGHT	87654321 | 12345678	LEFT
	87654321 | 12345678	

Deciduous dentition

Letters instead of numbers for deciduous teeth were added in 1874.

DECIDUOUS TEETH

RIGHT	EDCBA | ABCDE	LEFT
	EDCBA | ABCDE	

Advantages of Palmer notation,

- It can produce a very graphical image, akin to a 'map' of the dentition;
- Tooth transpositions or edentulous spaces can easily be depicted if desired.
- It would also be feasible to introduce additional alphabetic characters or other symbols, for example to denote supernumerary teeth or bridge pontics, to which a purely numerical method such as the FDI system does not lend itself easily.

2. The Universal / National System

Proposed by a German dentist, Julius Parreidt (1812), this method begins with upper right third molar = 1. It proceeds clockwise around the mouth and ends with lower right third molar = 32. As this system is digital, it is easily transcribed and computerized, but does not allow a 'visual' perception of the tooth type and location. It is the commonly used method in USA.

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PERMANENT TEETH

RIGHT	1 2 3 4 5 6 7 8	9 10 11 12 13 14 15 16	LEFT
	32 31 30 29 28 27 26 25	24 23 22 21 20 19 18 17	

DECIDUOUS TEETH

ABCDE	FGHIJ
TSRQP	ONMLK

3. The FDI two digit system (1971) (The ISO/FDI two-digit system)

The FDI two-digit system was introduced in 1970 by the Fédération Dentaire Internationale (now known as the FDI World Dental Federation). It is a wholly digital system of tooth notation that makes visual sense, cognitive sense, and computer sense. This notation is also known as ISO-3950 notation.

A mention is in order about the ISO and the "TC 106" standards (of which the FDI system is a part) that the ADA officially endorsed. The ISO (International Standards Organization) is a worldwide federation of national standards bodies based in Geneva, Switzerland. It consists of technical committees that represent an array of disciplines seeking improved international standardization. Technical Committee (TC) 106 specifically represents the field of Dentistry in the organization. In 1977, ISO TC 106 published ISO 3950 entitled, "Dentistry--Designation system for teeth and areas of the oral cavity," based upon the FDI two-digit tooth numbering system with additional numeric notations for areas of the mouth. A second edition of the ISO 3950 document was issued in 1984.

FDI World Dental Federation notation is widely used by dentists internationally to associate information to a specific tooth.

Orientation of the chart is traditionally "dentist's view", i.e. patient's right corresponds to notation chart left. The designations "left" and "right" on the chart, however, nonetheless correspond to the patient's left and right, respectively.

This numerical coding system is used for

MAXILLA

RIGHT	55 54 53 52 51 18 17 16 15 14 13 12 11	61 62 63 64 65 21 22 23 24 25 26 27 28	LEFT
	48 47 46 45 44 43 42 41 85 84 83 82 81	31 32 33 34 35 36 37 38 71 72 73 74 75	

MANDIBLE

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recording the status of deciduous and permanent teeth. It uses:

- The first digit specifies the quadrant of the mouth
- The second digit is the actual tooth

Permanent teeth use the prefix:

1 = upper right; 2 = upper left; 3 = lower left; 4 = lower right

Deciduous teeth use the prefix:

5 = upper right; 6 = upper left, 7 = lower left; 8 = lower right

E.g. the upper right first molar is 16 (one-six not sixteen)

International Organization for Standards (ISO) has added refinements (ISO 3950) to the FDI system to designate areas of the oral cavity and to provide 'sextants' as with the CPITN.

00 whole oral cavity

01 maxillary area

02 mandibular area

03 upper right sextant

04 upper anterior sextant

05 upper left sextant

06 lower left sextant

07 lower anterior sextant

08 lower right sextant

09 additional document

Thus ISO 3950 provides a two-digit designation of the teeth and indicates areas of the oral cavity.

IDEAL REQUISITES OF AN INDEX

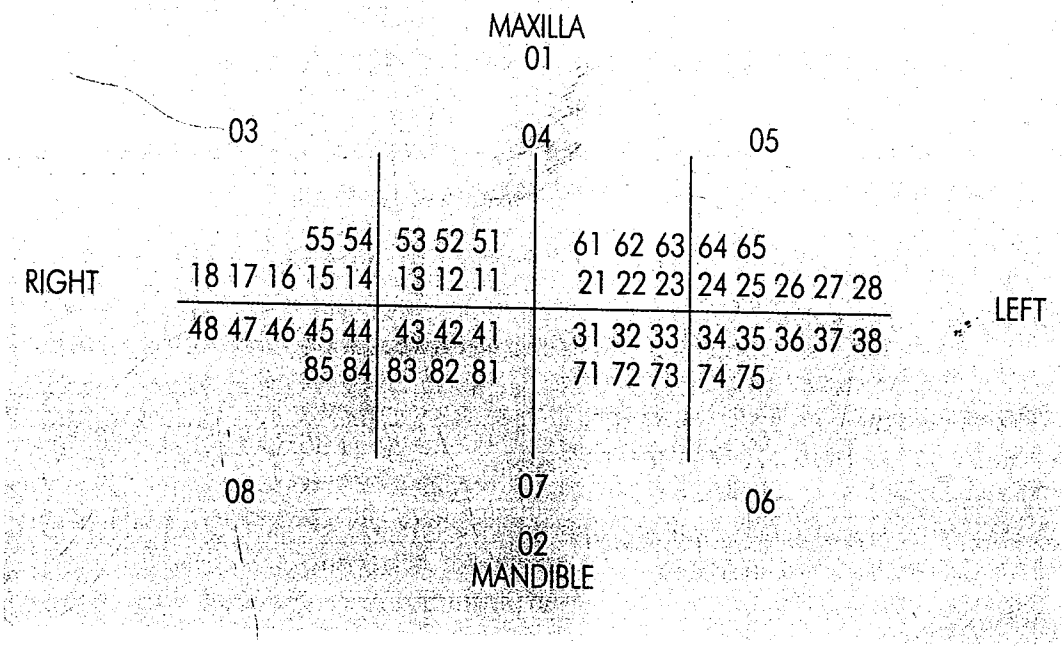
Ideally, an index should possess the following properties:

Clarity, simplicity and objectivity:

The examiner should be able to remember the rules of the index clearly in his mind. The index should be simple and easy to apply so that there is no undue time lost during field examinations. The criteria for the index should be objective and unambiguous, with mutually exclusive categories.

Validity:

The index must measure what it is intended to measure and it should correspond with the clinical stages of the disease under study at each point.



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Reliability:

The index should measure consistently at different times and under a variety of conditions. The term "reliability" is virtually synonymous with reproducibility, which means the ability of the same (intra examiner reproducibility) or different examiners (inter examiner reproducibility) to interpret and use the index in the same way.

Quantifiability:

The index should be amenable to statistical analysis, so that the status of a group can be expressed by a number that corresponds to a relative position on a scale from zero to the upper limit.

Sensitivity:

The index should be able to detect reasonably small shifts, in either direction in the group condition.

Acceptability:

The use of the index should not be painful or demeaning to the subject.

In practice no index or measure is wholly accurate and probably no index used in oral epidemiology completely meets all of these conditions, but the choice of an index in any given situation should be made on the basis of how closely the index approximates them and by the requirements of the study in which the index is being used.

CRITERIA FOR SELECTING AN INDEX

1. The index must be simple to use and calculate.
2. The index should permit the examination of many people in a short period of time.
3. The index should require minimum armamentarium and expenditure.
4. The index should have the criteria's, which defines its components clear and readily understandable so as to promote miner maximum intra and inter examiner reproducibility and standardization.
5. The index should be as free as possible from subjective interpretation.
6. The index should define clinical conditions objectively.
7. The index should be highly reproducible in assessing a clinical condition when used by one or more examiners.
8. The index should be amenable to statistical analysis.
9. The index should be strongly related numerically to the clinical stages of the specific disease under investigation.
10. The index should be equally sensitive throughout the scale, if it relates to the severity of a variable.
11. The index should not cause discomfort to the patient and should be acceptable to the patient.

CLASSIFICATION OF INDICES

In general, there are two types of dental indices.

The first type of index measures the 'number' or 'proportion' of people in a population with or without a specific condition at a specific point in time or interval of time.

The second type of dental index measures the 'number' of people affected and the 'severity' of the specific condition at a specific time or interval of time.

1. Based upon the direction in which their scores can fluctuate,

- Irreversible Index:
  An index that measures conditions whose scores will not decrease on subsequent examinations.

Eg : DMFT Index

- Reversible Index:
  An index that measures conditions that can increase or decrease on subsequent examinations. Eg : Loe and Silness Gingival Index.

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2. Depending upon the extent to which areas of oral cavity are measured,

- Full Mouth Indices:

  These indices measure the patient's entire periodontium or dentition.

Eg: Russell's Periodontal Index (PI).

- Simplified Indices:
  These indices measure only a representative sample of the dental apparatus. Eg: Greene & Vermillion's Oral Hygiene Index-Simplified (OHI-S).

3. Indices may be classified under certain general categories according to the entity which they measure,

- Disease Index
  The 'D' (decay) portion of the DMFT Index best exemplifies a disease index.
- Symptom Index
  The indices measuring gingival / sulcular bleeding are essentially symptom indices.
- Treatment Index
  The 'F' (filled) portion of the DMFT Index best exemplifies a treatment index.

4. Dental indices can also be classified under special categories as,

- Simple Index:
  An index that measures the presence or absence of a condition.

Eg: Silness and Loe Plaque Index

- Cumulative Index:
  An index that measures all the evidence of a condition, past and present.

Eg : DMFT Index for dental caries.

USES OF AN INDEX

When used for individuals, an index can,

1. Provide individual assessment to help a patient recognize an oral problem.
2. Reveal the degree of effectiveness of present oral hygiene practices.
3. Motivate the person in preventive and professional care for the elimination and control of oral disease.
4. Evaluate the success of individual and professional treatment over a period of time by comparing index scores.

When used in research, an index can,

1. Determine baseline data before experimental factors are introduced.
2. Measure the effectiveness of specific agents or devices for the prevention, control or treatment of oral conditions.

When used in community health, an index can,

1. Show the prevalence and trends of incidence of a particular condition occurring within a given population.
2. Provide baseline data to show existing dental health conditions in the community.
3. Assess the needs of a community.
4. Compare the effects of a community program and evaluate the results.

INDICES USED FOR ASSESSING ORAL HYGIENE AND PLAQUE

ORAL HYGIENE INDEX (OHI)

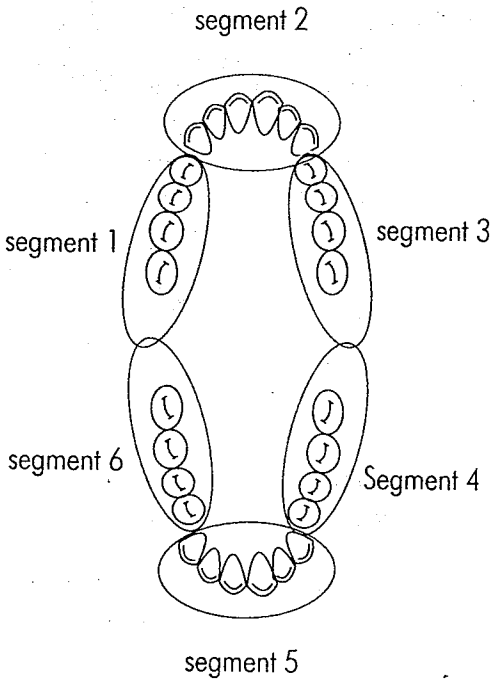
The Oral Hygiene Index (OHI) was developed in 1960 by John C. Greene and Jack R. Vermillion to classify and assess oral hygiene status.

This index was developed to study variations in gingival inflammation in relation to the degree of mental retardation in children. It was depicted as a sensitive, simple and rapid method for assessing group or individual oral hygiene quantitatively.

Methodology:

The Oral Hygiene Index comprises of 2

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components, the Debris Index (DI) and the Calculus Index (CI). Each of these index is based on 12 numerical determinations representing the amount of debris or calculus found on the buccal and lingual surfaces of each of the three segments of each dental arch (see picture) namely

Segment 1: Distal to the right cuspid on the maxillary arch

Segment 2: Mesial to the right and left first bicuspids on the maxillary arch

Segment 3: Distal to the left cuspid on the maxillary arch

Segment 4: Distal to the left cuspid on the mandibular arch

Segment 5: Mesial to the right and left first bicuspids on the mandibular arch

Segment 6: Distal to the right cuspid on the mandibular arch

Each segment is examined for debris or calculus. From each segment one tooth is used for calculating the individual index, for that particular segment. The tooth used for the calculation must have the greatest area covered by either debris or calculus.

Rules:

1. Only fully erupted permanent teeth are scored. (occlusal or incisal surface has reached the occlusal plane)
2. Third molars are not included.
3. The scoring for the buccal/labial and lingual surfaces is based on the tooth in the designated segment that has the greatest surface area of debris for the DI or supragingival and subgingival calculus for the CI. Therefore, the buccal/labial score and the lingual score for a segment need not be taken from the same tooth.

Procedure:

For the Debris Index,

The surface area covered by debris is estimated by running the side of a No. 23 explorer (Shepherd's hook) along the buccal/labial and lingual surfaces and noting the occlusal or incisal extent of the debris as it is removed from the tooth surface.

For the Calculus Index,

A No. 5 explorer is used for estimating the amount of supragingival and subgingival calculus.

The oral hygiene examination and scoring for the DI always should precede the oral examination and scoring for the CI.

In all, there are a total of 12 scores and a maximum number of 6 segments to be examined. According to the developers, less than four minutes per person were required to record scoring for oral hygiene.

For the DI and CI, the sequence of the oral hygiene examination should proceed in the following manner: First, the buccal, then the lingual surfaces of the teeth in the upper right posterior segment. Next, the labial and lingual surfaces of the teeth in the upper anterior segment. And finally, the buccal and lingual surfaces of the upper left posterior.

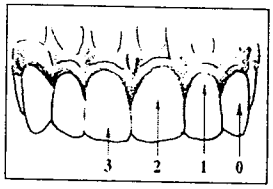
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This same procedure continues in the lower arch, except from left to right, the lower left posterior segment, lower anterior segment, and the lower right posterior segment.

The criteria and scoring are as follows,

Debris Index (DI)

Score	Criteria
0	No debris or stain present
1	Soft debris covering not more than one third of the tooth surface, or the presence of extrinsic stains without other debris regardless of surface area covered
2	Soft debris covering more than one third, but not more than two thirds, of the exposed tooth surface
3	Soft debris covering more than two thirds of the exposed tooth surface.



Calculus Index (CI)

Score	Criteria
0	No calculus present
1	Supragingival calculus covering not more than one third of the exposed tooth surface.
2	Supragingival calculus covering more than one third but not more than two thirds of the exposed tooth surface or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth or both.
3	Supragingival calculus covering more than two third of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth or both.

Calculation

The buccal/labial and lingual scores are tabulated and totaled for each segment and arch. The debris and calculus scores are tabulated separately and the indices for each are calculated independently.

For an individual, the formulas for the DI and CI are:

DI = Buccal total score + Lingual total score/Number of segments scored

CI = Buccal total score + Lingual total score/Number of segments scored

To calculate the OHI, the DI and CI are summed:

OHI = DI + CI

The DI and CI values range from 0 to 6, and OHI value ranges from 0 to 12.

The OHI can also be calculated for groups by dividing the sum of the indices determined for individuals by the total number of persons.

Interpretation

- The minimum number of points for all segments in either the debris or calculus score is 0.
- The maximum number of points for all segments in either the debris or calculus score is 36.
- Since the oral hygiene index is the sum of the two indices, its range of values is from 0 to 12.
- The higher the score, the poorer the oral hygiene.

SIMPLIFIED ORAL HYGIENE INDEX (OHI-S)

The Simplified Oral Hygiene Index (OHI-S) was developed in 1964 by John C. Greene and Jack R. Vermillion.

Even though the Oral Hygiene Index was determined to be simple and sensitive, it was time-consuming and required more

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decision-making. So, an effort was made to develop a more simplified version with equal sensitivity.

The Simplified Oral Hygiene Index (OHI-S) differs from the Oral Hygiene Index in,

- The number of tooth surfaces scored (6 rather than 12)
- The method of selecting the surface to be scored
- The scores, which can be obtained

However, the criteria and scoring for the tooth surfaces remain the same.

Surfaces and Teeth to be examined

16 - Upper right first molar	Buccal
11 - Upper right central incisor	Labial
26 - Upper left first molar	Buccal
36 - Lower left first molar	Lingual
31 - Lower left central incisor	Labial
46 - Lower right first molar	Lingual

Substitution:

For tooth 16	:	Tooth 17
If 17 is missing		Tooth 18
For tooth 11	:	Tooth 21
For tooth 26	:	Tooth 27
If 27 is missing		Tooth 28
For tooth 36	:	Tooth 37
If 37 is missing		Tooth 38
For tooth 31	:	Tooth 41
For tooth 46	:	Tooth 47
If 47 is missing		Tooth 48

At least two of the six possible tooth surfaces must have been examined. Third molars are included only if they are functional

Exclusions:

Natural teeth with full crown restorations and surfaces reduced in height by caries or trauma are not scored.

Instruments used:

Mouth mirror, No. 23 explorer (Shepherd's Hook)

Examination Methods and Scoring System

The OHI-S has two components, the Simplified Debris Index (DI-S) and the Simplified Calculus Index (CI-S).

Debris Index - Simplified (DI - S)

The surface area covered by debris is estimated by running the side of an explorer (Shepherd's Hook) along the tooth surface being examined. The occlusal or incisal extent of the debris is noted as it is removed.

The oral hygiene examination and scoring for the DI always should precede the oral examination and scoring for the CI.

Scoring criteria for Debris Index - Simplified

Score	Criteria
0	No debris or stain present
1	Soft debris covering not more than one third of the tooth surface, or presence of extrinsic stains without other debris regardless of surface area covered
2	Soft debris covering more than one third, but not more than two thirds, of the exposed tooth surface.
3	Soft debris covering more than two thirds of the exposed tooth surface.

After the six possible debris scores are recorded, the teeth are then examined for calculus.

Calculus Index Simplified (CI - S)

There are two main types of dental calculus, which are differentiated primarily by location on the tooth in relation to the free gingival margin.

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1) Supragingival Calculus - denotes deposits, usually white to yellowish-brown in color, occlusal to the free gingival margin.
2) Subgingival Calculus - denotes deposits usually light brown to black in color, apical to the free gingival margin.

Scoring criteria for Calculus Index - Simplified

Score	Criteria
0	No calculus present
1	Supragingival calculus covering not more than one third of the exposed tooth surface.
2	Supragingival calculus covering more than one third but not more than two thirds of the exposed tooth surface or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth or both.
3	Supragingival calculus covering more than two third of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth or both.

Calculation of the Index

For each individual, the debris and calculus scores are totaled and divided by the number of tooth surfaces scored.

Calculation of DI-S score = $\frac{\text{Total score}}{\text{No. of surfaces examined}}$

Calculation of CI-S score = $\frac{\text{Total score}}{\text{No. of surfaces examined}}$

Once the DI-S and CI-S are calculated separately, then they are added together to get the OHI-S score.

RECORDING FORMAT FOR OHI-S

Debris Index - Simplified (DI-S)

16 11 26

☐ ☐ ☐ Score ☐

☐ ☐ ☐ Good/ Fair/Poor

46 31 36

Calculus Index - Simplified (CI-S)

16 11 26

☐ ☐ ☐ Score ☐

☐ ☐ ☐ Good/ Fair/Poor

46 31 36

OHI-S = DI-S + CI-S

Score ☐ Good/ Fair/Poor

OHI-S = DI-S + CI-S

Interpretation:

For the DI-S and CI-S score,

Good - 0.0 to 0.6

Fair - 0.7 to 1.8

Poor - 1.9 to 3.0

For the OHI-S score,

Good - 0.0 to 1.2

Fair - 1.3 to 3.0

Poor - 3.1 to 6.0

For an individual score,

- Scores are calculated to one decimal place

For a group of individuals,

- The debris and calculus scores are obtained by calculating the average of the individual scores.

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- The group scores may be calculated to one or two decimal places, depending on the sample size.

Uses of OHI-S Index :

- It has been widely used in studies of the epidemiology of periodontal disease.
- It is useful in evaluation of dental health education programs in public school systems.
- It is used in evaluating the cleansing efficiency of tooth brushes.
- It is used to evaluate an individual's level of oral cleanliness

PLAQUE INDEX (PII)

The Plaque Index was described by Silness P. and Loe H. in 1964 and more fully described by Loe H. in 1967.

The Plaque Index is unique among the indices used for assessment of plaque because it ignores the coronal extent of plaque on the tooth surface area and assesses only the thickness of plaque at the gingival area of the tooth. This index is one of the most widely used and has demonstrated good validity and reliability. It can be used as a full mouth index or as a simplified index.

Drawback:

One criticism is the subjectivity in estimating plaque. To overcome this, it is recommended that a single examiner be trained and used with each group of patients.

The six index teeth are,

16	Maxillary right first molar
12	Maxillary right lateral incisor
24	Maxillary left first bicuspid
36	Mandibular left first molar
32	Mandibular left lateral incisor
44	Mandibular right first bicuspid

If any one of the above mentioned index teeth are missing, there is no substitution and a full mouth examination has to be done.

The surfaces examined are,

The four gingival areas of the tooth,

the disto-facial, facial, mesio-facial and lingual surfaces.

- Third molars are not examined or scored in the upper or lower arch
- When both the GI and PII are to be assessed, the examination for the PII should always precede the examination for the GI.
- Under optimal conditions and chair-side assistance, the scoring of all teeth for the PII takes approximately five minutes per person.

In 1967, Loe modified the criteria for score 1 so as to exclude the application of disclosing solution. Other criteria remained the same. He also gave the detailed examination as,

1. For the maxillary arch, examination starts with the upper right second molar and continues over the midline to the upper left second molar.
   For teeth on the right side of the midline, the exam sequence is distal, buccal (labial), and mesial. On the left side, the exam sequence is mesial, buccal (labial), and distal.
   When the three surfaces of all teeth have been scored, the lingual surfaces of all the upper or maxillary teeth are assessed beginning with the upper left second molar.
2. For the mandibular arch, the examination begins with the lower left second molar through to the right second molar.
   On the left side of the midline, the exam sequence is distal, buccal (labial) and mesial, and on the right side it is mesial, buccal (labial) and distal.
   Afterwards, all lingual surfaces are scored beginning with the left second molar.

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Instruments used:

A mouth mirror, a dental explorer and airdrying of the teeth and gingiva

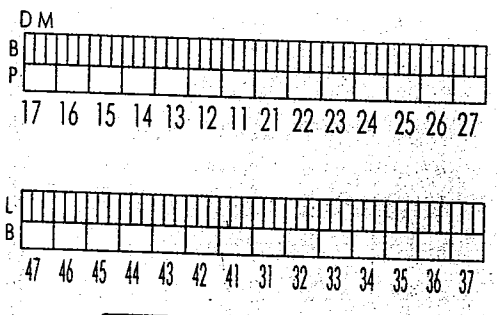
Procedure:

The tooth is air dried and examined visually. When no plaque is visible an explorer is used to test the surface. The explorer is passed across the tooth surface in the cervical third and near the entrance to the gingival sulcus. When no plaque adheres to the point of the explorer, the area is considered to have a '0' score. When plaque adheres, a score of '1' is assigned. Plaque that is on the surface of calculus deposits and on dental restorations of all types in the cervical third is evaluated and included.

Scoring Criteria:

Score	Criteria
0	No plaque
1	A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may be seen only by running a probe across the tooth surface.
2	Moderate accumulation of soft deposits within the gingival pocket, on the gingival margin and/or adjacent tooth surface, which can be seen by the naked eye.
3	Abundance of soft matter within the gingival pocket and/or on the gingival margin and adjacent tooth surface.

RECORDING FORMAT FOR PLAQUE INDEX



Score = ☐ Excellent/Good/Fair/Poor

Calculation of PII :

PII score for the area :

Each area (disto-facial, facial, mesio-facial, lingual) is assigned a score from 0 to 3.

PII score for a tooth :

The scores from the four areas of the tooth are added and then divided by four.

PII score for the individual :

The indices for each of the teeth are added and then divided by the total number of teeth examined. The scores range from 0 to 3.

PII score for a group :

The indices for each member of a group or population is added up and then divided by the total number of individuals in the group or population.

Interpretation:

Excellent	'0'
Good	0.1 - 0.9
Fair	1.0 - 1.9
Poor	2.0 - 3.0

Uses of PII :

1. A reliable technique for evaluating both mechanical anti-plaque procedures and chemical agents.
2. The PII may be used in large-scale epidemiological studies as well as for smaller groups or within the dentition of an individual.

TURESKY - GILMORE - GLICKMAN MODIFICATION OF THE QUIGLEY - HEIN PLAQUE INDEX

Quigley G. and Hein. J in 1962, reported a plaque measurement that focused on the gingival third of the tooth surface. They examined only the facial surfaces of the anterior teeth, using a basic fuchsin

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mouthwash as a disclosing agent. A numerical scoring system of '0' to '5' was used.

The Quigley -Hein plaque index was modified by Turesky S., Gilmore N.D. and Glickman I. in 1970.

This modification was done by strengthening the objectivity of the original criteria. This system of scoring plaque is relatively easy to use because of the objective definitions of each numerical score. This index emphasizes the differences in plaque accumulation in the gingival third of the tooth.

Instruments used:

Mouth mirror, disclosing agent

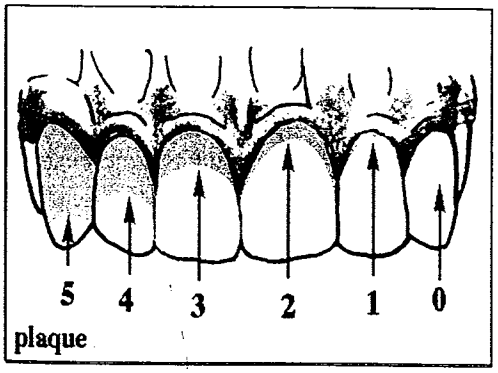
Method:

Plaque is assessed on the labial, buccal and lingual surfaces of all the teeth after using a disclosing agent. (Quigley and Turesky used basic fuchsin)

Scoring Criteria:

This index is based on a numerical scale of 0 to 5.

An index for the entire mouth is determined by dividing the total score by the number of surfaces (a maximum of 2 x 2 x 14 = 56 surfaces) examined. Third molars are not included.



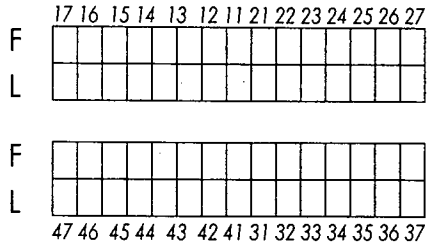
Plaque Scoring System by Quigley and Hein

Score	Criteria
0	No plaque
1	Flecks of stain at the gingival margin
2	Definite line of plaque at the gingival margin
3	Gingival third of surface
4	Two thirds of surface
5	Greater than two thirds of surface

Modified Plaque Scoring System by Turesky et al

Score	Criteria
0	No plaque
1	Separate flecks of plaque at the cervical margin of the tooth
2	A thin continuous band of plaque (up to 1 mm) at the cervical margin of the tooth
3	A band of plaque wider than 1 mm covering less than one third of the crown of the tooth
4	Plaque covering at least one-third but less than two thirds of the crown of the tooth
5	Plaque covering two-thirds or more of the crown of the tooth

Recording format



Calculation:

Index score = (total score) / (number of surfaces examined)

Interpretation:

A score of 0 or 1 is considered low.

A score of 2 or more is considered high.

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Uses:

- It provides a comprehensive method for evaluating anti-plaque procedures such as tooth brushing and flossing, as well as chemical anti-plaque agents.

INDICES USED FOR ASSESSING GINGIVAL AND PERIODONTAL DISEASE

PAPILLARY-MARGINAL-ATTACHMENT INDEX (PMA INDEX)

The papillary - marginal - attachment index (PMA index) was developed by Maury Massler and Schour I. in 1944.

The basic philosophy used in the development of the PMA index was very similar to the DMF index, i.e, the number of gingival units affected were counted rather than the severity of the inflammation.

Method

A gingival unit was divided into three component parts.

1. Papillary gingiva (P) - the gingival portion between the teeth.
2. Marginal gingiva (M)- the marginal collar surrounding the teeth.
3. Attached gingiva (A) -the gingival portion overlying the bony alveolar process.

- The presence or absence of inflammation on each gingival unit is recorded respectively.
- Although all of the facial tissues surrounding all the teeth could be assessed in this manner, usually only the maxillary and mandibular incisors, canines and premolars are examined.
- The routine examination procedure from the maxillary right second premolar around to the maxillary left second premolar and then from the mandibular left second premolar to the mandibular right second premolar is followed.

In general, mild gingivitis is confined to the papillary area, moderate gingivitis means spread to marginal gingiva and severe gingivitis is identified by its spread to the attached gingiva.

Scoring Criteria :

Papillary Component (P)

0 Normal; no inflammation
1+ Mild papillary engorgement; slight increase in size.
2+ Obvious increase in size of gingival papilla; bleeding on pressure.
3+ Excessive increase in size with spontaneous bleeding.
4+ Necrotic papilla.
5+ Atrophy and loss of papilla (through inflammation)

Marginal Component (M)

0 Normal; no inflammation visible.
1+ Engorgement; slight increase in size, no bleeding.
2+ Obvious engorgement; bleeding upon pressure.
3+ Swollen collar; spontaneous bleeding; beginning infiltration into attached gingiva.
4+ Necrotic gingivitis.
5+ Recession of the free marginal gingiva below the CEJ due to inflammatory changes.

Attached Component (A)

0 Normal; pale rose; stippled

1+ Slight engorgement with loss of stippling; changes in color may or may not be present.

2+ Obvious engorgement of attached gingiva with marked increase in redness. Pocket formation present.

3+ Advanced periodontitis. Deep pockets evident.

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Recording format

15 14 13 12 11 21 22 23 24 25

P										
M										
A									-	

P										
M										
A										

45 44 43 42 41 31 32 33 34 35

Calculation of the Index

The number of affected Papillary, Marginal and Attached units are counted and the P, M and A numerical values are totaled separately, then added together and expressed numerically as the PMA index score per person.

P= ☐ M= ☐ A= ☐

PMA score = P + M + A = ☐

Uses :

1. In clinical trials
2. On individual patients
3. For epidemiologic surveys.

GINGIVAL INDEX (GI)

The Gingival Index (GI) was developed by Loe H and Silness P in 1963, solely for the purpose of assessing the severity of gingivitis and its location in four possible areas by examining only the qualitative changes (i.e., severity of the lesion) of the gingival soft tissue.

This index shows good validity, reliability, and ease of use. However, although this index has demonstrated sufficient sensitivity to distinguish between groups with mild and severe gingivitis, it may not discriminate as well between the middle ranges.

Instruments used:

Mouth mirror, periodontal probe

Method :

The severity of gingivitis is scored on all teeth or on selected index teeth.

The index teeth are :

16 - Maxillary Right First Molar
12 - Maxillary Left Lateral Incisor.
24 - Maxillary Left First Premolar.
36 - Mandibular Left First Molar.
32 - Mandibular Left Lateral Incisor
44 - Mandibular Right First Premolar

The tissues surrounding each tooth are divided into four gingival scoring units: disto-facial papilla, facial margin, mesio-facial papilla and the entire lingual gingival margin. Unlike the facial surface, the lingual surface is not subdivided in an effort to minimize examiner variability in scoring, since it will most likely be viewed indirectly with a mouth mirror.

The teeth and gingiva should be dried lightly with a blast of air and/or cotton rolls.

Scoring criteria

Score	Criteria
0	Absence of inflammation/normal gingiva
1	Mild inflammation, slight change in color, slight edema; no bleeding on probing.
2	Moderate inflammation; moderate glazing, redness, edema and hypertrophy, bleeding on probing.
3	Severe inflammation; marked redness and hypertrophy, ulceration, tendency to spontaneous bleeding.

Recording format

D M
B
P
17 16 15 14 13 12 11 21 22 23 24 25 26 27
B
L
47 46 45 44 43 42 41 31 32 33 34 35 36 37
Score = ☐

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Calculation:

GI score for the area :

Each area (disto-facial, facial, mesio-facial, lingual) is assigned a score from 0 to 3.

GI score for a tooth :

The scores from the four areas of the tooth are added and then divided by four.

GI score for the individual :

The indices for each of the teeth are added and then divided by the total number of teeth examined. The scores range from 0 to 3.

GI score for a group :

The indices for each member of a group or population is added up and then divided by the total number of individuals in the group or population.

Interpretation:

Gingival scores	Condition
0.1 - 1.0	Mild Gingivitis
1.1 - 2.0	Moderate Gingivitis
2.1 - 3.0	Severe Gingivitis

Uses :

1. To determine the prevalence and severity of gingivitis in epidemiologic surveys.
2. For assessment of severity of gingivitis in individual dentition.
3. In controlled clinical trials of preventive or therapeutic agents.

RUSSELL'S PERIODONTAL INDEX (PI)

The Periodontal Index (PI) was developed by Russell A.L. in 1956, over a trial period of ten years.

The PI was intended to estimate deeper periodontal disease by measuring the presence or absence of gingival inflammation and its severity, pocket formation, and masticatory function. This index is reported to be useful among large populations, but it is only of limited use for individuals or small groups.

The PI is a composite index because it records both the reversible changes due to gingivitis and the more destructive and presumably irreversible changes brought about by deeper periodontal disease.

Method :

All the teeth present are examined. All of the gingival tissue circumscribing each tooth (i.e., all of the tissue circumscribing a tooth is considered a scoring or gingival unit) is assessed for gingival inflammation and periodontal involvement.

Instruments used:

- Mouth mirror
- Plain probe

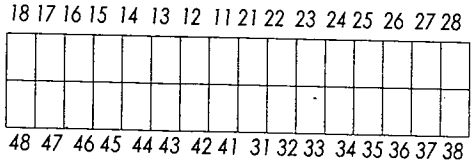
Scoring criteria :

Russell chose the scoring values (0,1,2,4,6,8) in order to relate the stages of the disease in an epidemiological survey to the clinical conditions observed.

Russell's Rule

The Russell's rule states that "When in doubt assign the lesser score".

Recording format



Calculation of the Index

The Periodontal Index score (PI score) per individual is obtained by adding all of the individual scores and dividing by the number of teeth present or examined

PI score per person =

$$\frac{\text{Sum of individual scores}}{\text{Number of teeth present}}$$

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SCORE	CRITERIA	ADDITIONAL RADIOGRAPHIC FEATURES
0	NEGATIVE: There is neither overt inflammation in the investing tissues nor loss of function due to destruction of supporting tissue	Radiographic features essentially normal.
1	MILD GINGIVITIS: There is an overt area of inflammation in the free gingivae, which does not circumscribe the tooth.	
2	GINGIVITIS: Inflammation completely circumscribes the tooth but there is no apparent break in the epithelial attachment.	
4	Used only when radiographs are available.	There is early notch like resorption of the alveolar crest.
6	GINGIVITIS WITH POCKET FORMATION: The epithelial attachment has been broken and there is a pocket. There is no interference with normal masticatory function, the tooth is firm in its socket and has not drifted.	There is horizontal bone loss involving the entire alveolar crest up to half of the length of the root.
8	ADVANCED DESTRUCTION WITH LOSS OF MASTICATORY FUNCTION: The tooth may be loose; may have drifted; may sound dull on percussion with a metallic instrument; may be depressible in its socket	Advanced bone loss involving more than half of the tooth root or a definite infrabony pocket with widening of periodontal ligament. There may be root resorption or rarefaction at the apex

Interpretation:

Clinical condition	Individual PI score
Clinically normal supportive tissues	0 - 0.2
Simple gingivitis	0.3 - 0.9
Beginning destructive periodontal disease	1.0 - 1.9
Established destructive periodontal disease	2.0 - 4.9
Terminal disease	5.0 - 8.0

Drawbacks:

- Since only a mouth mirror, and no calibrated probe is used, there might be an underestimation of the true level of periodontal disease.

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PERIODONTAL DISEASE INDEX (PDI)

The Periodontal Disease Index (PDI) was developed by Sigurd P. Ramfjord in 1959.

The PDI is a clinician's modification of the Russell's Periodontal Index (PI). The PDI was devised for use among large populations, as well as for individuals and small groups. The most important feature of PDI is measurement of the level of the periodontal attachment related to the Cemento - Enamel Junction of the teeth.

Objectives:

The following objectives were incorporated into the design of the index,

1. To assess the prevalence and severity of gingivitis and periodontitis within the individual dentitions and in population groups.
2. To provide a meaningful basis for estimation of need for periodontal therapy in selected population groups.
3. To provide accurate recordings for clinical trials of preventive and therapeutic procedures in periodontics.
4. To provide measurable reference data for assessment of correlations with factors of potential significance in the etiology of periodontal disease.

Components:

The three components are,

1. Plaque Component
2. Calculus Component
3. Gingival & Periodontal Component

Scoring Methods:

Only six selected teeth are scored for assessment of the periodontal status of the mouth; however, for short term clinical trials and where a limited number of patients are available, one may concern all of the teeth in the mouth. The six selected index teeth are,

16 -Maxillary right first molar.
21 -Maxillary left central incisor.
24 -Maxillary left first premolar.
36 -Mandibular left first molar.
41 -Mandibular right central incisor.
44 -Mandibular right first premolar.

PLAQUE COMPONENT OF THE PERIODONTAL DISEASE INDEX

The surfaces scored are the facial, lingual, mesial and distal.

Instruments used:

Mouth mirror and a dental explorer

Method :

Scoring of plaque is done after staining with Bismarck Brown solution. Bismarck brown solution is placed in a dappen dish and two Richmond cotton pellets are placed in the dish until they appear completely saturated with the solution. One cotton pellet is removed with a cotton plier and touched gently on to the lingual and buccal surfaces of the mandibular teeth. The second pellet is touched on to the palatal and buccal surface of the maxillary teeth. The occlusal surfaces are also rubbed with the pellet. So the disclosing solution flows over all the surfaces of the teeth. The patient is then instructed to spit and rinse thoroughly twice. The Scoring is then done, by noticing the stained surfaces.

Scoring criteria

Score	Criteria
0	No Plaque present
1	Plaque present on some but not on all interproximal, buccal and lingual surfaces of the tooth.
2	Plaque present on all interproximal, buccal and lingual surfaces, but covering less than one half of these surfaces.
3	Plaque extending over all interproximal, buccal and lingual surfaces, and covering more than one half of these surfaces.

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SHICK & ASH MODIFICATION OF PLAQUE CRITERIA

The original criteria of the Plaque component of Ramfjord's Periodontal Disease Index (PDI) was modified by Shick R.A. and Ash M.M. in 1961.

The modified criteria consists of examining the six selected teeth by excluding consideration of the interproximal areas of the teeth and restricting the scoring of plaque to the gingival half, of the facial and lingual surfaces of the index teeth.

The teeth selected are the same as in the plaque component of Ramfjord's periodontal disease index.

Scoring criteria

Code	Criteria
0	Absence of dental plaque
1	Dental plaque at the gingival margin covering less than one third of the gingival half of the facial or lingual surface of the tooth.
2	Dental plaque covering more than 1/3rd but less than 2/3rd of the gingival half of the facial or lingual surface of the tooth.
3	Dental plaque covering 2/3rd or more of the gingival half of the facial or lingual surface of the tooth.

Only fully erupted teeth should be scored.

Missing teeth should not be substituted.

Calculation:

The Plaque Score per person is obtained by totaling all of the individual tooth scores and dividing by the number of teeth examined.

$$\text{Plaque score of an Individual} = \frac{\text{Total Score}}{\text{No of teeth examined}}$$

CALCULUS COMPONENT OF THE PERIODONTAL DISEASE INDEX

The calculus component of the periodontal Disease Index (PDI) assesses the presence and extent of calculus on the facial (buccal/labial) and lingual surfaces of the 6 index teeth.

Instruments used:

Mouth mirror and a dental explorer

Scoring criteria

Score	Criteria
0	Absence of calculus.
1	Supragingival calculus extending only slightly below the free gingival margin (not more than 1 mm)
2	Moderate amount of supra and subgingival calculus or sub gingival calculus alone.
3	An abundance of supra and subgingival calculus.

Calculation

The calculus score per tooth are totaled and then divided by the number of teeth examined to yield the calculus score per person.

The calculus component of PDI also has a high degree of examiner reproducibility and also can be performed quickly.

GINGIVAL AND PERIODONTAL COMPONENT

The gingival status is scored first. The gingivae around the teeth to be scored are first dried superficially by gently touching with absorbing cotton.

Gingiva is examined for changes in color, form, consistency and for any evidence of ulceration with bleeding. Then the crevice depth is recorded in relation to the Cemento-Enamel Junction.

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Instruments used:

Mouth mirror and University of Michigan Number 0 probe.

The University of Michigan Number 0 probe is graduated at 3, 6 and 8 mm. from the end, making it necessary to estimate intervening measurements.

Method:

The probe should be held with a light grasp. The end of the probe should be placed against the enamel surface coronally to the margin of the gingiva so that the angle formed by the working end of the probe and long axis of the crown of the tooth is approximately 45^0. Minimal force should be used to pass the probe in an apical direction maintaining contact with the tooth. The probe should always be pointed towards the apex of the tooth or the central axis in case of multirooted teeth.

The buccal measurements should be made at the middle of the buccal surfaces. The mesial measuring should be made at the buccal aspect of the interproximal contact area with the probe touching both teeth if there is a neighboring tooth present and the probe pointing in the direction of the long axis of the tooth to be scored.

The criteria used for crevicular measurements :

A. If the gingival margin is on enamel, measure from gum margin to cemento-enamel junction and record the measurement. If the epithelial attachment is on the crown and the cemento-enamel junction cannot be felt by the probe, record the depth of the gingival crevice on the crown. Then record the distance from the gingival margin to the bottom of the pocket if the probe can be moved apically to the cemento-enamel junction without resistance or pain. The distance from the cemento-enamel junction to the bottom of the pocket can then be found by substracting the first from the second measurement.

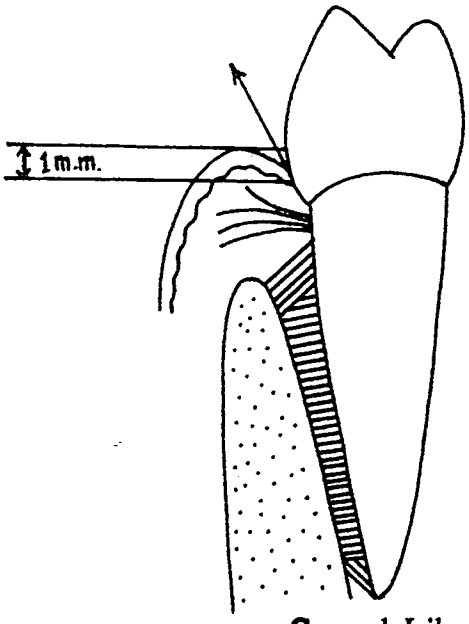
B. If the gingival margin is on cementum, record the distance from the cemento-enamel junction to the gingival margin as a minus value. Then record the distance from the cemento-enamel junction to the bottom of the gingival crevice as a plus value. Both loss of attachment and actual crevice depth can easily be assessed from these scores.

If the gingival sulcus in none of the measured areas extends apically to the cemento-enamel junction, the recorded score for gingivitis is the PDI score for that tooth. Whenever the gingival sulcus in any of the measured areas extends apically to the cemento-enamel junction, the tooth is assigned a PDI score of '4' or above and the gingivitis score is disregarded.

Scoring criteria

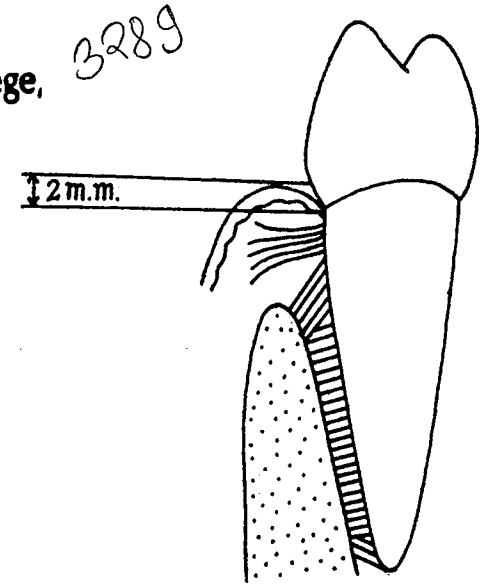
Score	Criteria
0	Absence of signs of inflammation
1	Mild to moderate inflammatory gingival changes not extending around the tooth.
2	Mild to moderately severe gingivitis extending all around the tooth.
3	Severe gingivitis characterized by marked redness, swelling, tendency to bleed, and ulceration.
4	Gingival crevice in any of the four measured areas (mesial, distal, buccal, lingual), extending apically to the cemento-enamel junction but not more than 3 mm.
5	Gingival crevice in any of the four measured areas extending apically to the cemento-enamel junction between 3-6 mm.
6	Gingival crevice in any of the four measured areas extending apically more than 6 mm from the cemento-enamel junction.

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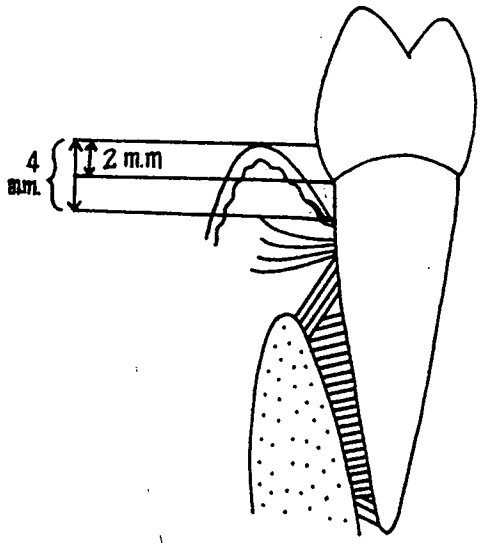


Gingival margin on the crown
Gingival crevice depth = 1 mm
No loss of periodontal attachment
(Epithelial attachment on the crown)
PDI SCORE = Gingival score for the tooth

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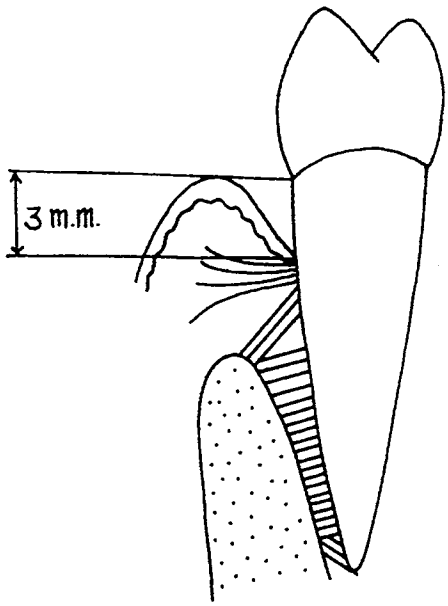


Gingival margin on the crown
No loss of periodontal attachment
(Epithelial attachment at CEJ)
Gingival margin to CEJ = 2 mm
PDI SCORE = Gingival score for the tooth

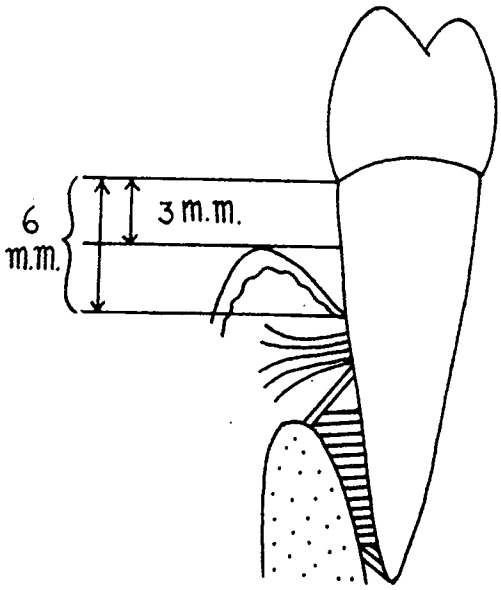


Gingival margin on the crown
Gingival crevice depth = 4 mm
Loss of periodontal attachment : 4-2=2mm
Gingival margin to CEJ = 2 mm
PDI SCORE = 4

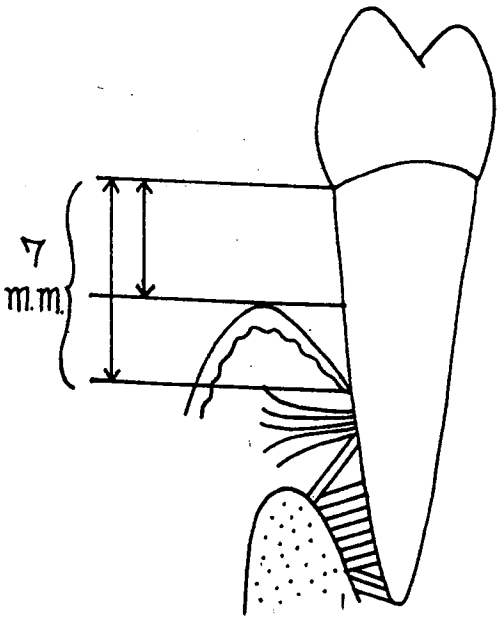
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Gingival margin at the level of CEJ
Gingival crevice depth = 3 mm
Loss of periodontal attachment = 3 mm
PDI SCORE = 4



Gingival margin on cementum
CEJ to gingival margin = 3 mm
CEJ to crevice bottom = 6 mm
Loss of periodontal attachment = 6 mm
PDI SCORE = 5



Gingival margin on cementum
CEJ to gingival margin = 3 mm
CEJ to crevice bottom = 7 mm
Loss of periodontal attachment = 7 mm
PDI SCORE = 6

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Calculation:

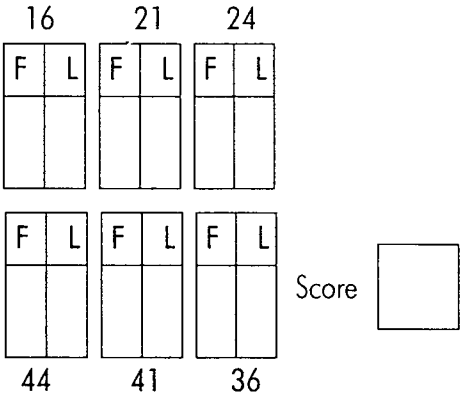
The PDI Score for the individual is obtained by totaling the scores for each tooth examined and then, dividing by the number of teeth examined. The PDI score will range from 0 to 6.

$$\text{PDI score} = \frac{\text{Total of individual tooth scores}}{\text{Number of teeth examined}}$$

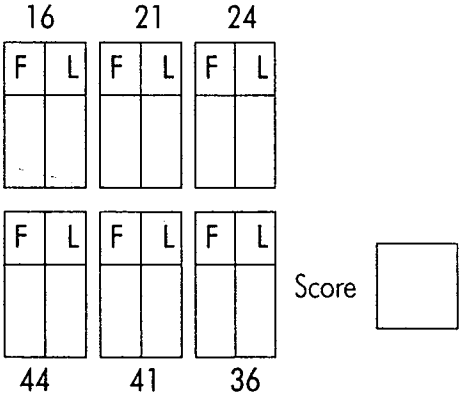
The PDI score for a group is obtained by totalling the individual PDI scores and then, dividing by the number of people examined.

Recording format

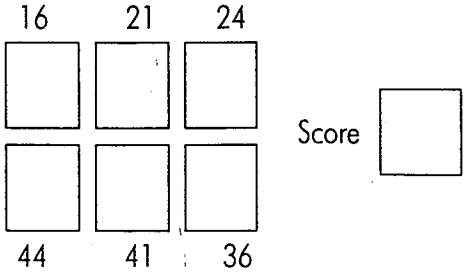
Plaque Component



Calculus Component



Gingival & Periodontal Component



COMMUNITY PERIODONTAL INDEX OF TREATMENT NEEDS (CPITN)

The "Community Periodontal Index of Treatment Needs" (CPITN) was developed for the "joint working committee" of the "World Health Organization" and "Federation Dentaire Internationale" (W.H.O./F.D.I.) by Jukka Ainamo, David Barmes, George Beagrie, Terry Cutress, Jean Martin, and Jennifer Sardo-Infirri in 1982. This index was developed primarily to survey and evaluate periodontal treatment needs rather than determining past and present periodontal status, i.e., the recession of the gingival margin and alveolar bone.

Primarily the CPITN is a screening procedure for identifying actual and potential problems posed by periodontal diseases both in the community and in the individual.

Advantages:

- Simplicity
- Speed
- International uniformity.

Limitations:

- Does not record the position of the gingival margin
- Does not provide assessment of past periodontal breakdown

CPITN is not a diagnostic tool and should not be used for planning of specific clinical treatment for individual patients.

Procedure:

The dentition is divided into sextants (sixths of the dentition), for assessment of periodontal treatment needs. Each sextant is given a score.

Sextants:

The mouth is divided into six sextants defined by tooth numbers as shown below

17 - 14	13 - 23	24 - 27
47- 44	43 - 33	34 - 37

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Index teeth:

In clinical practice, the highest score in each sextant is identified after examining all the teeth whereas in epidemiological surveys, only index teeth are examined.

For adults, aged 20 years or more, only ten teeth, known as the 'Index Teeth' are examined. These teeth have been identified as the best estimators of the worst periodontal condition of the mouth. The ten specified index teeth are,

17/16	11	26/27
47/46	31	36/37

17 Maxillary Right Second Molar
16 Maxillary Right First Molar
11 Maxillary Right Central Incisor
26 Maxillary Left First Molar
27 Maxillary Left Second Molar
37 Mandibular Left Second Molar
36 Mandibular Left First Molar
31 Mandibular Left Central Incisor
46 Mandibular Right First Molar
47 Mandibular Right Second Molar

The molars are examined in pairs and only one score, the highest is recorded. Only one score is recorded for each sextant.

For people upto 19 years, only six 'Index Teeth' are examined. The second molars are excluded at these ages because of the high frequency of false pockets (non - inflammatory, associated with tooth eruption). The six index teeth selected are,

16	11	26
46	31	36

In children less than 15 years, pockets are not recorded although probing for bleeding and calculus are carried out.

Instruments used:

Mouth mirror and CPITN probe

The CPITN Probe (WHO Periodontal Examination Probe):

The recommended periodontal probe for use with CPITN was first described by WHO (TRS 621-1978). This probe was designed for two purposes, namely measurement of pocket depth and detection of subgingival calculus. The CPITN probe is both thin in the handle and is of very light weight (5 gms). This probe is particularly designed for gentle manipulation of the often very sensitive soft tissues around the teeth.

The pocket depth is measured through color coding with a black mark starting at 3.5 mm and ending at 5.5mm. The probe has a 'ball tip' of 0.5 mm diameter that allows easy detection of subgingival calculus. This feature combined with the light probe weight facilitates the identification of the base of the pocket, thus decreasing the tendency for false reading by over measurement.

A variant of this basic probe has two additional lines at 8.5 mm and 11.5 mm from the working tip. The additional lines may be of use when performing a detailed assessment and recording of deep pockets for the purpose of preparing a treatment plan for complex periodontal therapy.

The joint working committee of WHO/FDI have advised the manufactures of CPITN probes to identify the instruments as either 'CPITN-E' for the epidemiological probe with 3.5 and 5.5 mm markings, or 'CPITN - C' for the clinical probe with additional 8.5 and 11.5 mm markings.

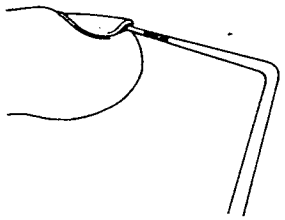
Probing procedure

A tooth is probed to determine pocket depth and to detect subgingival calculus and bleeding response. The probing force can be divided into a 'working component' - to determine pocket depth and a 'sensing component' - to detect subgingival calculus.

The probe is inserted between the tooth and the gingiva, and the sulcus depth or pocket

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depth is noted against the color code or measuring lines. The ball end of the probe should be kept in contact with the root surface. The direction of the probe during insertion should, whenever possible be in the same plane as the long axis of the tooth. For 'sensing' subgingival calculus, the lightest possible force which will allow movement of the probe ball point along the tooth surface is used. Pain to the patient during probing is in most cases indicative of the use of a too heavy probing force. The working force should not be more than 20 gms - a practical test for establishing this force is to gently insert the probe point under the finger nail without causing pain or discomfort.



The probing may be done by withdrawing the probe between each probing or alternatively, with the probe tip remaining in the sulcus or pocket, the probe may be 'walked' around the tooth. "Walking" the probe should be done with short upward and downward movements.A tooth should be probed in at least six points, the mesio-buccal, mid-buccal, disto-buccal, and the corresponding sites on the lingual surface.

Examination procedure

The aim is to determine the highest score applicable to each sextant with the least number of measurements.

First decide whether the sextant can be validly scored. The requirement is that more than one functional tooth is present. If 'no', then score 'X' and move to the next sextant. If 'yes' examine index teeth (in epidemiological procedure) or all teeth (in clinical screening procedure) for presence of 6 mm or deeper pockets, 4 or 5 mm pockets, calculus, bleeding only, in that order. Determine appropriate highest score for each sextant. Once the highest scored has been determined there is no need to examine for the presence of the lower score in that sextant.

Rules to be followed,

The index (and substitute) teeth are excluded from the CPITN scoring when the decision has been made to extract for any cause.

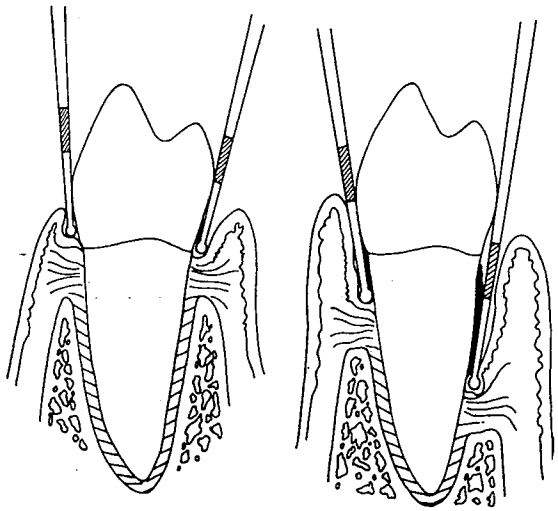
1. Remember that two or more functioning teeth must be present in a sextant for it to quality for scoring.
2. If in a posterior sextant, one of the two index teeth is not present or has to be excluded, then the recording is based on the examination of the remaining index tooth.
3. If both index teeth in a posterior sextant are absent or excluded from the examination, all the remaining teeth in that sextant are examined and the highest score is recorded.
4. In the anterior maxillary sextant if tooth 11 is excluded, substitute 21, if 21 is also excluded then identify the worst score for the remaining teeth. Similarly, substitute tooth 41 if tooth 31 is missing.
5. In subjects under 20 years of age, if the first molar is not present or has to be excluded, the nearest adjacent premolar is examined.
6. If all teeth in a sextant are missing or only one functional tooth remains the sextant is coded as missing.
7. A single tooth in a sextant is considered as a tooth in the adjacent sextant and subject to the rules for that sextant. If the single tooth is an index tooth, then the worst index tooth score is recorded.
8. The third molars are not included, except where they are functioning in place of

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Codes and criteria :

The appropriate code for each sextant is determined with respect to the following criteria. The codes are listed in descending order of severity as follows,

CODE	CRITERIA
CODE X	When only one tooth or no teeth are present in a sextant (third molars are excluded unless they function in place of second molars).
CODE 4	Pathological pocket of 6 mm or more present i.e, the black area of CPITN probe is not visible. Note : If the designated tooth or teeth are found to have a 6 mm or deeper pocket in the sextant being examined, a code of 4 is given to the sextant. Recording of code 4 makes further examination of that sextant unnecessary - ie, there is no need to record the presence or absence of pathological pockets of 4 or 5 mm, calculus or bleeding.
CODE 3	Pathological pocket of 4 mm - 5 mm present, i.e, when the gingival margin is on the black area of the probe. Note : If the deepest pocket found at the designated tooth or teeth in a sextant is 4 or 5 mm, a code of 3 is recorded- there is no need to examine for calculus or gingival bleeding.
CODE 2	Presence of supra or subgingival calculus
CODE 1	Gingival bleeding after gentle probing Note : The gingivae of the designated tooth or teeth should be inspected for presence or absence of bleeding before the subject is allowed to swallow or close his mouth. At times, bleeding may be delayed for 10-30 seconds after probing.
CODE 0	No signs of disease.



Community Periodontal Index of Treatment Needs (CPITN)

Code - 0 = No periodontal disease (Healthy Periodontium)
Code - 1 = Bleeding observed during or after probing
Code - 2 = Calculus or other plaque retentive factors either seen or felt during probing
Code - 3 = Pathological pocket 4 to 5 m.m. in depth. Gingival margin situated on black band of the probe
Code - 4 = Pathological pocket 6 m.m. or more in depth. Black band of the probe not visible

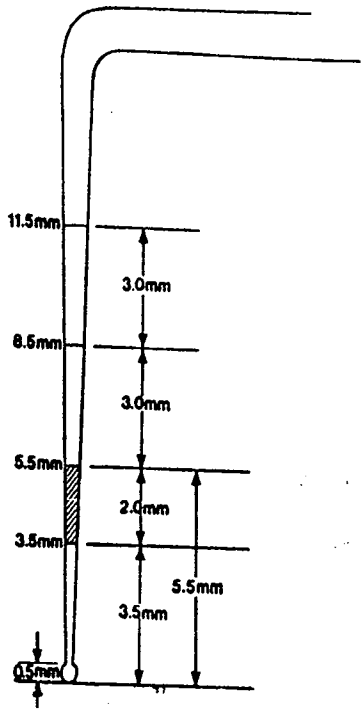
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Classification of treatment needs :

Population groups or individuals are allocated to the appropriate 'Treatment Need' (TN) category on the following basis,

TN 0	A recording of Code 0 (healthy) or Code X (missing) for all six sextants indicates that there is no need for periodontal treatment.
TN 1	A recording of code 1 Indicates a need for improving the personal oral hygiene of that individual.
TN 2a	A recording of code 2 Indicates a need for scaling Indicates a need for improving the personal oral hygiene of that individual.
TN 2b	A recording of code 3 (Shallow to moderate pocketing of 4 - 5 mm) Indicates a need for scaling and root planing Indicates a need for improving the personal oral hygiene of that individual
	Scaling and root planing will usually reduce inflammation and bring 4 mm or 5 mm pockets to values of 3 mm or below. Thus sextants with code 3 are placed in the same treatment category as for code 2.
TN 3	A recording of code 4 (6 mm or deeper pockets) Complex treatment which could involve deep scaling, root planing and more complex surgical procedures.

WHO PROBE



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HOW TO CALCULATE AND SUMMARIZE THE RECOMMENDED STANDARD TABULATIONS OF A CPITN SURVEY

The following recordings of a group of 21 adults are provided in order to demonstrate the summarization and reporting procedures.

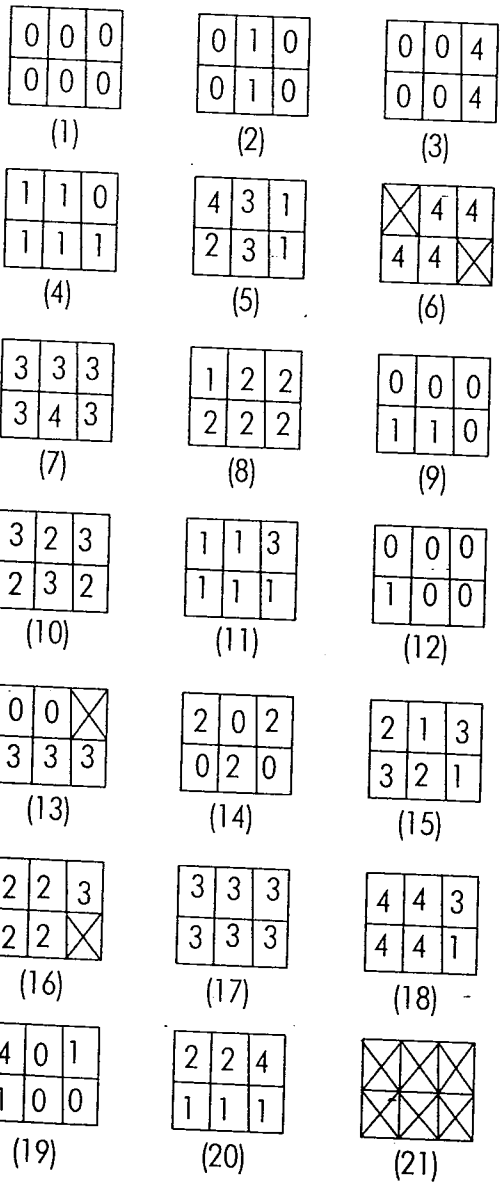


Table 1 shows the number of subjects examined, the number of dentate subjects and the percentage distribution of dentate subjects according to the highest score recorded. The sum of each horizontal line is 100 percent.

The tabulation is calculated by the following procedure,

Step 1 :

Count the number of charts with Code 0 only. This identifies the number of subjects with healthy sextants (H).
Note: There can be 0 or up to 5 Xs but no other codes

Count the number of charts with a Code 1 recorded as the highest score. This identifies the number of subjects with gingival bleeding (B) as their highest score.
Note: There can be 0, 1 or X but no other codes

Count the number of charts with Code 2 recorded as the highest score. This identifies the number of subjects with calculus and other plaque retentive factors (C) as their highest score.

Note: There can be Codes 0, 1, 2 or X but not codes 3 or 4

Count the number of charts with code 3 recorded as the highest score. This identifies the number of subjects with pokets of 4 or 5 mm (P1) as their highest score.

Note: There can be Codes 0, 1, 2, 3 or X, but not Code 4.

Count the number of charts with Code 4 recorded as the highest score. This identifies

Age	No. Examined	No. of dentate persons	% Persons coded				
			H	B	C	P1	P2
35-44	21	20	5	20	10	30	35

Note: Total H+B+C+P1+P2=(100%)

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the number of subjects with pokets of 6 mm or more (P2) as their highest score.

Calculations:

The charts show:

1 subject has Code 0 only (number 1)

4 subjects have Code 1 as highest code (numbers 2, 4, 9, 12)

2 subjects have Code 2 as highest code (numbers 8 and 14)

6 subjects have Code 3 as highest code (numbers 10, 11, 13, 15, 16, 17)

7 subjects have Code 4 (numbers 3, 5, 6, 7, 18, 19, 20)

Step 2:

Calculate the percentages (prevalence)

To obtain prevalence of subjects with Codes 0, 1, 2, 3, 4, as their highest score, divide the counts of codes respectively, by the total number of dentate subjects and multiply by 100

Code 0=$\frac{1}{20}$ x100; Code 1=$\frac{4}{20}$ x100

Code 2=$\frac{2}{20}$ x100; Code 3=$\frac{6}{20}$ x100

Code 4=$\frac{7}{20}$ x100

Step 3:

Tabulate data as shown in Table 1

Table 2

a. 35-44*	20	1.6	4.2	2.9	1.9	0.7	0.2
b. 35-44	20	1.6	1.3	1.0	1.2	0.7	0.2

*Note: Scores H+B+C+P1+P2+X do not =6 (except when all sextants score 0,1 or X)

†Note: Mean number of sextants (MNS) scores H+B+C+P1+P2+X=6

Table 2(a) This is the WHO preferred cumulative tabulation. It shows the mean number of sextants (per dentate subject) scoring 0, 1, 2, 3, 4, or X on a cumulative basis (that is 1 or higher score, 2 or higher score etc.) The sum of score 0, X and 1 or higher score adds to 6

Step 1:

From the charts of dentate persons, count the number of sextants which have:

Healthy tissues(H)	that is sextants coded 0
Bleeding (B)	that is sextants coded 1 or higher
Calculus or overhangs (C)	that is sextants coded 2 or higher
Pockets 4 or 5 mm (P1)	that is sextants coded 3 or higher
Pocket 6 mm or deeper (P2)	that is sextants coded 4
Edentate or Excluded sextants	that is sextants coded X

There are:
32 scored 0
84 scored 1 or higher scores
58 scored 2 or higher scores
38 scored 3 or higher scores
14 scored 4
4 scored X

Note: chart 21 has been excluded

Step 2:

For each condition, obtain the mean number of sextants (MNS) per person by dividing the total number of sextants with that score (or higher) by the number of dentate subjects.

Example: MNS Bleeding=

$$\frac{\text{No coded 1 (84)}}{\text{No. of dentate subjects (20)}} = 4.2$$

Note: MNS coded 0 + MNS coded 1+MNS coded X=6

Table 2(b) Is an alternative presentation of

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this information. It shows the mean number per dentate person of sextants scoring 0, 1, 2, 3, 4 or X. The sum of each horizontal line is 6.

This differs from the WHO version. The scores for each sextant are considered separately - not cumulatively.

Step 1:

Count the number of sextants of dentate persons which have:

Healthy tissues (H)	that is sextants coded 0
Bleeding (B)	that is sextants coded 1
Calculus and p.r.f (C)	that is sextants coded 2
Pockets 4 or 5mm(P1)	that is sextants coded 3
Pockets 6mm or deeper(P2)	that is sextants coded 4
Edentate or excluded Sextants(X)	that is sextants coded X

There are:
32 scored 0
26 scored 1
24 scored 3
14 scored 4
4 scored X

Step 2:

For each condition obtain the mean number of sextants with scores 0, 1, 2, 3, 4 or X respectively by the number of dentate subjects

Example: MNS Bleeding=

$$\frac{\text{No. coded 1 (26)}}{\text{No. of dentate subjects (20)}} = 1.3$$

Note: It is easy to transpose Table 2(a) to 2(b) or (b) to (a).

Table 3 shows the treatment needs expressed as percentage of subjects categorized by one of the three treatment options.

Table 3: Treatment needs

35-44	20	5	95	75(2.9)	35(0.7)	

In addition, for TN 2 and TN 3, the number of sextants requiring treatment appears as an average for all dentate subjects.

The three types of treatment needs (TN) are defined:

TN 0=no treatment required-periodontally healthy

TN 1=oral hygiene instruction (OHI)

TN 2=scaling and prophylaxis (SC) + OHI

TN 3=complex treatment +SC+OHI

TN3, TN2, TN1 are constructed directly from tables 1 and 2 as follows.

% TN 1=% Codes B+C+P1+P2 obtained from Table 1

% TN 2=% Codes C+P1+P2 obtained from Table1. The MNS shown in brackets for Codes C+P1+P2 is taken from Table 2 a.

% TN 3 = % code P 2 obtained from Table 1. The MNS shown in brackets is obtained from Table 2 a.

Table 4: Frequency distribution

Age	No. Of Sextants	Sextant score (No. Of subjects)					
		H	B	C	P1	P2	M
	0	11	9	13	11	13	17
	1	1	3	1	3	4	2
	2	1	5	2	2	1	1
	3	2	1	2	2	0	0
	4	3	0	1	0	2	0
	5	1	2	1	1	0	0
	6	1	0	0	1	0	NA*

NA* Only dentate subjects are included

Table 4 shows the frequency distribution of the number of sextants per person scored codes 0, 4 and X. For example, the table allows determination of what proportion of the population had a given number of healthy sextants. Sum of each vertical line equals the number of dentate subjects examined. In case of large groups, the table is best given as a frequency distribution (in percent). Table 4 shows that 11 of the 20 subjects had no 'all healthy' sextants at all; whereas one had 1 healthy sextant, one had 2 healthy sextants, 2 had 3 healthy sextants, 3 had 4 healthy sextants, 1 had 5 healthy sextants and 1 had all 6 healthy sextants. Indication of the age of the subjects should always be included.

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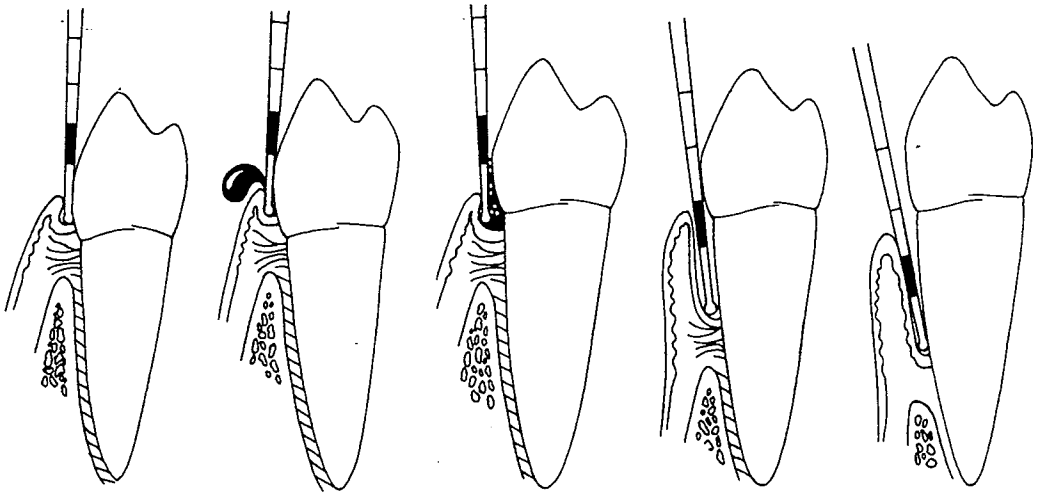
Table 5 gives the standard format for summarizing CPITN survey data.

Table 5: CPITN-Periodontal disease status and treatment needs

COUNTRY: AREA: YEAR: INTERVIEWER:

			TABLE I					TABLE II						TABLE III		
			Percentage of persons who have as highest score					Mean number of sextants with								
Age	Total subjects N(%)	Edentulousness Total Dentate	0 No perio-dontal disease	1 Bleeding only	2 Calculus	3 Shallow pockets	4 deep pockets	0 No perio-dontal disease	1+2+3+4 Bleeding or higher score	2+3+4 Calculus or higher score	3+4 Shallow pockets or higher score	4 Deep pockets	X Excluded less than 2 teeth	Oral hygiene instruction TN 1 %	Prophy laxis TN 2 % (MNS)	Complex care TN 3 % (MNS)

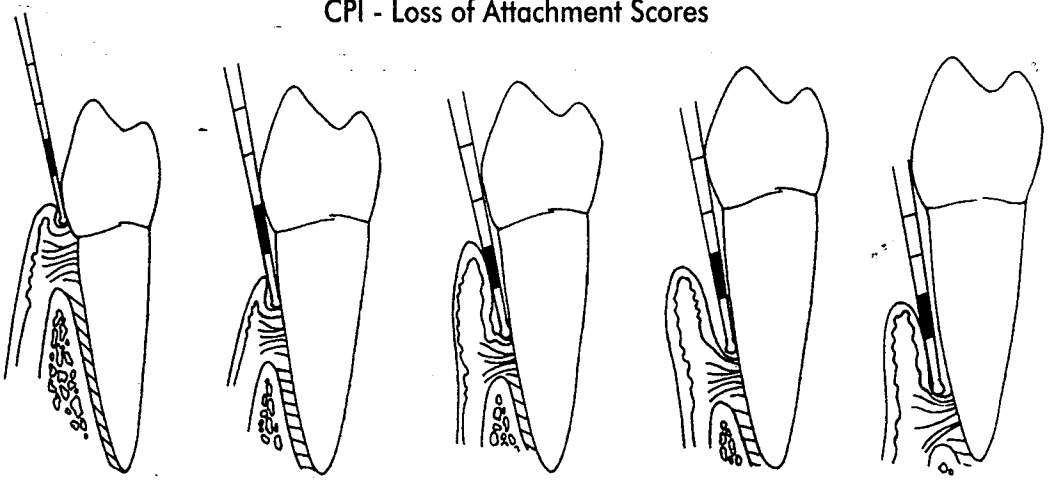
CPI Scores



Score 0 Score 1 Score 2 Score 3 Score 4

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CPI - Loss of Attachment Scores



Score 0 Score 1 Score 2 Score 3 Score 4

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COMMUNITY PERIODONTAL INDEX (CPI)

This index is based on a modification of the earlier used Community Periodontal Index of Treatment Needs (CPITN). The modification is done by the inclusion of measurement of "Loss of Attachment" and elimination of the "Treatment Needs" category.

Instruments used

- Mouth mirror
- The CPITN - C probe

Procedure:

The teeth to be examined, the procedure of probing and the codes and criteria are the same as that for the CPITN.

The codes and criteria for CPI are

Scoring criteria

Code	Criteria
0	Healthy
1	Bleeding observed, directly or by using a mouth mirror, after probing.
2	Calculus detected during probing, but all of the black band on the probe visible.
3	Pocket 4-5 mm (gingival margin within the black band on the probe)
4	Pocket 6 mm or more (black band on the probe not visible).
X	Excluded sextant (less than two teeth present).
9	Not recorded.

The treatment needs is not recorded. After recording the Community Periodontal Index score, the loss of attachment is recorded.

Loss of Attachment

Information on loss of attachment may be collected from index teeth in order to obtain an estimate of the lifetime accumulated destruction of the periodontal attachment. This permits comparisons between population groups but is not intended to describe the full extent of loss of attachment in an individual.

The most reliable way of examining for loss of attachment in each sextant is to record this immediately after recording the CPI score for that particular sextant. The highest scores for CPI and loss of attachment may not necessarily be found on the same tooth in a sextant.

Loss of attachment should not be recorded for children under the age of 15.

When the CEJ is not visible and the highest CPI score for a sextant is less than 4 (probing depth less than 6 mm), any loss of attachment for that sextant is estimated to be less than 4 mm (loss of attachment score = 0).

The extent of loss of attachment (LoA) is recorded using the following codes

Code	Criteria
0	Loss of attachment 0 -3 mm (CEJ not visible and CPI score 0 -3).
If the CEJ is not visible and the CPI score is 4 or if the CEJ is visible	
1	Loss of attachment 4 - 5 mm (CEJ within the black band).
2	Loss of attachment 6 - 8mm (CEJ between the upper limit of the black band and the 8.5 mm ring)
3	Loss of attachment 9 - 11mm (CEJ between the 8.5 mm and 11.5 mm rings)
4	Loss of attachment 12mm or more (CEJ beyond the 11.5 mm rings)
X	Excluded sextant (Less than two teeth present)
9	Not recorded (CEJ neither visible nor detectable)

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INDICES USED FOR ASSESSMENT OF DENTAL CARIES

DECAYED - MISSING - FILLED TEETH INDEX (DMFT INDEX)

The Decayed - Missing -Filled Teeth Index (DMFT Index) was developed by Henry T. Klein, Carrole E. Palmer and Knutson J. W. in 1938 to determine the prevalence of coronal caries.

Advantages:

- Simple
- Rapid
- Versatile
- Universally accepted and applicable measurement that has been used widely for several decades.

This index is based on the fact that the dental hard tissues are not self healing and established caries leaves a scar of some sort. The tooth either remains decayed or, if treated, it is extracted or filled. The DMFT index is therefore an irreversible index, measuring the lifetime caries experience.

Procedure

The DMFT Index is applied only to permanent teeth. It is composed of three components,

D- used to describe decayed teeth.
M- used to describe missing teeth due to caries
F- used to describe teeth that have been previously filled due to caries.

Instruments used

- Mouth mirror
- Explorer

All the 28 permanent teeth are examined. The teeth not included are:

1. The third molars
2. Unerupted teeth
3. Congenitally missing and supernumerary teeth.
4. Teeth removed for reasons other than dental caries such as for orthodontic treatment or impaction.
5. Teeth restored for reasons other than dental caries such as trauma (fracture), cosmetic purposes or for use as a bridge abutment.
6. Primary tooth retained with the permanent successor erupted. The permanent tooth is evaluated since a primary tooth is never included in this index.

The criteria for identification of dental caries are

a) The lesion is clinically visible and obvious,
b) The explorer tip can penetrate deep into soft yielding material,
c) There is discoloration or loss of translucency typical of undermined or demineralized enamel.
d) The explorer tip in a pit or fissure catches or resists removal after moderate to firm pressure on insertion and when there is softness at the base of the area.

Principles and rules in recording DMFT:

1. No tooth must be counted more than once. It is either decayed, missing, filled or sound.
2. Decayed, missing, and filled teeth should be recorded separately since the components of DMF are of great interest.
3. When counting the number of decayed teeth, also include those teeth, which have restorations with recurrent decay.
4. Care must be taken to list as missing only those teeth, which have been lost due to decay. Also included should be those teeth which are so badly decayed that they are indicated for extraction. The following should not be counted as missing
   A) Unerupted teeth
   B) Missing teeth due to accident

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C) Congenitally missing teeth
D) Teeth that have been extracted for orthodontic reasons.

5. A tooth may have several restorations but it is counted as one tooth.
6. Deciduous teeth are not included in DMF count.
7. A tooth is considered to be erupted when the occlusal surface or incisal edge is totally exposed or can be exposed by gently reflecting the overlying gingival tissue with the mirror or explorer.
8. A tooth is considered to be present even though the crown has been destroyed and only the roots are left.

Examination method for DMFT:

'D'-Decayed

Indicates the number of permanent teeth that are decayed. In counting the number of decayed permanent teeth, remember that a tooth can only be counted once. It cannot be counted as decayed and filled. If it has been restored and caries can be detected, count it as decayed. Be sure the explorer falls in to carious tooth substance and not just in a deep groove before counting occlusal caries.

'M' - Missing

Indicates the number of missing permanent teeth due to decay. Those teeth which are so badly decayed that they are indicated for extraction are counted as missing. Teeth that have been extracted for orthodontic reasons, unerupted permanent teeth, missing teeth because of accident or any congenitally missing teeth are not included. When possible histories should be taken when it is suspected that teeth have been lost for reasons other than caries.

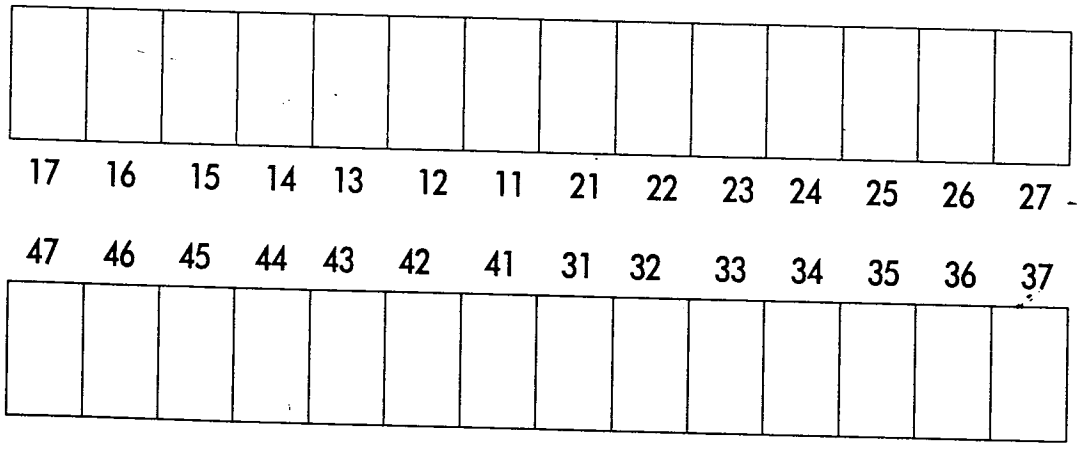
'F' - Filled

Indicates the number of permanent teeth that have been attacked by caries, but which have been restored to keep them in a healthy condition in mouth. A tooth may have several fillings but it is counted as one tooth. If a tooth has a filling but shows evidence of recurrent decay, it is counted as a decayed tooth.

Calculation of the Index:

The maximum number for an individual DMFT score is 28 or 32, if the third molars are included.

RECORDING FORMAT FOR DMFT INDEX



DT= ☐ MT= ☐ FT= ☐ DMFT Score = ☐

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A) Individual DMFT :

Total each component, i.e. D, M, & F separately, then, total D+M+F = DMF

For example, a DMFT score of 3+2+5=10 for an individual means that 3 teeth are decayed, 2 teeth are missing, and 5 teeth have fillings. Furthermore, it also means that 18 (i.e., 28 - 10 = 18) teeth are intact.

B) Group average :

Total the D,M and F for each individual. Then, divide the total 'DMF' by the number of individuals in the group.

Average DMFT =

$$\frac{\text{Total DMF}}{\text{Total number of the subjects examined}}$$

Limitations of DMFT Index :

1. DMFT values are not related to the number of teeth at risk.
2. DMFT index can be invalid in older adults because teeth can become lost for reasons other than caries.
3. DMFT index can be misleading in children whose teeth have been lost due to orthodontic reasons.
4. DMFT index can overestimate caries experience in teeth in which "preventive fillings", have been placed.
5. DMFT index is of little use in studies of root caries.
6. DMFT index equates a disease state with a healthy state by assigning the same score for a decayed tooth as well as for a filled healthy tooth.

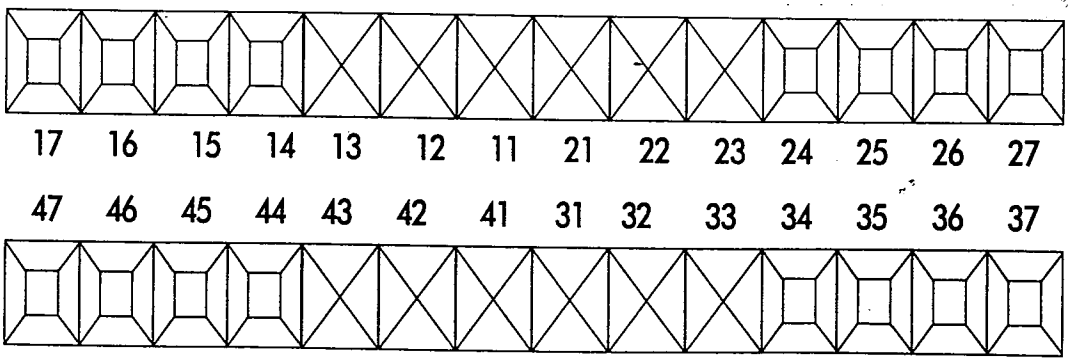
WHO modification of DMF Index (1987)

1. All third molars are included.
2. Temporary restorations are considered as 'D'
3. Only carious cavities are considered as 'D', the initial lesions (Chalky spots, stained fissures, etc) are not considered as 'D'.

WHO modification of DMFT index: (1997)

According to the criteria by the World Health Organization (WHO, 1987), only teeth missing due to caries were included for its M-component. However, in 1997, WHO has stated that for individuals 30 years and older, the M-component should comprise teeth missing due to caries or for any other reason. But for subjects under 30 years of age, the M-component should only include teeth missing due to caries. The instruments used to record dental caries are a mouth mirror and the WHO periodontal probe.

RECORDING FORMAT FOR DMFS INDEX



DS= ☐ MS= ☐ FS= ☐ DMFS Score = ☐

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DECAYED - MISSING FILLED TOOTH SURFACES INDEX (DMFS)

The Decayed, Missing, Filled Surfaces (DMFS) Index was developed by Henry T. Klein, Carrole. E. Palmer and Knutson J. W. in 1938 along with the Decayed, Missing, Filled Teeth (DMFT) Index to assess the prevalence of coronal caries.

Procedure:

The DMFS Index is applied only to permanent teeth surfaces. It is composed of three components,

D - Used to describe decayed teeth surfaces.
M - Used to describe missing teeth surfaces due to caries
F - Used to describe teeth surfaces that have been previously filled due to caries.

Advantages:

The DMFS Index is more sensitive and is usually the index of choice in a clinical trial of a caries -preventive agent.

Limitations:

- A DMFS examination takes longer,
- Is more likely to produce inconsistencies in diagnosis
- May require the use of radiographs to be fully accurate.

Instruments used

- Mouth mirror
- Explorer

The surfaces examined are:

1. For posterior teeth: Five surfaces: facial, lingual, mesial, distal and occlusal.
2. For anterior teeth : Four surfaces: facial, lingual, mesial and distal.

Calculation of DMFS Index:

If 28 teeth are examined (i.e., third molars are excluded)

16 posterior teeth (16 x 5) = 80 surfaces
12 anterior teeth (12 x 4) = 48 surfaces
Total = 128 surfaces
If third molars are included (4 x 5) = 20 surfaces
Total = 148 surfaces

The principles, rules, criteria and calculation for DMFS Index is the same as that for DMFT Index.

CARIES INDICES FOR PRIMARY DENTITION

'def' Index

The 'def index' was described by Gruebbel A.O. in 1944, as an equivalent index to DMF index, for measuring dental caries in primary dentition. The caries indices used for primary dentition are 'deft' index and 'defs' index equivalent to the DMFT and DMFS indices used for permanent dentition.

As defined by Gruebbel, d = decayed tooth, e = extracted tooth and f = filled tooth.

The basic principles and rules for def index are the same as that for DMF index.

Examination method for def index

'd' - decayed teeth

'e'- extracted teeth.

Indicates those deciduous teeth which have been extracted due to caries or which are so badly decayed that they are indicated for extraction. Because of the wide variation in the time of exfoliation of deciduous teeth, it is difficult to determine whether a tooth missing from the deciduous dentition was normally exfoliated or was extracted because of advanced caries. If it can be accurately established that a missing deciduous tooth has been lost due to caries, it is included in the 'e' component.

'f'- filled teeth

Indicates the number of deciduous teeth that

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have been attacked by caries but which have been restored without any recurrent decay present. A tooth may have several fillings but it is counted as one tooth. If a tooth has a filling but shows evidence of recurrent decay, it is counted as a decayed tooth.

Calculation of def index :

For deciduous or primary teeth, the maximum 'deft' score for an individual would be 20 and the maximum score for the 'defs' will be 88 since primary dentition has a maximum of 20 teeth.

Calculations are the same as that for the DMFT index

Modifications of 'def' index :

'dmf' index :

dmf index is used in children before the age of exfoliation.

'df' index :

Another method of getting around the exfoliation problem is the 'df' index in which the missing teeth are ignored. This is the method of choice adopted by the World Health Organization in their basic survey techniques.

The 'df' index can be applied to the whole tooth as the decayed-filled-tooth ('dft' index) or to the individual surfaces as the decayed-filled-surfaces ('dfs' index).

Mixed dentition

In case of mixed dentitions, the caries indices for the permanent and the deciduous teeth have to be done separately and calculated separately. A DMFT / DMFS and a 'deft' / 'defs' are never added together. Each child is given a separate index for permanent teeth and another for primary teeth. The index for the permanent teeth is usually determined first, and then the index for the primary teeth separately.

SIGNIFICANT CARIES INDEX

The 'Significant Caries Index' (SiC) was proposed in the year 2000, by Bratthall D

Purpose:

A detailed analysis of the caries situation in many countries showed that there was a skewed distribution of caries prevalence - meaning that a proportion of 12-year-olds still had a high or even a very high DMFT value even though a proportion was totally caries free. Clearly, the mean DMFT value did not accurately reflect this skewed distribution leading to incorrect conclusion that the caries situation for the whole population was controlled, while in reality, several individuals still had caries. To bring attention to those individuals with the highest caries scores in each population, the SiC index was proposed.

Procedure:

The SiC Index is the mean DMFT of one third of the study group with the highest caries score. The index is used as a complement to the mean DMFT value.

Calculation:

- Sort the individuals according to their DMFT
- Select the one third of the population with the highest caries values
- Calculate the mean DMFT for this subgroup.

Step 1:

The original set of data must be presented as the DMFT distribution in a population or in a group.

The sum of the DMFT values: 0+0+2+1+0+5+0+14+2+0+3=27

The total number of individuals: 11

The average of the DMFT values: 27/11=2.4545...

The Mean DMFT: 2.5

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Individual No.	DMFT
1	0
2	0
3	2
4	1
5	0
6	5
7	0
8	14
9	2
10	0
11	3

Step 2:

Examine how many individuals are there in 'the one third of the population'. The value of the one third in the given example: 11/3=3.6666...

The rounded number of the subgroup: 4

Sort the data numerically and select the 4 individuals of the population with the highest DMFT values.

DMFT
0
0
0
0
0
1
2

The DMFT values in the selected subgroup: 2, 3, 5, 14

Add each DMFT value in the subgroup.

The sum of the DMFT values in the subgroup: 2+3+5+14=24

Divide this sum by the total number of individuals in the subgroup.

The average of the DMFT values in the subgroup: 24/4= 6

Result: the SiC Index of this population: 6.0

Simultaneously, a new oral health goal was proposed by WHO that, once the goal of 3 DMFT has been achieved, the next step is to achieve a SIC index of less than 3 DMFT among the 12-year-olds, globally by the year 2015. When a country has reached this goal, the proposed idea is to look at provinces, districts, cities or parts of districts/cities, so that in any defined population, the SiC Index is lower than 3 DMFT.

INDICES FOR ROOT SURFACE CARIES

Root surface caries is generally confined to exposed root surfaces and is therefore an unusual condition, because it is dependent on previous disease, resulting in loss of attachment and exposure of cementum.

"Katz et al" has defined root caries lesions as soft, progressive, destructive lesions, either totally confined to the root surface or involving undermining of enamel at the cemento-enamel junction but clinically indicating that the lesion initiated on the root surface.

ROOT CARIES INDEX (RCI)

The Root Caries Index (RCI) was developed by Ralph V Katz in 1979, to make the simple prevalence measures for root caries more specific by including the concept of teeth at risk for root caries.

RCI is based on the requirement that gingival recession must occur before root surface lesions can begin. Teeth with gingival recession represent the true intraoral unit at risk, thus preventing an underestimation of the attack rate of root caries. Therefore, only teeth with gingival recession are examined.

Procedure:

To obtain the RCI, each of the four surfaces, the mesial, distal, buccal (labial), and lingual, of a root are examined for a single tooth. All teeth are examined in both the lower and upper arch. For teeth with multiple

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roots (i.e., two or three roots) and extreme recession, it is the suggested rule that when multiple types of root surfaces are exposed, the most severely affected root surface be recorded for that tooth, even though this occurrence is judged to be rare.

The root surfaces are characterized and recorded as

R-N = Recession present; surface normal or sound

R-D =Recession present; with a decayed root surface

R-F = Recession present; with a filled root surface

No-R = No association with gingival recession

M = Root surfaces characterized as missing

A designation of missing (M) is made for the whole tooth and not for a single surface. Therefore, once a tooth is observed to be missing, all the root surfaces are recorded as missing. A judgement of no recession (No-R) is made if the cementoenamel junction (CEJ) cannot be observed. In addition, if calculus is present in the absence of any other findings on a recessed root surface, a judgement of sound (R-N) is made on the assumption that decay is not found underneath the band of calculus.

Diagnostic conventions proposed for RCI

Ralph V Katz in 1986 presented the following conventions for RCI.

Convention 1	If the diagnosis of caries or of filled is uncertain, score the surface as 'sound'.
Convention 2	All caries detected on root surfaces near the Cemento-Enamel-Junction (CEJ) shall be scored as 'decayed' regardless of the adjacent enamel condition
Convention 3	For any coronal filling which extends on to a root surface, the filling material must extend more than 3 mm beyond the CEJ in order to score that root surface as 'Filled' (exception : cast crowns extending on to a root surface are never recorded as filled for that root surface).
Convention 4	In order to score a filling as involving multiple surfaces, the filling must extend across at least 1/3 rd of each additional surface.
Convention 5a	Recurrent decay associated with a root surface filling should be recorded as an independent disease category called "Recurrent Root Decay".
Convention 5b	Recurrent decay associated with a coronal filling (i.e. a coronal filling extending less than 3 mm onto the root surface) or a crown should be recorded as an independent disease category called "Root Decay Contiguous with Coronal Filling".
Convention 6	For any root surface that is decayed, the events of an additional but separate root lesion is recorded as an independent disease category called " Additional Root Caries Lesion". (N.B. For Conventions 5a, 5b and 6 the primary data analysis should incorporate each of the named disease categories into the Decay-Category, with Decay taking precedence over Filled as the rule, with a secondary data analysis which reports the more detailed set of decay categories).
Convention 7	Any root surface which appears sound but has more than 20% of its area inaccessible to clinical examination due to calculus and/or heavy plaque deposits shall be scored as unreadable

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The data collected is entered on a format for each tooth examined, as given below :

	M	D	B	L
R-N				
R-F				
R-D				
No-R				

The columns represent four surfaces : M-Mesial, D-Distal, B- Buccal, L-lingual. The rows represent the conditions that could occur on the surfaces.

The root caries index is calculated for an individual using the formula:

$$\text{RCI Score} = \frac{(R-D)+(R-F)}{(R-D)+(R-F)+(R-N)} \times 100$$

INDICES USED FOR DENTAL FLUOROSIS

Dental fluorosis is a hypoplasia or hypomineralization of tooth enamel or dentine produced by the chronic ingestion of excessive amounts of fluoride during the period when teeth are developing.

The intensity of fluorosis ranges from barely noticeable whitish striations that may affect only a small portion of enamel to confluent pitting of almost the entire enamel surface and unsightly dark brown to black staining.

DEAN'S FLUOROSIS INDEX

It was introduced by Trendley H. Dean in 1934. It is also known as 'Dean's Classification System For Dental Fluorosis'.

Procedure

To obtain Dean's fluorosis index score, the examiner's recording is based on the two teeth most affected. However, if the two teeth are not equally affected, the score for the less affected tooth is recorded. When teeth are scored, the examiner should start at the higher end of the index ("severe") and eliminate each score or category until he or she arrives at the present condition. If there is any doubt, the lower score should be recorded.

Criteria

The criteria for Deans fluorosis index was based on a 7-point ordinal scale: normal, questionable, very mild, mild, moderate, moderately severe, and severe.

Dean's Fluorosis Index - Original Criteria (1934)

Normal

The enamel represents the usual translucent semi- vitriform type of structure. The surface is smooth, glossy, and usually of a pale creamy white color.

Questionable

Slight aberrations in the translucency of normal enamel, ranging from a few white flecks to occasional white spots, 1 to 2 mm in diameter.

Very Mild

Small, opaque, paper-white areas are scattered irregularly or streaked over the tooth surface. It is principally observed on the labial and buccal surfaces, and involves less than 25% of the tooth surface of the particular teeth affected. Small pitted white areas are frequently found on the summits of the cusps. No brown stain is present in the mottled enamel of this classification.

Mild

The white, opaque areas on the surfaces of the teeth involve at least half of the tooth surface. The surfaces of molars, bicuspids, and cuspids subject to attrition show thin white layers worn off and the bluish shades of underlying normal enamel. Faint brown

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stains are sometimes apparent, generally on the upper incisors.

Moderate

No change is observed in the form of the tooth, but generally all of the tooth surfaces are involved. Surfaces subject to attrition are definitely marked. Minute pitting is often present, generally on the labial and buccal surfaces. Brown stain is frequently a disfiguring complication. It must be remembered that the incidence of brown stain varies greatly in different endemic areas, and many cases of white opaque mottled enamel, without brown stain, are classified as "moderate" and listed in this category.

Moderately Severe

Macroscopically, a greater depth of enamel appears to be involved. A smoky white appearance is often noted. Pitting is more frequent and generally observed on all the tooth surfaces. Brown stain, if present, is generally deeper in hue and involves more of the affected tooth surfaces.

Severe

The hypoplasia is so marked that the form of the teeth is at times affected, the condition often being manifest in older children as a mild pathologic incisal-occlusal abrasion. The pits are deeper and often confluent. Stains are widespread and range from chocolate brown to almost black in some cases.

However, the "moderately severe" and "severe" categories were combined, resulting in the revised 6-point ordinal scale Dean's Fluorosis Index which came into existence in 1942 and that is extensively used today and is the one still recommended by the World

Difference between milder forms of dental fluorosis & non fluoride enamel opacities

Characteristic	Milder Forms of Fluorosis	Nonfluoride Enamel Opacities
Area affected	Usually seen on or near tips of cusps or incisal edges	Usually centered in smooth surface; may affect entire crown.
Shape of lesions	Resembles line shading in pencil sketch; lines follow incremental lines in enamel, form irregular caps on cusps	Often round or oval
Demarcation	Shades off imperceptibly into surrounding normal enamel	Clearly differentiated from adjacent normal enamel
Colour	Slightly more opaque than normal enamel; "paper white". Incisal edges, tips of cusps may have frosted appearance. Does not show stain at time of eruption	Usually pigmented at time of eruption; Often creamy-yellow to dark reddish-orange
Teeth affected	Most frequent on teeth that calcify slowly, (Cuspids, bicuspids, second and third molars). Rare on lower incisors. Usually seen on six or eight homologous teeth. Extremely rare in deciduous teeth	Any tooth may be affected. Frequent on labial surfaces of lower incisors. May occur singly. Usually one to three teeth affected. Common in deciduous teeth
Gross hypoplasia	None. Pitting of enamel does not occur in the milder forms. Enamel surface has glazed appearance, is smooth to point of explorer	Absent to severe. Enamel surface may seem etched, be rough to explorer
Detection	Often invisible under strong light; most easily detected by line of sight tangential to tooth crown.	Seen most easily under strong light on line of sight perpendicular to tooth surface

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Health Organization in its basic survey manual (W.H.O, 1997). The scoring system ranged from 0 (normal) - 4 (severe)

Dean's Fluorosis Index - Modified Criteria (1942)

Normal (0)

The enamel represents the usual translucent semivitriform type of structure. The surface is smooth, glossy and usually of a pale, creamy white color.

Questionable (0.5)

The enamel discloses slight aberrations from the translucency of normal enamel, ranging from a few white flecks to occasional white spots. This classification is used in those instances where a definite diagnosis of the mildest form of fluorosis is not warranted and a classification of "normal" not justified.

Very Mild (1)

Small, opaque, paper white areas scattered irregularly over the tooth, but not involving as much as approximately 25% of the tooth surface. Frequently included in this classification are teeth showing no more than about 1-2 mm of white opacity at the tip of the summit of the cusps of bicuspids or second molars.

Mild (2)

The white opaque areas in the enamel of teeth are more extensive, but do not involve as much as 50% of tooth.

Moderate (3)

All enamel surfaces of the teeth are affected and surfaces subject to attrition show wear. Brown stain is frequently a disfiguring feature.

Severe (4)

All enamel surfaces of the tooth are affected and hypoplasia is so marked that the general form of the tooth may be affected. The major diagnostic sign of this classification is discrete or confluent pitting. Brown stains are widespread and teeth often present a corroded-like appearance.

COMMUNITY FLUOROSIS INDEX (CFI)

To determine the severity of dental fluorosis as a public health problem, Trendley H. Dean in 1946 devised a method of calculating the prevalence and severity of fluorosis in a group or community which he termed as the "Community fluorosis Index" (CFI).

This gave an indication of the public health significance of the fluorosis

$$CFI = \frac{n \times w}{N}$$

Where n=Number of individuals in each category

w=The weighting for each category

N= Total population

Range of Scores for Community Fluorosis Index	Public Health Significance
0.0 - 0.4	Negative
0.4 - 0.6	Borderline
0.6 - 1.0	Slight
1.0 - 2.0	Medium
2.0 - 3.0	Marked
3.0 - 4.0	Very marked

Dean did not consider CFI Scores below 0.4 to have public health significance. Scores that ranged between 0.4 and 0.6 were of borderline significance, and CFI scores above 0.6 were of increasing public health concern as they progressed to a maximum of 4.0.

INDICES USED FOR MALOCCLUSION

Malocclusion has proved to be a difficult entity to define because individual

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perceptions of what constitutes a malocclusion problem differ widely.

DENTAL AESTHETIC INDEX (DAI)

The Dental Aesthetic Index (DAI) was developed by Naham C. Cons, Joanna Jenny, and Frank J. Kohout in 1986 to assess orthodontic treatment need. It is an orthodontic index based on socially defined aesthetic norms.

The DAI has two components,

- A physical component
- An aesthetic component.

The aesthetic component of the DAI is based on a sampled public's perceptions or ratings of dental aesthetics, illustrated by 200 photographs of occlusal configurations with each showing a full-front view and both right and left profiles. Each photograph also contains 49 anatomical measurements of traits, considered to be important occlusal traits in the development of an orthodontic index. By using regression analysis, the sample public's rating of dental aesthetics in each of the photographs is related to the anatomical measurements which provide the basis for the 10 occlusal traits selected and their regression coefficient weights.

The 10 occlusal traits are (1) missing teeth (i.e., incisors, canines, and bicuspids), (2) anterior crowding, (3) anterior spacing, (4) diastema between the two maxillary central incisors, (5) the largest anterior irregularity in the maxilla, (6) the largest anterior irregularity in the mandible, (7) overjet, (8) underjet, (9) anterior open bite, and (10) anteroposterior molar relationship.

The DAI is a regression equation or formula that mathematically links societal perceptions of dental aesthetics (i.e., psychosocial) with the objective physical measurements of occlusal traits associated with malocclusion to produce a single score.

Advantages

- It is considered to be a quick and useful index for identifying unmet orthodontic treatment needs and as a screening device for determining orthodontic treatment priority.
- It has demonstrated a high degree of validity and reliability.

The DAI has also been adopted by the World Health Organization (WHO) as a cross-cultural index and as a model for the WHO's Pathfinder Survey protocol.

Procedure:

The DAI can be obtained from study models or directly from the mouth (i.e., intraorally) without the use of radiographs.

Although the DAI was developed for use in permanent dentition, its procedure may easily be adapted for use in mixed dentition. Instead of counting the number of missing incisors, canines, and bicupsids, a mixed dentition modification is used. When scoring a case of mixed dentition, the space from a recently exfoliated deciduous or primary tooth is not scored as "missing" if it appears that the permanent replacement will erupt soon.

Components

1. Number of missing visible teeth - incisors, canines, and premolars (i.e., bicuspids) in the maxillary and mandibular arches (5.76, 6)*.
2. Assessment of crowding in the incisal segments: 0 = no segments crowded; 1 = 1 segment crowded; 2 = 2 segments crowded (1.15, 1)*
3. Assessment of spacing in the incisal segments: 0 = no segments spaced; 1 = 1 segment spaced; 2 = 2 segments spaced (1.31, 1)*
4. Measurement of any midline diastema in mm (3.13, 3)*
5. Largest anterior irregularity on the maxilla in mm (1.34, 1)*

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6. Largest anterior irregularity on the mandible in mm (.75, 1)*
7. Measurement of anterior maxillary overjet in mm (1.62, 2)*
8. Measurement of anterior mandibular overjet in mm (3.68, 4)*
9. Measurement of vertical anterior openbite in mm (3.69, 4)*
10. Assessment of anteroposterior molar retention; largest deviation from normal either left or right, 0 = normal, 1 = 1/2 cusp either mesial or distal, 2 = 1 full cusp or more either mesial or distal (2.69, 3)*

Constant (13.36, 13)*

Total = DAI score (actual or rounded)

*Note: (actual weight, rounded weight)

Calculation

The 10 occlusal traits are scored and/or measured. Then, these trait scores/measurements are multiplied by their actual or rounded weights (i.e., regression coefficients) provided within the parentheses, and the products are summed with the constant number, 13, to compute the DAI score.

Decision points for categorizing severity levels that approximate treatment needs

DAI scores of 25 and below represent normal or minor malocclusions with no or slight treatment need

DAI scores 26 to 30 represent definite malocclusions with treatment elective

DAI scores 30 to 35 are severe malocclusions with treatment highly desirable

DAI scores 36 and higher represent very severe or handicapping malocclusions with treatment considered mandatory.

INDEX OF ORTHODONTIC TREATMENT NEED (IOTN)

The Index of Orthodontic Treatment Needs (IOTN) was described in 1989 by P.H. Brook and W.C. Shaw to assess orthodontic treatment need from an anatomical and aesthetic perspective.

The IOTN consists of two components,

- The functional and Dental Health Component (DHC)
- The Aesthetic Component (AC).

Dental Health Component (DHC)

The DHC is categorized into five different grades ranging from grade 1, representing "no need" for treatment, to grade 5, representing a "very great need" of orthodontic treatment based on the evaluation of five occlusal traits,

1. Missing teeth
2. Overjet
3. Crossbite
4. Contact point displacement
5. Overbite

For the DHC, the measurements can be made directly from the mouth or from study models/casts. With adequate lighting, a millimeter ruler, and mouth mirror, the DHC occlusal traits are measured or assessed. The order in which these occlusal traits are assessed is not important. Afterward, the grading assigned is based on the most severe trait indicating the priority or need for treatment. Summing scores for the series of occlusal traits is not done.

Grade 5-Very great

- Defects of cleft lip and/or palate.
- Increased overjet greater than 9 mm.
- Reverse overjet greater than 3.5 mm with reported masticatory or speech difficulties.
- Impeded eruption of teeth (with the exception of third molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous

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teeth and any other pathological cause.
- Extensive hypodontia with restorative implications (more than one tooth missing in any quadrant) requiring pre-restorative orthodontics.

Grade 4-Great

- Increased overjet greater than 6 mm but less than or equal to 9 mm.
- Reverse overjet greater than 3.5 mm with no reported masticatory or speech difficulties.
- Reverse overjet greater than 1 mm but less than or equal to 3.5 mm with reported masticatory or speech difficulties.
- Anterior or posterior crossbites with greater than 2 mm displacement between retruded contact position and intercuspal position.
- Posterior lingual crossbites with no occlusal contact in one or both buccal segments.
- Severe displacement of teeth, greater than 4 mm.
- Extreme lateral or anterior open bite greater than 4 mm.
- Increased and complete overbite causing notable indentations on the palate or labial gingivae.
- Patient referred by colleague for collaborative care e.g. periodontal, restorative or TMJ considerations.
- Less extensive hypodontia requiring pre-restorative orthodontics or orthodontic space closure to obviate the need for a prosthesis (not more than 1 tooth missing in any quadrant).

Grade 3-Moderate

- Increased overjet greater than 3.5 mm but less than or equal to 6 mm with incompetent lips at rest.
- Reverse overjet greater than 1 mm but less than or equal to 3.5 mm.
- Increased and complete overbite with gingival contact but without indentations or signs of trauma.
- Anterior or posterior crossbite with less than or equal to 2 mm but greater than 1 mm displacement between retruded contact position and intercuspal position.
- Moderate lateral or anterior open bite greater than 2 mm but less than or equal to 4 mm.
- Moderate displacement of teeth greater than 2 mm but less than or equal to 4 mm.

Grade 2-Little

- Increased overjet greater than 3.5 mm but less than or equal to 6 mm with lips competent at rest.
- Reverse overjet greater than 0 mm but less than or equal to 1 mm.
- Increased overbite greater than 3.5 mm with no gingival contact.
- Anterior or posterior crossbite with less than or equal to 1 mm displacement between retruded contact position and intercuspal position.
- Small lateral or anterior open bites greater than 1 mm but less than or equal to 2 mm.
- Pre-normal or post-normal occlusions with no other anomalies.
- Mild displacement of teeth greater than 1 mm but less than or equal to 2 mm.

Grade 1-None

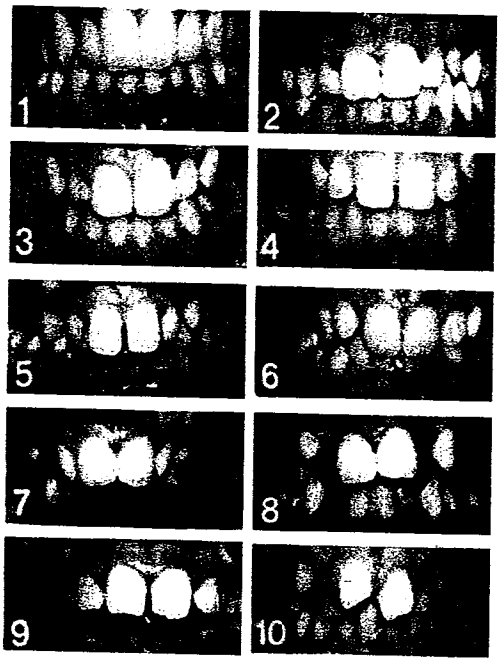
- Other variations in occlusion including displacement less than or equal to 1 mm.

Aesthetic Component (AC)

A Standardized Continuum of Aesthetic Need (SCAN) Scale was used for the development of the aesthetic component. The AC is a visual 10-point scale, illustrated by a series of 10 dental photographs, from 0.5 (i.e., attractive dental appearance) to 5.0 (i.e., unattractive dental appearance).

For direct mouth assessments, self-retaining lip/cheek retractors are used. However, for

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study casts, the occlusion is examined from the front, and the appearance of the dentition is judged as it would be seen in normal day-to-day interaction. The AC rating is based on matching the patient's dental appearance with one of the photographs and is allocated for overall dental attractiveness rather than specific morphological similarity to the photographs. This component may either be rated in the normative manner by the health care professional (e.g., orthodontist) or by the patient for a self-perceived determination of orthodontic treatment need.

Each component is mutually exclusive, and the component showing the greatest need takes priority.

Grade 1 = most aesthetic arrangement of the dentition

Grade 10 = least aesthetic arrangement of the Dentition

Grade 1-4 = little or no treatment required

Grade 5-7 = moderate or borderline treatment required

Grade 8-10 =treatment required

The evaluaton of a plain plaster model or black and white photographs has the advantage that the estimate is not influenced by the oral hygiene, the condition or color of the gingiva.

There seems to be a general agreement that a DHC of less than 4 and an AC score of below 7 do not justify treatment by a hospital based consultancy except for teaching or research purposes.

Advantages

It is considered to be a valid and reliable index.

It is a simple, quick, and satisfactory reproducible method for recording orthodontic treatment needs in epidemiological surveys

Modifications of IOTN

1. A major modification of the DHC and the AC was suggested in 1993 to improve the reliability of both components. For the DHC, the suggestion was to reduce the five grades to three grades, with grades 1 and 2 indicating "no need" for treatment; grade 3, "borderline need"; and grades 4 and 5, "definite need." The suggestion for the AC was to change the 10-point scale to a 3-point scale, with photographs 1 to 4 representing "no need," photographs 5 to 7 representing "borderline need," and photographs 8 to 10 representing "definite need" for treatment based on aesthetics. These suggested modifications were accepted by the IOTN specialist team in Manchester, England, and currently are used as the British standards for orthodontic treatment.
2. The aesthetic component of the IOTN was also modified into a tactile graphics version for visually impaired orthodontic patients.
3. Another modified version of the IOTN was also introduced in 2001 for establishing priorities for treatment in oral health surveys. For this modification, the DHC was reduced to 2 grades (i.e., 0 = no

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definite need, and 1 = definite need) by combining grades "borderline need" and "no need" into one category grade (i.e., 0 = no definite need). For the AC, the 10-point scale is still utilized as in the original IOTN. However, for this modified IOTN, only those malocclusions with a definite dental health need and aesthetic need for treatment (i.e., AC photographs 8, 9, and 10) are recorded. A small metal ruler was also developed to assist with the intraoral measurements of overjet, crowding, and open bites and is considered much simpler to understand and use than the original DHC ruler (Burden, Pine, and Burnside, 2001).

OTHER INDICES

PATIENT HYGIENE PERFORMANCE INDEX (PHP INDEX)

This index for assessing an individual's oral hygiene performance was introduced by Podshadley A.G and Haley J.V in 1968.

GLASS INDEX

The Glass Index system was developed by Glass R.L. in 1965. This index assesses the presence and extent of debris accumulation, for evaluating tooth-brushing efficacy.

NAVY PLAQUE INDEX (NPI)

The Navy Plaque Index was developed by Grossman F.D. and Fedi P.F. in 1970. This index was designed to assess the plaque control status among naval personnels and to measure any subsequent changes.

CALCULUS SURFACE INDEX (CSI)

The calculus Surface Index (CSI) was developed by Ennever J, Sturzenberger C.P and Radike A.W. in 1961. The CSI is one of the two indices that are used in short-term (i.e. less than 6 weeks) clinical trials of calculus inhibitory agents.

CALCULUS SURFACE SEVERITY INDEX (CSSI)

The Calculus Surface Severity Index (CSSI) was developed by Ennever J, et al in 1961 as a companion index to their Calculus Surface Index (CSI). The CSSI measures the quantity of calculus present on a scale of 0 to 3 on each of the surfaces examined for CSI.

MARGINAL LINE CALCULUS INDEX (MLCI)

The Marginal Line Calculus Index (MLCI) was developed by Muhlemann H.R. and Villa P. in 1967. MLCI, is another index that is frequently used in short-term clinical trials (i.e less than 6 weeks) of anticalculus agents.

This index was developed to assess the accumulation of supra gingival calculus on the gingival third of the tooth or, more specifically, supragingival calculus along the margin of the gingiva.

VOLPE-MANHOLD INDEX (VMI)

The Volpe-Manhold Probe Method of Calculus Assessment was developed by Volpe A.R. and Manhold J.H. in 1962 to assess the presence and severity of calculus formation, specifically new deposits of supragingival calculus, following an oral prophylaxis.

MODIFIED GINGIVAL INDEX (MGI)

The Modified Gingival Index (MGI), was developed by R.R. Lobene, T. Weather-ford, N.M. Ross, R.A. Lamm, and L. Menaker in 1986, as a modification of the Loe and Silness Gingival Index to assess the prevalence and severity of gingivitis.

SULCUS BLEEDING INDEX (SBI)

The Sulcus Bleeding Index (SBI) is an index for assessment of gingival bleeding, developed by Muhlemann H.R. and Son S. in 1971. This index system is a modification of the Papillary-Marginal Index (PM index) of Muhlemann & Mazor (1958). The purpose of this index is to

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locate areas of gingival sulcus bleeding upon gentle probing and thus recognize and record the presence of early inflammatory gingival disease.

PAPILLARY BLEEDING INDEX (PBI):

The Papillary Bleeding Index (PBI) was developed by Muhlemann H.R. in 1977 as a modification of the Sulcus Bleeding Index (SBI) of Muhlemann and Son. The PBI is based on bleeding following gentle probing of the interdental papilla.

GINGIVAL BLEEDING INDEX (GBI):

The Gingival Bleeding Index was developed by Carter H.G. and Barnes G.P. in 1974, to record the presence or absence of gingival inflammation as determined by bleeding from interproximal gingival sulci.

MODIFIED SULCULAR BLEEDING INDEX (MSBI)

The Modified Sulcular Bleeding Index (mSBI), also known as the Modified Sulcus Bleeding Index, was developed in 1987 by A. Mombelli, M.A. Van Oosten, E. Schurch, Jr., and N.P. Land to determine the severity of gingival bleeding.

EASTMAN INTERDENTAL BLEEDING INDEX (EIBI)

The Eastman Interdental Bleeding Index was developed by Abrams, K., Caton, J., and Polson, A., in 1984, to assess the presence of inflammation in the interdental area by the presence or absence of bleeding.

GINGIVAL PERIODONTAL INDEX (GPI)

The Gingival Periodontal Index (GPI) was developed by O'Leary T.J, Gibson W.A, Shannon I.L, Schuessler C.F. and Nabers C.L. in 1963.

The GPI is a modification of the PDI of Ramfjord for the purpose of screening individuals to determine who needs periodontal treatment.

GINGIVAL - BONE COUNT INDEX

The Gingival-Bone (GB) Count Index was developed by Dunning J.M. and Leach L.B. in 1960.

The Gingival-Bone Count Index records the gingival condition and the level of the crest of the alveolar bone.

EXTENT AND SEVERITY INDEX (ESI)

The Extent and Severity Index (ESI) was developed in 1986 by J.P. Carlos, M.D. Wolfe, and A. Kingman to assess the extent (i.e., number of sites affected within the mouth) and severity (i.e., stage of advancement) of loss of periodontal attachment (LPA) by determining the percentage of sites within the mouth with LPA greater than 1 millimeter (i.e., extent) and the mean LPA for affected sites (i.e., Severity).

STONE'S INDEX

The Stone's caries index was developed by Stone H. H, Lawton F. E, Bransby E. R. and Hartley H.O. in 1949.

CARIES SEVERITY INDEX

The Caries Severity Index was developed by Tank Certrude and Storvick Clara in 1960. This index was developed to study the depth and extent of the caries surfaces and the extent of pulpal involvements.

CZECHOSLOVAKIAN CARIES INDEX:

The Czechoslovakian Caries Index was introduced by Poncova, Novak and Matena in 1956.

CARIES SUSCEPTIBILITY INDEX:

The Caries Susceptibility Index was developed by Richardson A. in 1961, for

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assessing caries susceptibility.

D-M-F SURFACE PERCENTAGE INDEX

The Decayed-Missing-Filled-Surface (DMFS) Percentage Index was developed by Jager C.L in 1963.

MOLLER'S INDEX

This index system was developed by Moller I.J and Poulsen S. in 1966,. as a standardised system for diagnosing, recording and analysing dental caries data.

DEVELOPMENTAL DEFECTS OF ENAMEL INDEX (DDE INDEX)

The developmental defects of enamel index (DDE Index) was developed by "FDI-Commission on Oral Health, Research and Epidemiology" in 1982.

MODIFIED DEVELOPMENTAL DEFECTS OF DENTAL ENAMEL INDEX (MODIFIED DDE)

The Modified Developmental Defects of Enamel (Modified DDE) was developed by Clarkson J.J. and O'Mullane D.M. in 1989 to assess developmental enamel defects to avoid the need for diagnosising fluorosis before recording enamel opacities.

TOOTH WEAR INDEX (TWI)

The Tooth Wear Index (TWI) was introduced by B.G.N. Smith and J.K. Knight in 1984 to assess the extent and severity of dental erosion, attrition, and abrasion as well as any combination of these conditions.

TOOTH SURFACE INDEX OF FLUOROSIS (T S I F)

The Tooth Surface Index of Fluorosis (TSIF) was developed by Herschel. S. Horowitz, William S. Driscoll, Rhea J. Meyers, Stanley B. Heifetz, and Albert Kingman in 1984, at the National Institute of Dental Research, U.S.A. to assess the prevalence of fluorosis from a tooth surface perspective.

THYLSTRUP AND FEJERSKOV INDEX FOR FLUOROSIS (TFI)

This Fluorosis Index was developed by Thylstrup A. and Fejerskov O. in 1978 to assess the prevalence and severity of dental fluorosis.

FLUOROSIS RISK INDEX (FRI)

The Fluorosis Risk Index (FRI) was introduced by David G. Pendrys, in 1990. This index was developed to investigate risk factors for fluorosis by identifying the associations between age-specific exposures to fluoride sources and the development of enamel fluorosis. It is designed for analytical epidemiologic study usage.

HANDICAPPING LABIO-LINGUAL DEVIATIONS INDEX (HLD INDEX)

The Handicapping Labio-Lingual Deviations (HLD) Index was introduced by H.L. Draker in 1960 to identify the presence or absence and the degree of the physical dento-facial handicap based on seven components, and not to diagnose malocclusion.

TREATMENT PRIORITY INDEX (TPI)

The Treatment Priority Index (TPI), referred to as the Orthodontic Treatment Priority Index, was developed by R.M. Grainger in 1967 to assess the severity of malocclusion, the degree of handicap, and primarily the need for orthodontic treatment.

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Chapter 14

RESEARCH METHODOLOGY AND BIOSTATISTICS

INTRODUCTION TO RESEARCH METHODOLOGY

PURPOSE OF ORAL HEALTH RESEARCH

CATEGORIES OF RESEARCH

SCIENTIFIC METHOD

- PROBLEM FORMULATION
- HYPOTHESIS FORMULATION AND WRITING-THE PROTOCOL
- SAMPLING AND SAMPLE DESIGNS
- COLLECTION OF DATA
- PRESENTATION OF DATA
- ANALYSIS AND INTERPRETATION
- WRITING THE REPORT

GLOSSARY

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INTRODUCTION

Research "is the continual search for truth using the scientific method."

Research is a quest for knowledge through diligent search or investigation or experimentation aimed at the discovery and interpretation of new knowledge. Scientific method is a systematic body of procedures and techniques applied in carrying out investigation or experimentation targeted at obtaining new knowledge. Research and scientific methods may be considered a course of critical inquiry leading to the discovery of fact or information, which increases our understanding of human health and disease.

Research includes,

1. A problem in need of solution.
2. Collection of data as evidence necessary to solve a problem.
3. Organization, classification and analysis of the evidence into a logical pattern.
4. Use of reasoning and statistical analysis to solve the problem, according to the evidence collected.
5. A conclusion or solution to the problem.

"Oral health research refers to laboratory, clinical and field investigations that lead to improvement in the control of oral diseases and health care delivery." The ultimate goal is to improve the quality of life for the population.

PURPOSE OF ORAL HEALTH RESEARCH

1. To promote the oral health of the public by improving education, service, practice and delivery.
2. To contribute new knowledge or reevaluate current knowledge to improve all phases of oral health care.
3. To improve the techniques and practices of identifying, preventing and treating oral diseases in individuals and in groups.
4. To develop and test theories related to oral health care and oral disease processes.
5. To identify and solve problems indigenous to advancement, decision making and change in oral health care delivery.

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CATEGORIES OF RESEARCH

1. Basic and applied

Research can be functionally divided into basic (or pure) research and applied research. Basic research is usually considered to involve a search for knowledge without a defined goal of utility or specific purpose. Applied research is problem-oriented, and is directed towards the solution of an existing problem.

2. Empirical and theoretical research

Health research mainly follows the empirical approach, i.e. it is based upon observation and experience more than upon theory and abstraction. Epidemiological research, for example, depends upon the systematic collection of observations on the health-related phenomena of interest in defined populations. Empirical and theoretical research complement each other in developing an understanding of the phenomena, in predicting future events, and in the prevention of events harmful to the general welfare of the population of interest.

Empirical research in the health sciences can be qualitative or quantitative in nature.

3. Quantitative (numeric) or qualitative (non-numeric)

Quantitative research is concerned with counting and calculation of numbers in relation to subjects under study and is mainly used in epidemiology. Data is collected quantitatively, e.g. the number of decayed, missing and filled teeth of a group of 5-year-old children are counted and then the mean number for the group can be calculated (dmft

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index). Each category of an index, if numeric, must be consistently greater than the previous one i.e. with the above example if d=1 then d=2 must be twice as many teeth, d=3 three times greater than 1 and so on.

However, in some periodontal indices a grading is used e.g. good/fair/poor and this is in fact qualitative data as it is non-numeric. Also with CPITN, the categories are numeric but arbitrarily assigned i.e. a CPITN score of 2 is not twice as severe as 1, so this is qualitative also. Hence, quantitative research uses both quantitative and qualitative data.

Quantitative research usually uses a specific random sample size representative of the population being studied.

Qualitative research uses less rigid methods, such as unstructured interviews to elicit facts and opinions which cannot be measured quantitatively. This technique may be used to define a problem followed by a quantitative method to test a hypothesis. Therefore both methods are complimentary and can provide information on the same problem from a different perspective.

Qualitative researchers aim to gather an in-depth understanding of human behavior and the reasons that govern human behavior. Qualitative research relies on reasons behind various aspects of behavior. Simply put, it investigates the why and how of decision making, not just what, where, and when. Hence, the need is for smaller but focused samples rather than large random samples.

Qualitative researchers typically rely on four methods for gathering information:

- Participation in the setting
- Direct observation
- In depth interviews
- Analysis of documents and materials

4. Health research triangle

Yet another way of classifying health research, be it basic or applied, empirical or theoretical, quantitative or qualitative, is to describe it under three operational interlinked categories of

- Biomedical research
- Health services research
- Behavioral research-

This is called the health research triangle.

Biomedical research deals primarily with basic research involving processes at the cellular level; health research deals with issues in the environment surrounding man, which promote changes at the cellular level; and behavioral research deals with the interaction of man and the environment in a manner reflecting the beliefs, attitudes and practices of the individual in society.

SCIENTIFIC METHOD

"It refers to a series of standardized procedures used in research to increase the likelihood that information gathered will be relevant, reliable and unbiased".

The scientific method offers an objective, logical, comprehensive and systematic mode for solving problems, answering questions or testing hypotheses in the laboratory, field or clinic.

The steps in the scientific method are:

1. Problem formulation: Identification and statement of a problem in need of a solution or a question in need of an answer
2. Hypothesis formulation: Formulation of a solution or answer to the question that is observable, measurable and consistent with what is already known in the field.
3. Data collection: Collection of facts than can be used to solve the problem, answer the question or test the hypothesis.
4. Analysis and interpretation: Analysis and interpretation of the meaning of the data collected.
5. Writing a report: The final step in the scientific method whose purpose is to communicate the findings of the research.

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These steps are cyclic and involve inductive and deductive reasoning.

Inductive reasoning involves the observation of facts and their organization into a method of explaining phenomena in the real world (theory).

Deductive reasoning is applied to observe and verify the conditions of a theory developed through induction.

PROBLEM FORMULATION

"A researchable problem is a statement or question that poses an unknown relationship between variables and serves to focus the entire investigation."

Ideal requirements of a researchable problem.

1. A problem must be significant to some aspect of oral health care.
2. If solved, it should contribute to oral health delivery by leading to new knowledge, confirming or improving current practices or developing new theories.
3. The problem must be observable and capable of measurement through known methods of quantification.
4. The problem should be of interest to the researcher, who must be capable of accessing the necessary resources for proper scientific investigation.

HYPOTHESIS FORMULATION

Hypotheses are carefully constructed statements about a phenomenon in the population. The hypotheses may have been generated by deductive reasoning, or based on inductive reasoning from prior observations. One of the most useful tools of health research is the generation of hypotheses which, when tested, will lead to the identification of the most likely causes of disease or changes in the condition being observed. Although we cannot draw definite conclusions, or claim proof using the inductive method, we can come ever closer to the truth by knocking down existing hypotheses and replacing them with ones of greater plausibility. Hypotheses are often constructed and tested to identify causes of disease and to explain the distribution of disease in populations.

How to write a protocol

A protocol is a document that explicitly states the reasoning behind and structure of a research project. It is a draft summary indicating why and how the study will be undertaken.

The preparation of a protocol is a most important stage in the research process and is carried out for the following reasons,

1) It states the question you want to answer.
2) It encourages you to plan the project in detail, before you start.
3) It allows you to see the total process of your project.
4) It acts as a guide for all personnel involved in the project.
5) It acts as a 'reminder' to you and your co-workers of the initial structure and aims of the project.
6) It enables you to monitor the progress of the project.
7) It is necessary if you need to apply for funding or ethical approval
8) It helps in the continuation of the study if the original examiner(s) are not able to.

All protocols are divided into two main sections,

1. The problem to be investigated

- Project title
- The research problem
- Background (including the literature review)
- The aims
- The hypothesis

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2. Method of investigation

- Plan of the investigation (including sample size calculation and statistical methods)
- Project milestones
- Dissemination of the results
- Resources required

The problem to be investigated

The project title

The project title is one of the most important features of the protocol because it attracts the attention of the potential reader. It is, therefore, necessary to make it as short and to the point as possible. If we consider two possible examples,

"An investigation to evaluate the effect of fluoride varnishes, Duraphat and Fluorprotector on the occurrence of new carious lesions. A randomized controlled trial."

This title is overlong and states the obvious in a rather 'wordy' way. It goes without saying that because it is the title of a research protocol it is an investigation that will evaluate something. A preferable approach may be:

A randomized controlled trial of Duraphat and Fluorprotector varnishes.

The second title comes straight to the point without stating the obvious. It not only attracts the attention of a reader, but it immediately tunes them into the subject matter.

The research problem

Research problems are explanatory devices. They are carefully designed sentences about what you intend to find out. The statement of the problem should be written in a precise and concise form, including the essential points. When the problem statement is written, the words must show an understanding of the research phenomena and should explicitly reveal the purpose. Information about the problem should be summarized so that the reader is not 'drowned' in detail.

Go directly to the problem. Resist the temptation to give background or set the stage for the problem. When the protocol is read, the reader will want to know the purpose of the study immediately. They will not want to search through several pages of text to discover what the protocol is about. To be effective the opening words should be clear and demand attention, for example:

1. In this study I intend to find whether the use of a Duraphat varnish will result in greater caries protection than a Fluorprotector varnish. If I can show that this occurs this will be an important finding for preventive care.

2. This will be an investigation to evaluate the effect of fluoride varnish upon dental caries incidence.

The statement 1 is easier to read because it is in the first person. This should be the preferred writing style as opposed to the use of passive voice (statement 2). However, care should be taken to see that the first person is not over-used. As a result, the statement of the problem should be explicit.

Background (including the literature review)

The most important feature of the background to the project is that it should be brief and to the point.

- For a research protocol the background should be no longer than two pages of A4 paper.
- In this section, the literature that is relevant to the problem that is to be solved should be concisely reviewed. In this respect, it is probably good practice to limit the number of papers quoted to less than 20.
- When the review is written, attention should be drawn to the good points and

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the deficiencies of the studies quoted. It should also be remembered that if a study has been published in a journal, it does not always mean that it is flawless in its methodology and conclusion. Nevertheless, being too critical of previous investigators is also not justified, because research technology and understanding of data analysis is a fast-moving field.

- In terms of writing style it is good practice to make the writing flow. Avoid the tendency to introduce concepts and previous studies by simply going through a shopping list of papers.

For example: McNamara has shown that Duraphat varnish produces a reduction of caries incidence by 30%. Pancherz (1979) used Fluorprotector varnish and showed a caries reduction of 30%. This is in agreement with a study by Hansen (1984). However, Tulloch et al. (1990) have suggested that it is not possible to come to any conclusions concerning the effect of these two varnishes.

It is better to take the following approach:

'There have been many retrospective investigations that have concluded that either Duraphat or Fluorprotector have a dental caries inhibiting effect. (McNamara, 1984; Pancherz, 1986; Hansen, 1991). However, Tulloch et al. (1990) in a review of this literature have been critical of past research and concluded that most studies are characterized by weak designs. As a result, it is not possible to come to any conclusions concerning the effect of these two varnishes'.

The literature review should logically lead to the statement of the aims of the proposed project.

The source of information may include the following:

- indices, such as the Index Medicus, which identifies journal articles by subject, author and title
- computer-based literature searches such as MEDLINE and MEDLARS
- bibliographies, such as those found at the end of books, articles and theses, or prepared as separate documents

The aims

Aim is an overall statement of the reason for undertaking the study, e.g. to determine the dental health of 12-year-old state school children within a, b, c districts.

The aims of the project should be explicitly stated. These should be confined to the intention of the project.

The objectives

Objectives are the means to achieve the aim. They must be

- measurable
- achievable
- statements to achieve aim
- appropriate to the group under study

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Using the example of the aim above, the objectives could be as follows,

a. select a representative sample of the study population, i.e. 12-year-old state school children.
b. conduct a cross-sectional survey of the above to describe dental caries and oral cleanliness.
c. estimate professionally judged treatment need.
d. To describe the variation in dental caries, treatment need and oral cleanliness between districts.

Differentiation between 'general' and 'specific' objectives may eliminate unnecessary confusion. The general objective of research is what is to be accomplished by the research project and why.

Example: to determine whether or not a new vaccine should be incorporated into public health programs.

The specific objectives are, in detail, the

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specific aims of the research project, often breaking down what is to be accomplished into smaller logical components. In other words, specific objectives relate to the specific research questions the investigator wants to answer through a proposed study.

Example: in evaluating a new vaccine, to determine the degree of protection that is attributable to the vaccine in a study population by comparing the vaccinated and unvaccinated groups.

Hypothesis

A hypothesis can be defined as a tentative prediction or explanation of the relationship between two or more variables. A hypothesis, in other words, translates the problem - statement into a precise, unambiguous prediction of expected outcomes. Hypotheses are not meant to be haphazard guesses, but should reflect the depth of knowledge, imagination and experience of the investigator. A hypothesis can be as simple in form as predicting the relationship between two variables, one independent and one dependent. Therefore, in the process of formulating hypotheses, all variables relevant to the study should be identified.

It is general practice that hypotheses are stated in the null form.

Eg: 'The null hypothesis is: There is no difference in the effect of Duraphat and Fluorprotector varnishes on the dental caries incidence.'

The alternative hypothesis is, then,

'There is a difference in the effect of Duraphat and Fluorprotector varnishes on the dental caries incidence.'

Method of investigation

This is a description of the tactics of the research and is probably the easiest part of a research protocol to prepare. If the method has to be made easy to read, it is better to use the active voice, instead of the passive, for example:

'We will randomly allocate the subjects to the Duraphat and the Fluorprotector group, stratifying by age and sex'.

This is easier to read than: 'The subjects will be randomly allocated to the Duraphat and the Fluorprotector group, stratifying by age and sex'.

In a study protocol, the method should be stated in the future tense. The method should be structured using the following subheadings: (i) subjects (ii) design (iii) procedure (iv) materials, measurements, and apparatus used (v) sample size calculation and finally (vi) the statistical methods that is going to be used.

The subjects

When the subjects of a study are described, the following information is required,

1. The population the subjects will be drawn from.
2. The total number and the number in any subgroups within the investigation.
3. All aspects of subject selection that will provide information on the removal or minimization of bias.
4. The inclusion and exclusion criteria for the subjects.

The design

The selection of a research strategy is the core of research design and the choice of strategy, whether descriptive, analytical, experimental, or a combination of these, depends on a number of considerations. The specific types of studies are as follows,

- Descriptive strategies (observational hypothesis generation rather than testing)
- Observational analytical strategies (hypothesis testing)
- Experimental strategies

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At this stage of the protocol the inclusion and exclusion criteria can also be determined.

Sample size calculation

Sampling is the process or technique of selecting a sample of appropriate and manageable size for study. In epidemiological investigations, it is almost always possible to deal with a sample drawn from a reference population or universe. The universe may be a population of people (healthy and sick), a population of cases of a certain disease, or recipients of a certain treatment.

- Selection of sampling method
- Determination of sample size
- Plans should be made to ensure representativeness and reliability of the sample to minimize sampling errors.

If the sample size is too small, there is a considerable risk that the study may not be sufficiently powerful to detect a difference between the groups, if a true difference exists. The study would, therefore, be worthless and a great deal of effort will be wasted.

The procedure

This will describe exactly what is going to be done with the subjects, how the data will be collected, who will be collecting the data, what is the duration of the study, examiner training and calibration and the systematic procedure of examination.

Details of consent/ permission of appropriate authorities and the conduct of pilot study should also be included.

Materials, measurement and apparatus

Describe the materials and the instruments to be used in the study.

Instruments are tools by which data are collected. They include:

- questionnaire and interview schedules
- medical examination
- laboratory tests
- screening procedures

When indices/criteria are used, write the criteria in full e.g. if using WHO criteria for caries, state all the details.

Statistical methods

It is also essential that the statistical methods to be used in the investigation are outlined in detail. It is not sufficient to merely state the names of the tests to be used. The rationale for the choice of statistical tests should be described.

For example: 'The research question is concerned with the comparison of two groups (Duraphat versus Fluorprotector). The dependent variable will be the incidence of caries. The independent variables will be the study group, sex and age. Before we analyze the data, we will check for normality and if necessary transform the data. Because the influence of several, possibly interrelated independent variables will be evaluated, we will use linear regression analysis'.

Method of dissemination of findings

Although this is not always essential, it does let the reader know what will happen to the results of the study.

Resources required

Finally a list of all the resources that are required to successfully complete the investigation must be made. If these resources have cost implications, the potential cost of the investigation must be noted.

Although, preparing and presenting a protocol is one of the most difficult parts of carrying out a research project, it can also be the most interesting and satisfying. The result of this process should be a short (not more that 2500 words) document that clearly outlines the research project. If the protocol is poorly prepared and not adhered to, it is unlikely that the project will yield the

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information that is hoped for.

The next step in the scientific method is sampling and data collection.

SAMPLING AND SAMPLE DESIGNS

A sample is a part of a population, called the 'Universe', 'reference' or 'parent' population. Sampling is the process or technique of selecting a sample of appropriate characteristics and adequate size.

'Sampling frame' is the total of the elements of the survey population, redefined according to certain specifications. It consists of sampling units, which are individual entities that form the focus of the study.

Advantages of sampling

- It reduces the cost of the investigation, the time required and the number of personnel involved
- It allows thorough investigation of the units of observation
- It helps to provide adequate and in-depth coverage of the sample units

Ideal requirements of a sample

1. Efficiency: It is the ability of the sample to yield the desired information.
2. Representativeness: A sample should be representative of the parent population so that inferences drawn from the sample can be generalized to that population with measurable precision and confidence.
3. Measurability: The design of the sample should be such that valid estimates of its variability can be made, that is, the investigator should be able to estimate the extent to which findings from the sample are likely to differ from the parent population.
4. Size: A sample should be large enough to minimize sample variability and to allow estimates of the population characteristics to be made with measurable precision.
5. Coverage: Adequate coverage is essential if the sample has to remain representative. High rates of refusal / non-response, loss to follow-up and other missing data can make a sample un representative of the parent population.
6. Goal orientation: Sample selection should be oriented towards the study objectives and research design.
7. Feasibility: The design should be simple enough to be carried out in practice
8. Economy and cost-efficiency: The sample design should be such that it should yield the desired information with appreciable savings in time and cost and with least sampling error.

The actual sample selection can be accomplished in two basic ways,

(1) Purposive Selection

The selection of a sample primarily aims at representing the population as a whole. Hence, there can be a great temptation to deliberately or purposively select the individuals who seem to represent the population under study. For instance, in a study on oral hygiene in an urban school, 30 representative students may be picked, examined and assessed for poor oral hygiene.

Purposive selection is easy to carry out and does not need the preparation of sampling frame. However, it can substantially under-represent the rates of the population under study.

(2) Random Selection

Here a sample of units is selected in such a way that all the characteristics of the population are reflected in the sample. This is possible by selecting the units of sample at random. A sample in which each individual in the population has an equal chance of appearing is a random sample.

SAMPLING DESIGNS

Different sampling designs are available

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depending upon the type and nature of the population and the objectives of the investigation. Some designs commonly used are,

a) Simple random sampling

This is a sampling technique in which each and every unit in the population has an equal chance of being included in the sample. In this method, the selection of the unit is determined by chance only. To ensure randomness one may choose any one of the following methods:

i) Lottery method: A very popular method, wherein the population units are numbered on separate slips of paper of identical size and shape. These slips are then shuffled and a blindfold selection of the number of slips is made to constitute the desired sample size. However, when the population size is large, this method becomes cumbersome.

ii) Table of random numbers: The table of random numbers consist of random arrangements of digits from 0 to 9 in rows and columns. The selection is done either in a horizontal or vertical direction. This method assures randomness and eliminates personal bias. However, it necessitates a complete cataloguing of the population and sometimes in the field survey, the units so selected may be so widely spread that it enhances the cost and time to collect data.

b) Systematic random sampling

A systematic sample is obtained by selecting one unit at random and then selecting additional units at evenly spaced interval till the sample of required size has been got. For example, to obtain a sample of the patients attending a dental clinic, suppose there are 200 patients in a clinic and it is decided to select a sample of size 20, then 200/20 gives quotient 10. The first number is selected at random, say 4. The next unit will be 4 + 10 =14. Hence the serial numbers of the sample units will be 4, 14, 24, 34, and 44, and so on till 20 numbers are got.

This method can be adopted as long as there is no periodicity of occurrence of any particular event in the population.

c) Stratified Random Sampling

A stratified random sample is obtained using the following procedure:

i) The population to be sampled is subdivided into groups known as strata, such that each group is homogeneous in its characteristic.

ii) A simple random sample is then chosen from each stratum. This type of sampling is used when the population is heterogeneous with regard to the characteristic under study. For example, to determine the prevalence of DMF teeth in different age groups, the different age groups form the strata and a random sample is to be chosen from each stratum i.e. age group.

This method ensures more representativeness, provides greater accuracy and can concentrate on a wider geographical area. The limitation of this method is that care has to be taken while dividing the population into strata regarding the homogeneity in each stratum.

d) Cluster sampling

This method is used when the population forms natural groups or clusters, such as, villages, wards blocks or children of a school etc. First a sample of the clusters is selected and then all the units in each of the selected clusters are surveyed. This method is simpler and involves less time and cost, but gives a high standard error.

e) Multiphase sampling

In this method, part of the information is collected from the whole sample and a part from the sub-sample. For example, in a school health survey, all the children in the

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school are examined. From these, only the ones with oral health problems are selected in the second phase. A section needing treatment are selected in the third phase. The number of children in the sub-samples in the 3rd and 4th phase becomes smaller and smaller. This method may be adopted when the interest is in any specific disease. Survey by such procedure is less costly, less laborious and more purposeful.

f) Multistage sampling

The first stage is to select the groups or clusters. Then subsamples are taken in as many subsequent stages as necessary to obtain the desired sample size.

Eg:1st stage: Choice of states within countries, 2nd stage: Choice of towns within each state, 3rd stage: Choice of neighborhoods within each town

SAMPLE SIZE

Bigger the sample, higher will be the precision of the estimates of the sample. An optimum size of the sample is to be considered, keeping in mind the following factors.

- An approximate idea of the estimate of the characteristics under study and its variability from unit to unit in the population. This may be obtained from previous investigations or through pilot survey to be conducted immediately before the start of the actual investigation.
- Knowledge about the characteristic under study.
- The probability level within which the desired precision is to be maintained.
- The availability of experimental material, resources and other practical consideration.

For instance, if a field survey is conducted to estimate the prevalence rate of a disease, the sample size is calculated by the formula,

$$n = \frac{4pq}{L^2}$$

Where, n is the sample size, p is the approximate prevalence rate of the disease, q is 1-p and L is the permissible error in the estimation of p.

ERRORS IN SAMPLING

There are two types of errors that arise in sampling, sampling error and non-sampling error.

The sampling errors are errors that creep in due to the sampling process and could arise because of faulty sample design or due to the small size of the sample.

The non-sampling errors arise due to

a) Coverage error - due to non-response or non-cooperation of the informant.
b) Observational error - Due to interviewers bias or imperfect experimental technique or interaction of both.
c) Processing error - due to errors in statistical analysis.

COLLECTION OF DATA

Demographic data comprise details of population size, geographic distribution, ethnic groups, socio-economic factors and their trends over time. Such data are obtained from census / surveys, experiments, hospital records and other public service reports and are important determinants for oral health care programs.

Depending on the nature of the variable, data is classified into two broad categories,

1) Qualitative data: When the data is collected on the basis of attributes or qualities like sex, malocclusions, cavity etc., it is called qualitative data.
2) Quantitative data: When the data is collected through measurement using calipers, like arch length, arch width, fluoride concentration in water supply etc., it is called quantitative data.

Quantitative data can be classified into two kinds

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- Discrete

When the variable under observation takes only fixed values like whole numbers, the data is discrete. e.g. the DMF teeth.

- Continuous

If the variable can take any value in a given range, decimal or fractional, it is called as continuous data like arch length, mesiodistal width of the erupted teeth.

Data can be collected through

(a) Primary Source: Here the data is obtained by the investigator himself. This is first hand information.

(b) Secondary Source: The data already recorded is utilized to serve the purpose of the objective of the study. e.g. the records of the OPD of dental clinics.

Primary data can be obtained using any one of the following methods,

(A) Direct personal interviews:

In this method, there is face-to-face contact with the persons from whom the information is to be obtained (called as informants). This method enables to measure subjective phenomena such as the oral health status, the opinions, beliefs and attitudes and some behavioral characteristics. The advantage of this method is that all the information can be collected accurately and any ambiguity can be clarified. This method cannot be used when the study is extensive because it is time consuming and requires more personnel.

(B) Oral health examination:

It is used when information is needed on the oral health status. It is conducted by dentists and dental auxiliary personnel. This cannot be considered for an extensive study because it is expensive and also one has to consider the treatment to people suffering from certain diseases.

(C) Questionnaire method:

In this method, a list of the questions pertaining to the survey, known as questionnaire, is prepared and the various informants are requested to supply the information either personally or through post. While using the postal questionnaire, the postage should be paid by the investigator himself. This method is easy to adopt when a wide geographic area is to be covered. It is relatively economical and expeditious. The disadvantage of this method is that the informants must be literate so that they can understand the questions. This method may be adopted for knowing the general awareness and the attitudes of the people regarding their oral health practices.

On completion of data collection, the data has to be presented before it is analyzed and interpreted.

PRESENTATION OF DATA

Data collected and compiled from experimental work, surveys, registers or records are raw data. These are unsorted and not very helpful in understanding the underlying trends or its meaning. So, the next step is to sort and classify the data into characteristic groups or classes, according to age, sex, social class, DMFT score, etc. The objective of classification of data is to make the data simple, concise, meaningful, interesting and helpful in further analysis.

3289
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There are two main methods of presenting data:

A) Tabulation

Tables are simple devices used for presentation of statistical data. The general principles that are accepted as more or less standard for table construction are,

a. Tables should be as simple as possible. Two or three small tables are preferred to a single large table containing many details or variables. Generally, three variables constitute a maximum number, which can be read with ease.
b. The data must be presented according to size or importance, chronologically or

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alphabetically

c. Tables should be self-explanatory. Codes, abbreviations or symbols should be explained in detail in a footnote.
d. Each row and each column should be labelled concisely and clearly.
e. The specific units of measure for the data should be given.
f. The title should be clear, concise, and to the point.
g. Total should be shown.
h. Every table should contain a title as to what is depicted in the table. The title is commonly separated from the body of the table by lines or spaces.
i. In small tables, vertical lines separating the columns may not be necessary.
j. If the data are not original, their source should be given in a footnote.

Types of tables

1. Master table

They are tables, which contain all the data obtained from a survey.

2. Simple table

They are one-way tables which supply answers to questions about one characteristic of data only.

3. Frequency distribution table

The simplest table is a two-column frequency table. The first column lists the classes into which the data are grouped. The second column lists the frequencies for each classification.

While forming a frequency distribution table, the following additional rules are to be followed:

a. The number of the class intervals should not be too many or too less. It may be preferably between 5 and 20. However, there is no rigidity about it.

b. The class intervals should be at equal width.

c. The class limits should be clearly defined to avoid ambiguity. For e.g., 0-4, 5-9, 10-14, etc.

The tables can be prepared by manual tabulation or by mechanical tabulation.

B) Charts and diagrams

Charts and diagrams are one of the most convincing and appealing ways of depicting statistical results. Diagrams and graphs are extremely useful because

1. They are attractive to the eyes,
2. They give a bird's eye view of the entire data
3. They have a lasting impression on the mind of the layman
4. They facilitate comparison of data relating to different time periods and regions.

Basic rules in the construction of diagrams and graphs are as follows

1. Every diagram must be given a title that is self- explanatory.
2. It should be simple and consistent with the data.
3. Usually, the values of the variables are presented on the horizontal or X-axis and the frequency on the vertical line or Y-axis.
4. The number of lines drawn in any graph should not be many. This makes the diagram look clumsy.
5. The scale of presentation for the X and Y-axes should be mentioned.
6. The scale of division of the two axes should be proportional and the divisions should be marked along with the details of the variables and frequencies presented on the axes.

Bar chart:

It is a way of presenting a set of numbers by the length of a bar. The width of the bar remains the same and only the length varies according to the frequency in each category. The bars can be either vertical or horizontal. The bars are separated by spaces and a suitable scale must be chosen to present the

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length of the bars.

a) Simple bar chart: It represents only one variable.

Eg: Age-wise prevalence of dental caries (in percentage)

b) Multiple bar chart: This diagram is similar to the bar diagram except that for each category of the variable there are a set of bars of the same width corresponding to the different sections without any gap in between.

Eg: Prevalence of dental caries based on age and gender

c) Proportional / Component bar chart: The individual bars are divided into two or more parts. This diagram is used to compare the sub-groups between different major groups of observations.

Eg: Prevalence of dental caries based on age and gender

Pie diagram / charts:

These are so called because the entire graph looks like a pie and its components represent slices cut from a pie. The total angle at the centre of a circle is equal to 360° and it represents the total frequency. It is divided into different sectors corresponding to the frequencies of the variables in the distribution.

Eg: Distribution of dental disease in 30-40 yr olds

The segments are then shaded with different shades or colors and an index is provided for these shade colors. However, this diagram cannot be used to represent two or more data sets.

Line diagram:

This diagram is useful to study changes of values in the variable over time and is the simplest type of diagram. On the X-axis, the time such as hours, days, weeks, months or years are represented and the value of any quantity pertaining to this is represented along the Y-axis.

Eg: Age-wise prevalence of dental disease

Histogram:

It is a pictorial diagram of frequency distribution. There is no space between the cells on a histogram. This graph is not to be confused with a bar chart, which has space between the cells. The class intervals are given on the X axis and the frequencies along the Y axis.

Eg: Age-wise prevalence of dental caries

Frequency polygon:

It is also a pictorial diagram of frequency distribution. To draw a frequency polygon, a point is marked over the mid-point of the histogram blocks. Then, these points are connected by straight lines.

Eg: Age-wise prevalence of dental caries

Cartogram/Spot map/Shaded map:

These maps are used to show geographical distribution of frequencies of a characteristic. The coverage of cases of oral cancer by geographic area may be depicted through this diagram and dot or point may be used to indicate one such case. If shades are used it is called shaded map.

Pictogram:

Small pictures or symbols are used for presenting data. They are especially used for the common man.

Eg: Population per physician

Scatter diagram:

It is a diagram which shows the relationship between two variables. If the dots cluster around a straight line, it shows a linear relationship.

Eg: Relationship between sugar intake (x - axis) and dental caries prevalence (y - axis), showing a positive relationship.

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Master table

Sl. no	Age	Sex	Education	D	M	F	DMF	PI
001								
002								
003								
006								

Simple table

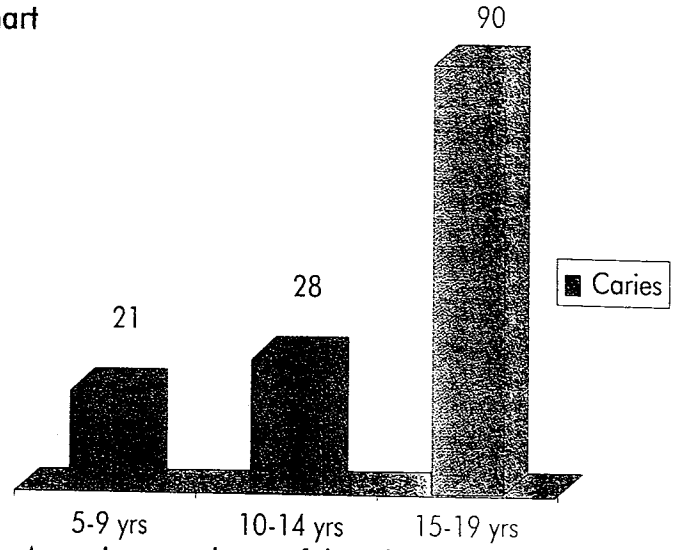
WHO Region (Unit)	2004
AFRO	1.15
AMRO	2.76
EMRO	1.58
EURO	2.57
SEARO	1.12
WPRO	1.48

Frequency distribution table

5-9 YRS	11
10-14 YRS	18
15-19 YRS	35

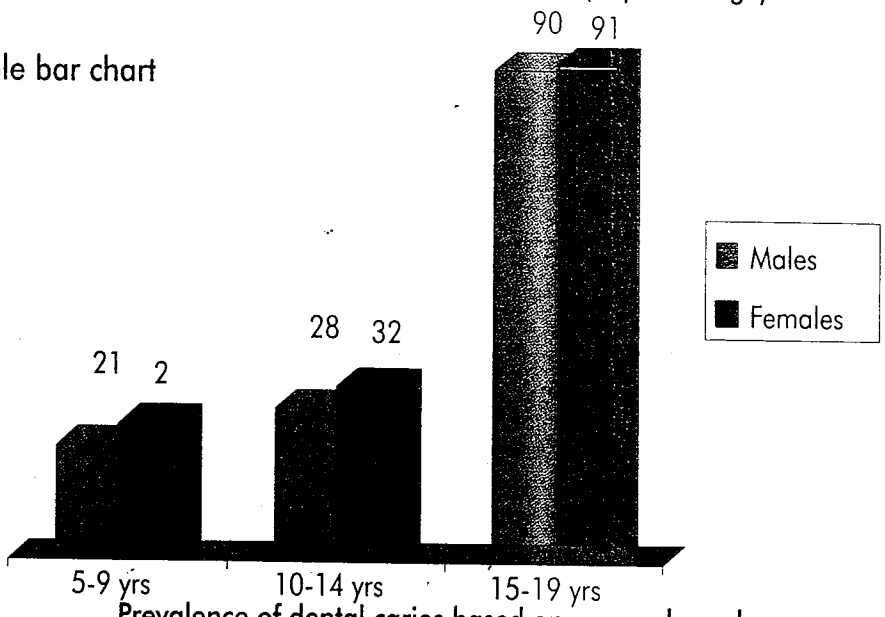
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Simple bar chart



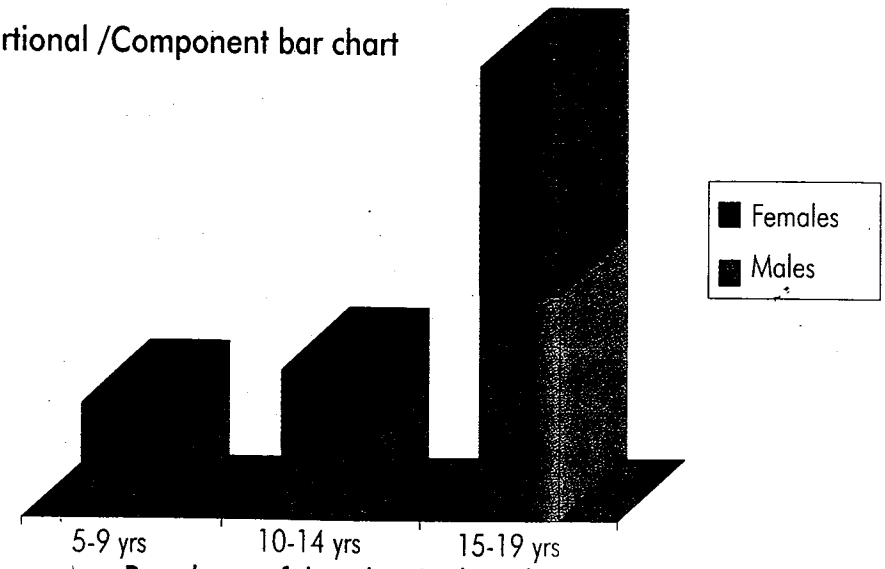
Age-wise prevalence of dental caries (in percentage)

Multiple bar chart



Prevalence of dental caries based on age and gender

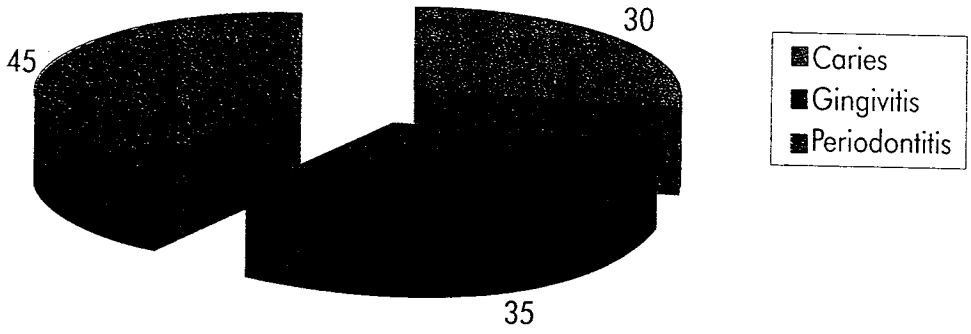
Proportional /Component bar chart



Prevalence of dental caries based on age and gender

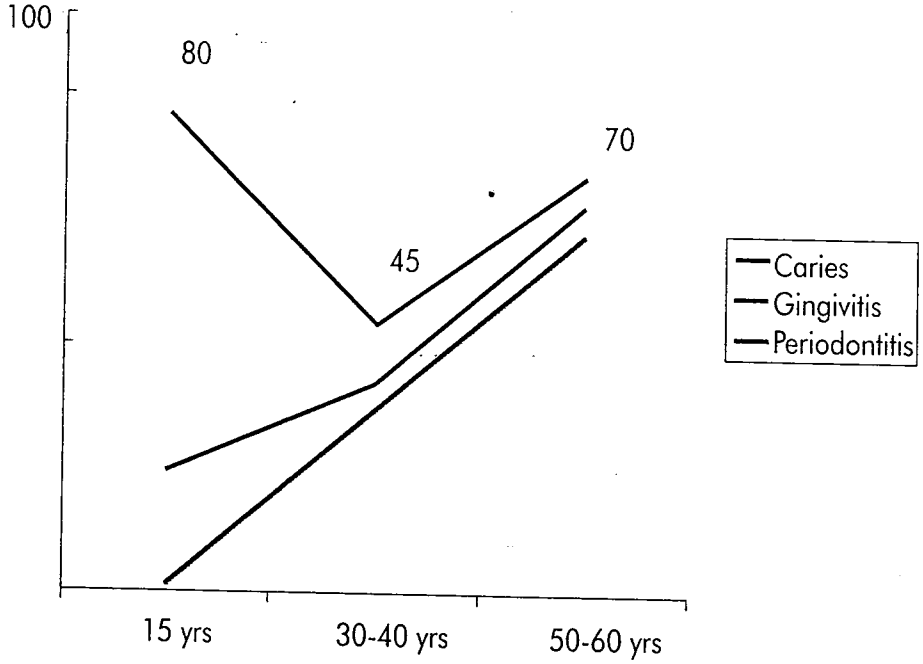
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Pie diagram



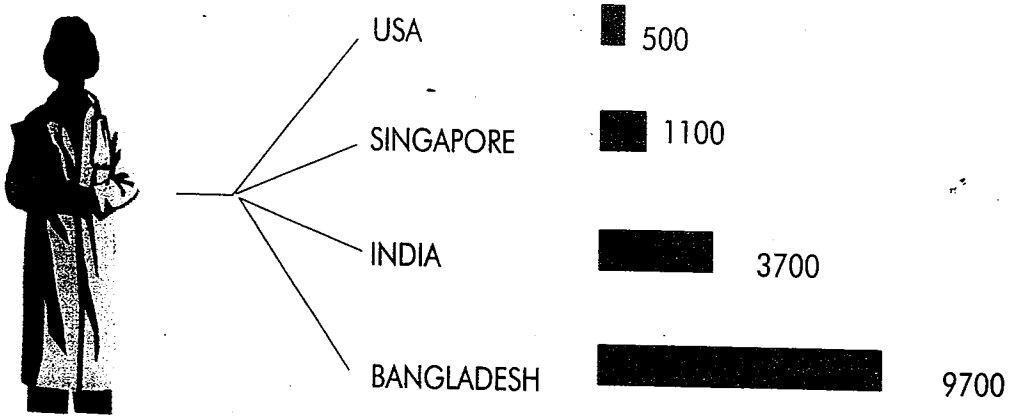
Distribution of dental disease in 30 - 40 yr olds

Line diagram



Age-wise prevalence of dental disease

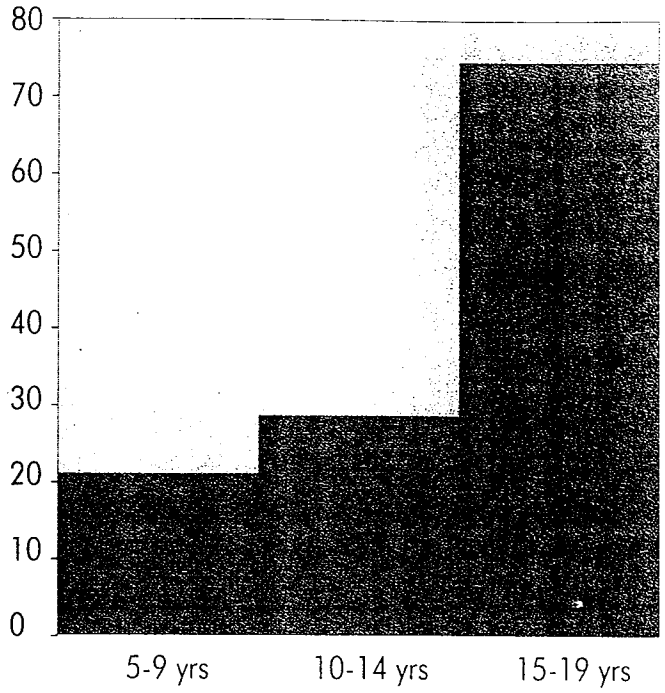
Pictogram



Population per physician

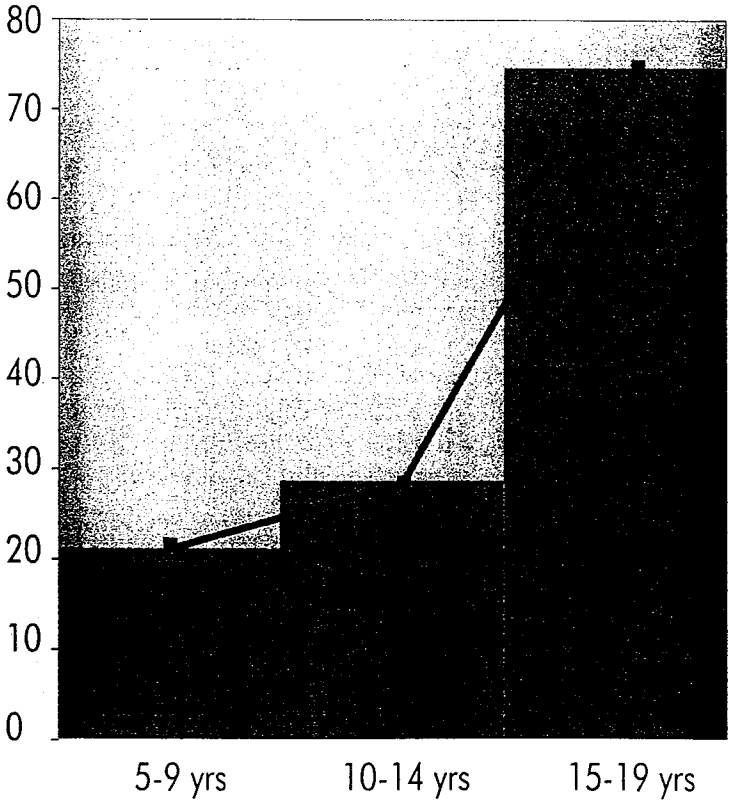
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Histogram



Age-wise prevalence of dental caries

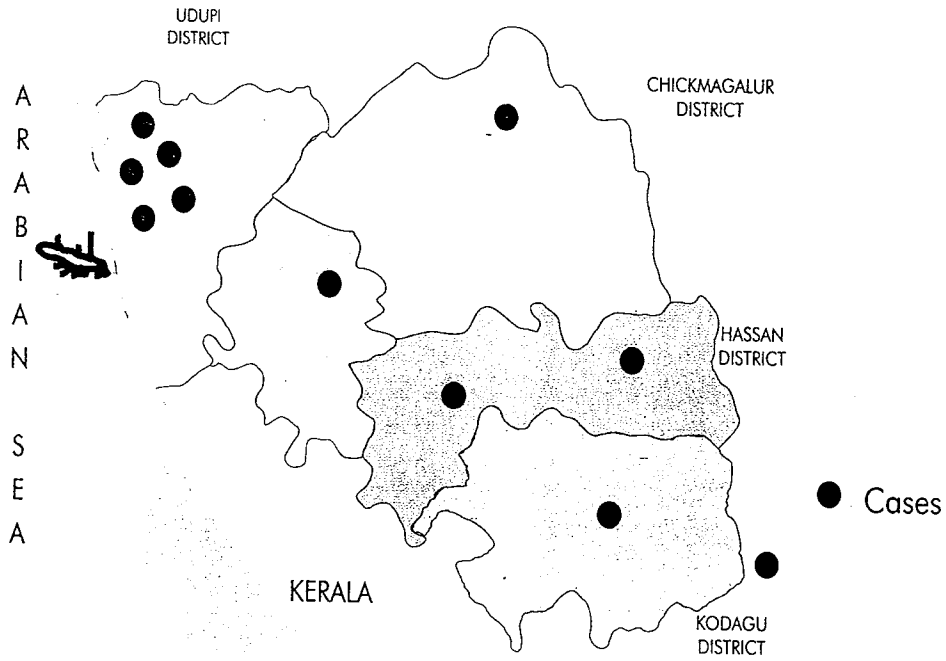
Frequency Polygon



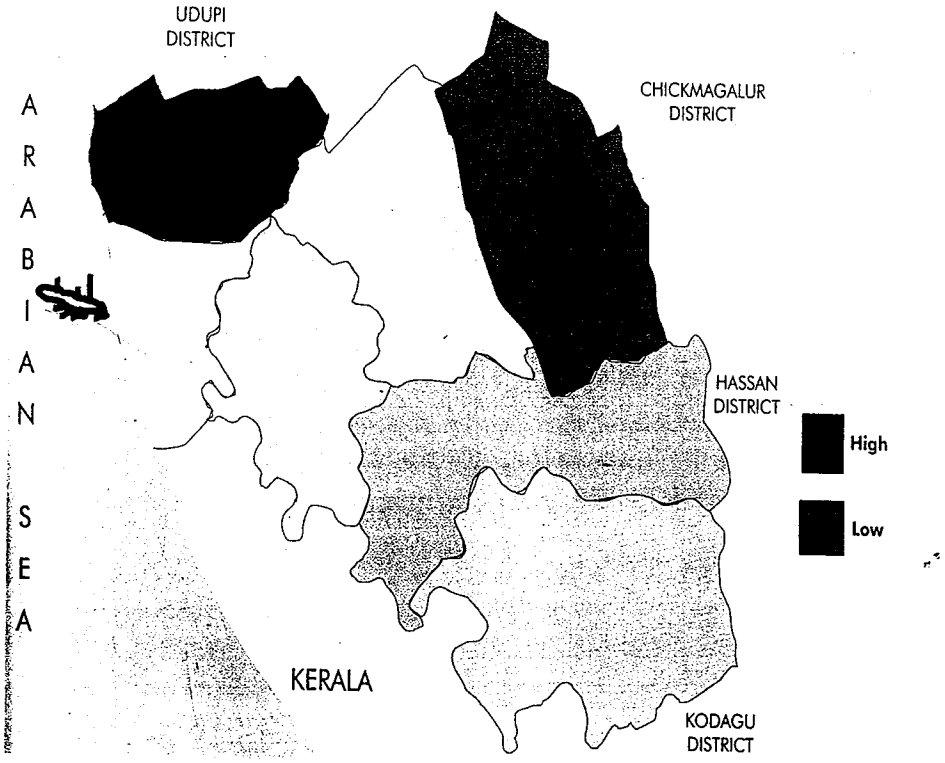
Age-wise prevalence of dental caries

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Spot map



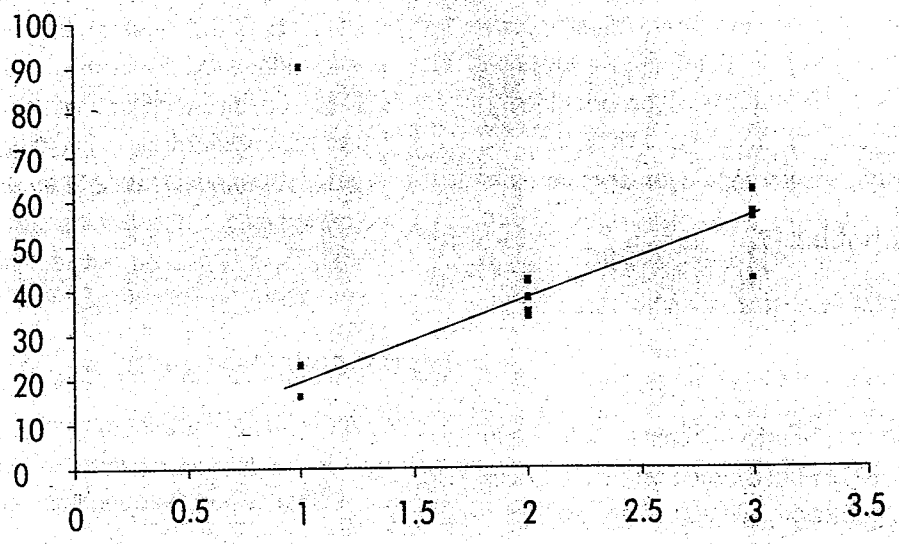
Shaded map



Prevalence of oral cancer

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Scatter diagram



Relationship between sugar intake (x - axis) and dental caries prevalence (y - axis), showing a positive relationship.

ANALYSIS AND INTERPRETATION

Analysis and interpretation is done using biostatistics. The word "statistics" comes from the Italian word 'statista' meaning "statesman" or the German word "statistik" which means a political state. The science of statistics is said to have developed from registration of heads of families in ancient Egypt to the Roman census on military strength, births and deaths, etc. and found its application gradually in the field of health and medicine. John Graunt (1620- 1674), who was neither a physician nor a mathematician is considered the father of health statistics.

Statistics is the science of compiling, classifying and tabulating numerical data and expressing the results in a mathematical or graphical form.

Biostatistics is that branch of statistics concerned with mathematical facts and data related to biological events.

Uses of biostatistics

- To test whether the difference between two populations is real ora chance occurrence
- To study the correlation between attributes in the same population
- To evaluate the efficacy of vaccines, sera etc.
- To measure mortality and morbidity
- To evaluate achievements of public health programs
- To fix priorities in public health programs
- To help promote health legislation and create administrative standards for oral health.

Basis for statistical analysis

Statistical analyses are based on three primary entities:

- the population (U) that is of interest,
- the set of characteristics (variables) of the units of this population (V),
- the probability distribution (P) of these characteristics in the population.

The population (U)

The population is a collection of units of observation that are of interest and is the target of the investigation. For example, in determining the effectiveness of a particular

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drug for a disease, the population would consist of all possible patients with this disease. It is essential, in any research study, to identify the population clearly and precisely. The success of the investigation will depend to a large extent on the identification of the population of interest.

The variables (V)

"A variable is a state, condition, concept or event whose value is free to vary within the population."

Once the population is identified, we should clearly define what characteristics of the units of this population (subjects of the study) are we planning to investigate.

For example, in the case of a particular drug, one needs to define the disease and what other characteristics of the people (e.g. age, sex, education, etc.) one intends to study.

Clear and precise definitions and methods for measuring these characteristics (a simple observation, a laboratory measurement, or tests using a questionnaire) are essential for the success of the research study.

Variables can be classified as,

1) Independent variables: variables that are manipulated or treated in a study in order to see what effect, differences in them will have on those variables proposed as being dependent on them. Synonyms: cause, input, predisposing factor, antecedent, risk factor, characteristic, attribute, determinant
2) Dependent variables: variables in which changes are results of the level or amount of the independent variable or variables. Synonyms: effect, outcome, consequence, result, condition, disease
3) Confounding or intervening variables: variables that should be studied because they may influence or 'confound' the effect of the independent variable(s) on the dependent variable(s). For instance, in a study of the effect of tobacco (independent variable) on oral cancer (dependent variable), the nutritional status of the individual may play an intervening role.
4) Background variables: variables that are so often of relevance in investigations of groups or populations that they should be considered for possible inclusion in the study. Synonyms: sex, age, ethnic origin, education, marital status, social status

The probability distribution (P)

The most crucial link between the population and its characteristics, which allows us to draw inferences on the population based on sample observations, depends on this probability distribution.

The probability distribution is a way to enumerate the different values the variable can have, and how frequently each value appears in the population. The actual frequency distribution is approximated to a theoretical curve that is used as the probability distribution. Common examples of probability distributions are the binomial and normal. Most statistical analyses in health research use one of these three common probability distributions. For example, the incidence of a relatively common illness may be approximated by a binomial distribution, whereas the distributions of continuous variables (blood pressure, heart rate) are often considered to be normally distributed.

Probability distributions are characterized by 'parameters', i.e., quantities that allow us to calculate probabilities of various events concerning the variable, or that allow us to determine the value of probability for a particular value. For example, the binomial distribution has two parameters. The binomial distribution occurs when a fixed number of subjects are observed, the characteristic is dichotomous in nature (only two possible values), and each subject has the same probability (p) of having one value

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and (1-p) of the other value. The statistical inference then involves finding out the value of p in the population, based on an observation of a carefully selected sample. The normal distribution, on the other hand, is a mathematical curve represented by two quantities, m and s. The former represents the mean of the values of the variables, and the latter, the standard deviation. The type of statistical analysis done depends very much on the design of the study. In particular, whether the study was descriptive, and what sampling design was used to draw the sample from the population

MEASURES OF CENTRAL TENDENCY / STATISTICAL AVERAGES

It is the central value around which the other values are distributed. The main objective of measure of central tendency is to condense the entire mass of data and to facilitate comparison. A good measure of central tendency should satisfy the following properties,

- It should be easy to understand and compute.
- It should be based on each and every item in the series.
- It should not be affected by extreme observations (either too small or too large values).
- It should have sampling stability, i.e., if different samples of same size say 10, are picked up from the same population, and the measure of central tendency is calculated, they should not differ from each other markedly.

The most common measures of central tendency that are used in dental sciences are,

a) Arithmetic mean- mathematical estimate.
b) Median - positional estimate.
c) Mode- based on frequency.

a) Arithmetic mean:

It is the simplest measure of central tendency. It is obtained by adding the individual observations and then divided by the total number of observations.

Mean is calculated using the formula,

$\Sigma Xi / n$

Where, Σ (sigma), means the sum of, Xi is the value of each observation in the data, n is the number of observations in the data.

Eg: The number of decayed teeth in a group of 10 children aged 5 years are as follows: 2,2,4,1,3,0,5,2,3,4. Then the mean number of decayed teeth for this group is calculated as:

n=10,

$\Sigma Xi = 2+2+4+1+3+0+5+2+3+4 = 26$

Mean number of decayed teeth = 26/10 =2.6 teeth.

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Advantages

- Easy to calculate and understand
- It is the most useful of all the averages

Disadvantages:

- It may be unduly influenced by abnormal values
- Sometimes it might look ridiculous

b) Median

The median is the middle value in a distribution such that one half of the units in the distribution have a value smaller than or equal to the median and one half has a value higher than or equal to the median. To calculate the median, all the observations are arranged in either ascending or descending order of their magnitude and then the middle value of the observations is selected as the median. When the number of observations is even, the mean of the two middle values may be taken as the median.

Eg: The following are the number of visits to a dentist by 10 patients in one year

13, 8, 4, 3, 5, 2, 8, 1, 7, 4.

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For calculating the median, the numbers are first arranged in order of magnitude as 1, 2, 3, 4, 4, 5, 7, 8, 8, and 13. Since there are 10 patients, the average of the 5th and 6th patient is calculated as the median, which is (4+5)/2 = 4.5 visits. Thus, it is seen that median is a positional average. It is not capable of future treatment.

For instance, if the median of two groups is given, the median of the combined group cannot be obtained.

Advantage:

It is not affected by abnormal values

c) Mode

The mode or the modal value is that value in a series of observations that occurs with the greatest frequency. For example, if the age at eruption of the canine is 6, 6, 5, 7, 8, 6, 7, 5, for 8 children, the mode will be 6, since it occurs more often than any of the others. The mode is located from the frequency distribution table, taking the value of the variable with the maximum frequency. There can be more than one mode for a series. When mode is ill defined, it can be calculated using the relation

Mode = 3 Median - 2 mean.

Depending on the nature of data and the objective of the study, the appropriate measure of central tendency may be used. The most commonly used measure is the arithmetic mean; if there are extremes values in the series of data, median may be used. If it is required to know the value that has high influence in the series, mode may be computed.

MEASURES OF DISPERSION

Measures of dispersion helps to know how widely the observations are spread on either side of the average. Dispersion is the degree of spread or variation of the variable about a central value. The most common measures of dispersion used in dental science are

1. Range:

It is the simplest method, defined as the difference between the value of the largest item and the value of the smallest item. This measure gives no information about the values that lie between the extreme values. Though this measure is simple to calculate, it is not based on all the items and is subject to fluctuations of considerable magnitude from sample to sample.

2. Mean deviation

It is the average of the deviations from the arithmetic mean. It is given by,

$$M.D = \frac{\Sigma (X - Xi)}{n}$$

Where, Σ (sigma), is the sum of, X is the arithmetic mean, Xi is the value of each observation in the data, n is the number of observations in the data

3. Standard Deviation

The standard deviation is the most important and widely used measure of studying dispersion. It is also known as root mean square deviation because it is the square root of the mean of the squared deviations from arithmetic mean.

Greater the standard deviation, greater will be the magnitude of dispersion from the mean. A small standard deviation means a higher degree of uniformity of the observations.

$$S.D = \sqrt{\frac{(X - Xi)^2}{n}}$$

Steps,

1. Calculate the mean of the series, X
2. Take the deviations of the items from the mean, X - Xi .
3. Square these deviations and add them up,

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$\Sigma(X - Xi)^2$

4. Divide the result by the total number of observations, n (or n-1 if sample size is less than 30)
5. Then obtain the square root. This gives the standard deviation.

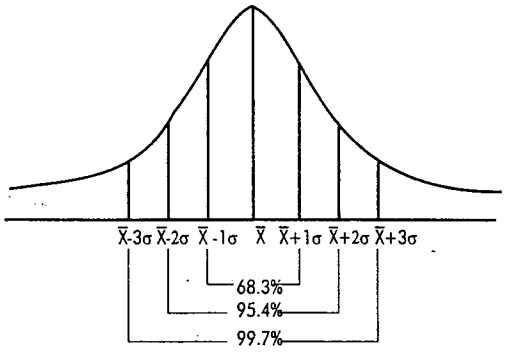
THE NORMAL CURVE / NORMAL DISTRIBUTION / GAUSSIAN DISTRIBUTION

When data is collected from a very large number of people and a frequency distribution is made with narrow class intervals, the resulting curve is smooth and symmetrical and it is called a normal curve.

In a normal curve,

1. The area between one standard deviation on either side of the mean will include approximately 68% of the values
2. The area between two standard deviations on either side of the mean will include approximately 95% of the values
3. The area between three standard deviations on either side of the mean will include approximately 99.7% of the values

The limits on either side of the mean are called 'confidence limits'.



Standard normal curve

There might be many normal curves but there is only one standard normal curve.

1. The standard normal curve is bell shaped.
2. The curve is perfectly symmetrical based on an infinitely large number of observations. The maximum number of observations is at the mean and the number of observations gradually decrease on either side with few observations at the extreme points.
3. The total area of the curve is one, its mean is zero and standard deviation one.
4. All the three measures of central tendency, the mean, median and mode coincide.

TESTS OF SIGNIFICANCE

When different samples are drawn from the same population, the estimates might differ. This difference in the estimates is called sampling variability. Hence, while dealing with estimates from two or more samples, one is interested to know whether the differences in the values of estimates between the groups are due to sampling variations or not. Tests of significance deals with techniques to know how far the differences between the estimates of different samples is due to sampling variation.

a) Standard error of mean

The standard error of mean gives the standard deviation of the means of several samples from the same population. Standard error can be estimated from a single sample.

Standard error (S.E.) of mean = $S.D/\sqrt{n}$

b) Standard error of proportion

Here, the focus is on proportions.

Standard error (S.E) of proportion = $\sqrt{\frac{pq}{n}}$

where p and q are the proportion of occurrence of an event in two groups of the sample and n is the sample size.

c) Standard error of difference between two means

It is used to find out whether the difference between the means of two groups is significant to indicate that the samples represent two different universes.

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Standard error between means =

$$\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

d) Standard error of difference between proportions

It is used to find out whether the difference between the proportions of two groups is significant or has occurred by chance.

Standard error between proportions =

$$\sqrt{\frac{p_1q_1}{n_1} + \frac{p_2q_2}{n_2}}$$

THE CHI SQUARE TEST FOR QUALITATIVE DATA (χ^2 TEST)

It was developed by Karl Pearson.

When the data is measured in terms of attributes or qualities, and it is intended to test whether the difference in the distribution of attributes in different groups is due to sampling variation or not, the Chi square test is applied. It is used to test the significance of difference between two proportions and can be used when there are more than two groups to be compared.

For example, if there are two groups, one of which has received oral hygiene instructions and the other has not received any instructions and if it is desired to test if the occurrence of new cavities is associated with the instructions.

Group	Occurrence of new cavities		
	Present	Absent	TOTAL
Number who received Instructions	10	40	50
Number who did not receive instructions	32	8	40
Total	42	48	90

STEPS

1. Test the null hypothesis

To test whether there is an association between oral hygiene instructions received and the occurrence of new cavities, state the null hypothesis as 'there is no association between oral hygiene instructions received in dental hygiene and the occurrence of new cavities'

2. Then the χ^2 -statistic is calculated as,

$$\chi^2 = \frac{\Sigma(O-E)^2}{E}$$

where, O = Observed frequency and E = Expected frequency, is calculated as

Proportion of people with caries = 42 / 90 = 0.47

Proportion of people without caries = 48 / 90 = 0.53

Among those who received instructions

Expected number attacked = 50 x 0.47 = 23.5

Expected number not attacked = 50 x 0.53 = 26.5

Among those who did not receive instructions

Expected number attacked = 40 x 0.47 = 18.8

Expected number not attacked = 40 x 0.53 = 21.2

The table showing the values,

Group	Attacked	Not attacked
Number who received instructions	O = 10 E = 23.5 O-E=13.5	O = 40 E = 26.5 O-E= 13.5
Number who did not receive Instructions	O = 32 E = 18.8 O-E= 13.2	O = 8 E = 21.2 O-E=13.2

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3. Applying the χ^2 test,

$$\chi^2 = \frac{\Sigma(O - E)^2}{E}$$

$$= \frac{(13.5)^2}{23.5} + \frac{(13.5)^2}{26.5} + \frac{(13.2)^2}{18.8} + \frac{(13.2)^2}{21.2}$$

$$= 7.76 + 6.88 + 9.27 + 8.22$$

$$= 32.13$$

4. Finding the degree of freedom (d.f)

It depends upon the number of columns and rows in the original table.

d.f = (column-1) (row - 1)

= (2-1) (2-1)

= 1

5. Probability tables

In the probability table, with a degree of freedom of 1, the χ^2 value for a probability of 0.05 is 3.84. Since the observed value 32 is much higher it is concluded that the null hypothesis is false and there is a difference in caries occurrence in the two groups with caries being lower in those who received instructions.

Z TEST

It is used to test the significance of difference in means for large samples (> 30).

The pre-requisites to apply Z test for means are,

1. The sample must be randomly selected.
2. The data must be quantitative.
3. The variable is assumed to follow a normal distribution in the population.
4. Sample should be larger than 30.

$$Z = \frac{\text{Observation-mean}}{\text{Standard deviation}} = \frac{x - \bar{x}}{SD}$$

't' TEST

When sample size is small, 't' test is used to test the hypothesis. This test was designed by W. S. Gossett, whose pen name was 'Student'. Hence this test is also called 'Student's t-test'.

t = ratio of observed difference between two means of small samples to the standard error of difference in the same.

It is applied to find the significance of difference between two proportions as,

- Unpaired 't' test
- Paired 't' test

Criteria for applying 't' test,

- The sample must be randomly selected.
- The data must be quantitative.
- The variable is assumed to follow a normal distribution in the population.
- Sample should be less than 30.

Unpaired 't' test

This test is applied to unpaired data of independent observations made on individuals of two different or separate groups or samples drawn from two populations, to test if the difference between the means is real or it can be attributed to sampling variability.

Steps:

1. As per the null hypothesis, assume that there is no real difference between the means of two samples.
2. Find the observed difference between means of two samples $(\bar{X}_1 - \bar{X}_2)$
3. Calculate the standard error of difference between the two means.
   $$SE = \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$
4. Calculate the 't' value
   $$t = \frac{X_1^2 - X_2^2}{SE}$$
5. Determine the pooled degrees of freedom from the formula
   $d.f = (n_1 - 1) + (n_2 - 1) = n_1 + n_2 - 2$
6. Compare calculated value with the table value (table of 't') at particular degrees of

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freedom to find the level of significance.

Paired "t" test

It is applied to paired data of independent observations from one sample only when each individual gives a pair of observations.

Steps:

1. As per the null hypothesis, assume that there is no real difference between the means of two samples.
2. Find the difference in each set of paired observations before and after ($X_1 - X_2 = X$)
3. Calculate the mean of the differences ($\bar{X}$)
4. Work out the standard error of mean, SE = SD/ $\sqrt{n}$
5. Determine 't' value

$$t = \frac{\bar{X}}{\text{Standard error of difference}}$$

6. Find the degrees of freedom (n - 1)
7. Refer 't' table and find the probability of 't' corresponding to n-1 degree of freedom.
8. If the probability is more than 0.05, the difference observed has no significance, because it can be due to chance.

ANALYSIS OF VARIANCE (ANOVA)

Many situations involve collecting data on three or more groups of individuals, with the objective of determining whether any true differences in mean performance exist among the conditions under the study. This often happens in experimental situations where several different treatments (for example, various therapeutic approaches to a specific problem or, various dosage levels of a particular drug) may be under comparison. In the above situation, ANOVA is a way to test the equality of three or more means of more than two groups.

CORRELATION AND REGRESSION

When dealing with measurements on two sets of variables in the same person, one variable may be related to the other in some way, such as the fluoride level in drinking water and the community fluorosis index. That is, a change in the value of one variable results in a change in the value of the other variable. The relationship between two such variables is correlation.

Correlation is the relationship (association) between two sets of variables. The magnitude or degree of relationship between two variables is called correlation coefficient and is denoted by 'r'. The correlation coefficient ranges from minus one (-1) to plus one (+1), i.e., $-1 < r < +1$.

The approximate idea about the type and extent of relationship between the two variables can be obtained by plotting a scatter diagram. In this diagram, one variable is represented on the X-axis and the other variable on the Y-axis. Against each pair of observations a dot is plotted.

As the value of X increases, the value of Y also increases. This represents a partial positive correlation. If, as the value of X increases, there is a decrease in the value of Y, then we have a partial negative correlation.

Interpretation of correlation coefficient:

a) The correlation coefficient is zero when there is no covariation between the two variables.
b) When there is complete relationship, the correlation coefficient is +1 or -1.
c) A value near +1, indicates a positive correlation and a value near -1, indicates a negative correlation.

The correlation coefficient can be obtained using ,

$$r = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\sqrt{\Sigma(x - \bar{x})^2 \; (y - \bar{y})^2}}$$

WRITING THE REPORT

After analysis and interpretation, the final research report is written. The basic purpose of a research report is to communicate the

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research process and observed findings to the professional community and colleagues so that findings may be evaluated and perhaps implemented for the benefit of a larger population.

General information

Pages are numbered. Numeric page numbering begins with the first page of Chapter 1 (although a page number is not placed on page 1).

The space given for margins are

- Left margin: 1½"
- Right margin: 1"
- Top margin: 1"
- Bottom margin: 1"

All pages are single sided. Text is double-spaced, except for long quotations and the bibliography (which are single-spaced). There is one blank line between a section heading and the text that follows it.

Any easily readable font is acceptable. The font should be 10 points or larger. Generally, the same font must be used throughout the manuscript, except tables and graphs, which may use a different font, and chapter titles and section headings may use a different font.

Contents of the report

1) Title page

All text on the title page is centered vertically and horizontally. The title page has no page number and it is not counted in any page numbering.

2) Table of contents

CHAPTER I - Introduction

This chapter begins with a few short introductory paragraphs (a couple of pages at most). The primary goal of the introductory paragraphs is to catch the attention of the readers and to get them "turned on" about the subject. It sets the stage for the paper and puts the topic in perspective. The introduction often contains general statements about the need for the study. It uses dramatic illustrations or quotes to set the tone. When writing the introduction, put yourself in the reader's position - would you continue reading?

Statement of the problem

The statement of the problem is the focal point of the research. It is just one sentence, always accompanied by several paragraphs that elaborate on the problem.

Purpose

The purpose is a single statement or paragraph that explains the aim or what the study intends to accomplish.

Significance of the study

This section creates a perspective for looking at the problem. It points out how the study relates to the larger issues and uses a persuasive rationale to justify the reason for the study. It makes the purpose worth pursuing. The significance of the study answers the questions:

- Why is the study important?
- To whom is it important?
- What benefit(s) will occur if the study is done?

Research questions and/or hypotheses and/or null hypotheses

It is equally acceptable to present the hypotheses or the null hypotheses.

CHAPTER II - Background

- It is a review of the literature. It is important because it shows what previous researchers have discovered. It usually depends upon how much research has previously been done in the area of investigation. If the study is planning to explore a relatively new area, the literature review should cite similar areas

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of study or studies that lead up to the current research. Never say that the area is so new that no research exists.

- This chapter should also include the special terms that are unique to the study. "Operational definitions" should also be included.

CHAPTER III - Methodology

The methodology section describes the basic research plan. It usually begins with a few short introductory paragraphs that restate the purpose and the research questions.

The basic research methodology includes:

1) Defining the population
2) Drawing a representative sample from the population
3) Doing the research on the sample
4) Inferring the results from the sample back to the population

- Usually, just one sentence is necessary to define the population. However, the sampling procedure needs to be described in extensive detail.
- If using a survey that was designed by someone else, the source of the survey must be stated. Describe the theoretical constructs that the survey is attempting to measure. Include a copy of the actual survey in the appendix.
- State exactly when the research began and when it was completed. Describe any special procedures that were followed (e.g., instructions that were read to participants, presentation of an informed consent form, etc.).
- The analysis plan should be described in detail. Each research question will usually require its own analysis. Thus, the research questions should be addressed one at a time followed by a description of the type of statistical tests that were performed to answer that research question. State what variables will be included in the analyses and identify the dependent and independent variables if such a relationship exists.
- If the survey used was designed by someone else, then the previous validity and reliability assessments need to be described. If the investigator has developed his own survey, then the steps undertaken to assess its validity and a description of how its reliability was measured must be described.

Validity

Validity refers to the accuracy or truthfulness of a measurement. Is it measuring what it is intended to? There are at least three types of validity that should be addressed.

Face validity refers to the likelihood that a question will be misunderstood or misinterpreted. Pre-testing a survey is a good way to increase the likelihood of face validity.

Content validity refers to whether an instrument provides adequate coverage of a topic. Expert opinions, literature searches, and pretest of open-ended questions help to establish content validity.

Construct validity refers to the theoretical foundations underlying a particular scale or measurement. It looks at the underlying theories or constructs that explain a phenomenon. In other words, if several survey items are used, then the investigator should describe, why he believes the items comprise a construct. If a construct has been identified by previous researchers, then the criteria they used to validate the construct must be described. A technique known as confirmatory factor analysis is often used to explore how individual survey items contribute to an overall construct measurement.

Reliability

Reliability is synonymous with repeatability or stability. A measurement that yields consistent results over time is said to be reliable. When a

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measurement is prone to random error, it lacks reliability.

All research studies have limitations and a finite scope. Limitations are often imposed by time and budget constraints. Precisely list the limitations of the study. Describe the extent to which the limitations degrade the quality of the research.

CHAPTER IV - Results

The various demographic information collected is reported in a simple way in the results without attempting to explain the results.

1) Restate the research question using the exact wording as in Chapter I
2) If the research question is testable, state the null hypothesis
3) State the type of statistical test(s) performed
4) Report the statistics and conclusions, followed by any appropriate table(s)

Numbers and tables are not self-evident. They should be explained in the text. All tables and figures have a number and a descriptive heading.

CHAPTER V - Conclusions and recommendations

- Begin the final chapter with a few paragraphs summarizing what was done and found (i.e., the conclusions from Chapter IV).
- Discuss the findings. Explain the reasons for the findings and present plausible reasons why the results might have turned out the way they did.
- Present recommendations based on the findings. Avoid the temptation to present recommendations based on beliefs or biases that are not specifically supported by data. Recommendations fall into two categories. The first is recommendations to the study sponsor. What actions are recommended based upon the data. The second is recommendations to other researchers. There are almost always ways that a study could be improved or refined. What changes would have to be done if the study was to be repeated over again?

Citing references

In any piece of research or written work it is necessary to acknowledge the sources of reference. A list of bibliographic references or citations usually appears at the end of a piece of work. A reference describes an item, usually published, (a book, report or thesis) or part of an item (a book chapter, journal article or electronic document). It provides essential details which enable the reader to locate cited publications with the minimum of effort.

The importance of references

- to give proper credit to other people's work and ideas, avoiding plagiarism
- to show that you have consulted widely, recognizing and acknowledging the relevant debate, arguments and practice in a given field
- to substantiate any statement that you make
- to signpost others to related works and prior publications
- to enable others to check the evidence and accuracy of your information

Reference list and bibliography

The terms reference list and bibliography are sometimes used interchangeably. The list of resources (articles / textbooks), that are not specifically referenced in the text would be headed bibliography whereas a list of resources (articles / textbooks) which are specifically cited in the essay, form the reference list.

Secondary referencing

Never cite an article you have not seen in full. You should not cite an article based only on an abstract. If it is impossible to read the original article, but you wish to include the

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findings of that research as reported in a review or textbook, then you must cite the article or book which refers to the original work, Eg: Brown's results cited by Jones (1999) indicated that ...

Citation & reference styles

There are two main methods of citing references,

HARVARD (AUTHOR-DATE) STYLE

The citations within the text are given using the author's name and the date in brackets, with the reference list at the end of the document being arranged alphabetically. It is also referred to as the Parenthetical system, because the name and date are placed in brackets (parentheses).

Example

"The author has discussed the implications of these proposals on the National Health Service in another paper (Loft, 1991). Other writers have commented on related issues, notably Lane (1992, 1994) and Lewis (1995, p.54)."

Names and dates are enclosed in parentheses unless the author's name is part of the sentence. If two papers are cited by the same author, and both are published in the same year, the first should be referenced as (Loft 1997a), then (Loft 1997b), and so on.

The full citation is listed at the end of the article, which is arranged in alphabetical order by author. Journal names are given in full and are italicized, as are book names. References would be cited as follows: Rao A (1997), 'Impact of oral health on the quality of life of diabetics', Int Dent J, vol. 37, no. 7, pp. 37-43.

Examples of the Harvard system of referencing

1. Journal article: Rao A, Kamath A, Sequeira PS, Peter S. (2003) Influence of parental beliefs on the caries experience of their children. Int Dent J, 240: 5-12.
2. Chapter in book: Shenoy R. (2008) Infection control in Dentistry. In: Rao A, editor. Textbook of preventive dentistry. 2nd ed. Edinburgh: Churchill Livingstone, 320-443
3. Theses or dissertations: Daniels HM. (1995) The role of the immune system in the persistence of hepatitis B virus infection [dissertation]. India: Manipal College of Dental Sciences, Mangalore.
4. Official publications: Department of Environment (1986) Landfill wastes. Government of India. (Waste management paper, 26).
5. Diagrams or illustrations: Should be referenced as though they were quotations, if they have been taken from a published work.
6. Full-text documents from online or CD ROM databases: A standard reference should contain: Author/editor, year, title, medium, place of publication and publisher.
   Eg: Rao A et al (1997) Changes in reported dietary habit and brushing pattern after an oral health education program in 12 year old children. J Clin Dent 6(2),153-160. Full-text [online]. CINAHL, Ovid Technologies Inc. [Accessed 28th May 1998].
   Some database producers may advise on the citation format, and this should be indicated in the references, eg: Renfrew MJ, Lang S, Woolridge MW. Early versus delayed eruption of maxillary canines (Cochrane Review). In: The Cochrane Library, Issue 1,2000. Oxford: Update Software. (Citation as instructed)
7. Internet sources: A standard reference to an internet source should include the author, the date the information was published or updated (either year or full date) the title of the work, the Url {including the internet access protocol (for example ftp://, telnet://, http://) and the hosting web site, if this is not obvious

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from the URL, plus the accessed date. The accessed date is the date the web page was viewed, downloaded or printed. This statement is necessary to allow for any subsequent changes which may be made to the page, or if the page is no longer available.

8. Web document: Nye, David. (1998) A physician's guide to fibromyalgia syndrome [online]. Available: http://www.muhealth.org/-fibro/fm-md.html [accessed 20.3.08]
9. E-journal article: Where journals are available in print form as well as online it is unnecessary to refer to the online access details, the standard journal reference information will suffice. If however the journal is only available in electronic form then the web address and access date are obviously essential, Eg:- Brown, M. A. (1996) Primary Oral Health Care in the Rainbow of Advanced Practice Dentistry Online Journal of Issues in Dentistry [online], 1st August 1996. Available from: http://www.dentalworld/ojin/tpcl/tpcl_6.htm [accessed 17th March 1998].

VANCOUVER (AUTHOR-NUMBER) STYLE

(The numeric approach) (The sequential numbering system)

It is also known as the citation-sequence approach. The Vancouver system differs from Harvard by using a number series to indicate references and the reference list at the end is ordered numerically as they appear in the text. In this system each citation is given a unique number in the order in which it appears in the text, either in brackets or superscripted. The details of the source are given either at the bottom of each page (called footnotes), or in a reference list at the end of the paper (called endnoting).

With endnoting, the reference list will be made up of a sequentially numbered list at the end of the chapter or paper.

In the Vancouver system, normally Roman numerals are used with the references listed in numerical order at the end of the paper.

The main advantage of the Vancouver style is that the main text reads more easily, and some editors consider this to be less obtrusive. Additionally, references are directly correlated to numbers, saving the reader time in searching alphabetically for the first author of a reference. Vancouver style is so named as it is based on the work of a group, who first met in Vancouver in 1978, which became the International Committee of Medical Journal Editors (ICMJE). The style was developed by the US National Library of Medicine (NLM) and adopted by the ICMJE as part of their 'uniform requirements for manuscripts submitted to biomedical journals'.

Medical journals generally require the Vancouver style, but it is important to consult 'Instructions for Authors' for any publication before writing and submitting a paper.

Examples of the Vancouver system of referencing

1. Book: Author's family name, author's first name or initial. Title of the book. Edition (if not first), place of publication: publisher; date of publication.
2. Article in journal: Author's family name, author's first name or initial, 'article title', journal title, year of publication, volume (issue number), page numbers of article.
3. Article in conference papers: Author's family name, author's first names or initials, 'title of paper' In: Editor's family name, editor's first name or initials, title of the conference, conference date; place of publication, date of publication, page numbers.
4. Newspaper reference: Author's family name, author's first name or initial, 'article title', name of newspaper, day, month year of publication, page numbers of article.
5. Citing electronic resources: When citing electronic material, the same details are required as for other materials. In

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addition, for most cases this will also mean providing the full URL address and date on which the material has been accessed.

General tips for electronic sources

- always bookmark useful web documents
- save and print all the documents and correspondence that you intend to cite, just in case they aren't effectively archived or disappear
- resources that don't cite a specific author or publication date should be treated with caution
- if there is no apparent author, try and identify the most relevant and specific corporate unit, or email the web master for advice
- if no date is available, state clearly no date given

Keeping records

Record the full bibliographic details of any item you read, if you think you might decide to refer to it later in your work. File cards are useful for noting down these details.

Computer referencing

Many word -processing programs have the ability to automatically create footnotes and endnotes. Thus the computer can assist in the organization of citations and will automatically alter the numbering if more sources are inserted into the text. Footnotes or endnotes created in this way may then be listed in numerical or alphabetical order in the reference list or bibliography.

Important points in citing references

- When two or more references to the same author have been cited, arrange them in the reference list in chronological order by date of publication, Eg: Brown 1991, 1994
- When two or more references to the same author have been cited from the same year, differentiate them with an a, b, c annotation, Eg: Smith 1996a, Smith 1996b
- If two authors have the same surname, add their initials in the citation, Eg: Smith TH 1992, Smith W 1992
- Rules for the number of authors' names to include in the citations and in the reference list are specified in the style guides for individual journals, Eg: in the citations: if an item has two authors, use 'and' Eg: Brown and Black 1995. If there are three or more authors use 'et al' which means 'and others' Eg: Rao A et al 1995).
- In the reference list, all authors names should be included.
- In the Harvard format the year appears after the author's name whereas in the Vancouver system the year is placed after the source name.
- Where two or more consecutive citations from the same source are cited, the word Ibid (from the Latin, ibedidem 'in the same place') is used,
  Eg: 1. Rao A. Utilization of dental services. Oxford: Oxford University Press, 2001, pp. 109-112.
  2. Ibid. p. 142
  3. Ibid. p.156
- If more than two numbers are cited in a continuous sequence, connect the first and last with a hyphen, otherwise use commas: for example, (1,2,5-9, 13, 17).

Appendix

Include a copy of any actual instruments. Also include a copy of the informed consent form.

GLOSSARY

Alternative hypothesis: In the event of rejection of the null hypothesis, we need another hypothesis. This is the alternative hypothesis. Usually stated as, there is a difference between the two groups being compared.

Analysis of variance: A widely used statistical

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technique that determines the presence of an effect by estimating the variance associated with it and comparing this with a benchmark variance known to be purely random.

Binomial distribution: The pattern usually followed by a set of binomial measurements provided that the individuals involved do not influence one another's behavior.

Binomial measurement: A measurement in which the individual is placed in one of two mutually exclusive categories.

Categorical measurement: A measurement in which the individual is located in one of a number of mutually exclusive categories that have no inherent order to them (for example, blood types).

Chi-squared statistic: A measure of the level of agreement between a set of observed and expected values.

Chi-squared test: A test for possible association between two categorical variables, based on a chi-squared statistic.

Clinical trial: A study that evaluates the effectiveness of one or more interventions in human subjects by comparing the intervention group(s) with a suitable control group. The participants are followed forward in time from initial intervention to final outcome.

Cluster sampling: A sampling procedure often used when sampling units naturally form themselves into groups or clusters. A number of such clusters are randomly selected from a list of clusters, and all sampling units in each selected cluster are entered into the final sample.

Completely randomized experiment: An experiment in which the available subjects are randomly allocated to the various treatments under investigation, with no attempt to impose any additional grouping or structure on the subjects.

Confidence limits: A range of values within which we are confident (often 95% confident) that the true but unknown population value lies.

Degrees of freedom: The number of truly independent or informative items of information in a set of data.

Dependent variable: A variable that depends on or is influenced (directly or indirectly) by another variable (known as the independent variable). For example, blood pressure (dependent variable) is influenced by age (independent variable).

Discrete variable: A variable that can take only a limited range of values.

Double-blind experiment: An experiment in which both the subjects and the investigators who interact with the subjects are unable to distinguish the treatments being compared.

Expected values: The number of individuals that some theory or hypothesis predicts should occur in the various categories of a categorical variable.

Fact: is a phenomenon whose existence has been documented through the use of the scientific method.

F tables: Tables (also known as variance ratio tables) that document the critical values used in analysis of variance testing.

Fisher's exact test: A test for the presence of an association between two categorical variables, used when the numbers involved are too small to permit the use of a Chi squared test.

Friedman's test: A nonparametric equivalent of the analysis of variance, which permits the analysis of an unreplicated randomized block design.

Histogram: A graphical representation of the pattern of variation present in a set of data. It is obtained by splitting a measurement scale into intervals and displaying the number of individuals falling into each interval.

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Hypothesis: is a proposition, condition or principle that predicts or indicates a relationship between or behavior of variables under certain conditions.

Hypothesis testing: The act of using the results from a sample-based investigation to answer research questions (for example, "Do men and women differ in their times of reaction to a stimulus?").

Independent variable: A variable (also known as an explanatory variable) that explains or influences (at least to some degree) the behavior of another variable known as the dependent variable. For example, age (independent variable) influences blood pressure (dependent variable).

Kruskal-Wallis test: A nonparametric test used to compare the medians of several independent samples. It is the nonparametric equivalent of the one-way analysis of variance.

Level of significance: Level of significance is the confidence with which the null hypothesis is rejected or accepted. If the P value is small, then the probability of attributing the difference between sample estimates to sampling fluctuations is small and hence the null hypothesis is rejected.

Longitudinal survey: A survey that describes or measures a population at several points in time.

Mann-Whitney U test: A nonparametric test used to compare the medians of two independent samples. It is the nonparametric equivalent of the t test.

McNemar's test: A variant of a Chi squared test, used when the data is paired.

Mean: A measure of the "typical" individual obtained by averaging (totaling the various individual results and dividing by the number of results involved) a data set.

Mean deviation: A measure of the extent of the variation in a set of data, obtained by taking the average of the absolute deviation between each individual result and the mean. It is easier to calculate than the standard deviation but much less useful.

Median: A measure of the "typical" individual, obtained by ranking the individual results in a data set from smallest to largest and selecting the middle value.

Mode: The most frequently occurring result in a set of data. (it is meaningful only if the measurement involved takes a limited range of values)

Multiple regression analysis: An extension of regression analysis that describes and tests the relationship between a dependent variable and a linear combination of several independent variables.

Multi-stage sampling: A sampling procedure often used when the sampling units can be defined in a hierarchical manner (for example, children within classes within schools). The final sample is selected in a corresponding series of steps (a number of schools are selected at random, for each selected school a number of classes are selected and so on).

Multi-way analysis of variance: An analysis of variance in which several main effects are tested simultaneously.

Nonparametric tests: A family of statistical tests (also called distribution-free tests) that do not require any assumptions about the distribution the data set follows and that do not require the testing of distribution parameters such as means or variances.

Normal distribution: The pattern followed by very many sets of continuous measurements. It is characterized by a symmetric, bell shaped curve.

Null hypothesis: The first step in testing of hypothesis is to set up an appropriate hypothesis with the problem. The null hypothesis asserts that there is no real

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difference between the two groups under consideration and the difference found is accidental and arises out of sampling variations. For instance, if we want to find out whether area of residence is related to DMF score or not, the null hypothesis is stated as there is no difference in the DMF scores of the rural and urban children.

Observational studies: Studies (often called surveys) in which the subjects are merely observed and no attempt is made to impose interventions on them.

Observed values: The number of individuals actually observed in practice in the various categories of a categorical variable.

One-tailed testing: A test procedure that evaluates the possibility that a specific alternative hypothesis is true.

Paired t test: A variant of the t test used when the test results form logical pairs.

Poisson distribution: The pattern usually followed by a set of results in which the measurements are counts. It is a special case of the binomial distribution in which the number of individuals involved is very large and the chance of one of the two possible outcomes occurring is very small.

Probability: The chance or likelihood of a particular event happening expressed as a proportion of 1, with 0 denoting impossible and 1 absolutely certain.

Protocol : A document that rigorously details the objectives of an investigation and how those objectives will be achieved in the investigation.

Purposive selection: The deliberate selection of a sample because it is believed to be representative of the target population.

Random allocation: A procedure for allocating experimental subjects to treatments (or groups) that removes the allocation decision entirely from the control of the investigator, hence eliminating the possibility of investigator-induced bias.

Random sampling: A procedure for selecting a sample from a population that removes the selection decision entirely from the control of the investigator, hence eliminating the possibility of investigator-induced bias.

Randomized block design: An experiment design in which the subjects are first formed into groups or blocks on the basis of similarity of subjects within a block. The subjects within each block are then randomly allocated to the treatments under investigation.

Range: The difference between the smallest and largest results in a set of data.

Retrospective study: A study (also called a case-control study) that looks backward in time from final disease outcome to potential cause. In it, groups of affected individuals (cases) and unaffected individuals (controls) are compared in the extent of their exposure to some suspected risk factor

Sample: The group of individuals (usually a relatively small number) who are actually available for investigation. The sample is selected from the population of interest.

Sampling fraction: The proportion of the population that will be included in the study

Sampling frame: A comprehensive list of the sampling units that form the target population.

Sampling units: The individual entities that form the focus of the survey. These are often individual people but might be other entities such as individual hospitals, depending on the objective of the survey.

Spearman's rank correlation: A nonparametric equivalent of the correlation coefficient that measures the strength of the relationship between two variables using their rankings rather than the original measurements.

Standard deviation: A measure of the magnitude of the variation present in a set of

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data. It is obtained by finding the square root of the variance and therefore is expressed in conventional measurement units.

Standard error: A measure of the variability of the mean sample, the variation in mean values which would be seen if a number of samples were collected. It is obtained by dividing the standard deviation of the sample values by the square root of the sample size.

Standardizing: Expressing the difference between two values in terms of standard deviations rather than the original units of measurement.

Sum of squares: A measure of the total amount of variation present in a set of data. It is obtained by summing the squared deviations between each individual result and the mean, and hence is measured in squared units.

Systematic sampling: A sample selection procedure in which every Kth member of the population under study is selected. The value of K is determined by the size of the desired sampling fraction.

t distribution: A variation of the normal distribution that allows for the fact that, in practice, we must use a standard deviation that is usually just a sample estimate of the true population value and hence is somewhat unreliable.

t test: A statistical procedure used to test the equality of the means of two samples. It assumes that the results follow a normal distribution and that the variance of the two samples are equal.

Target population: The population that a survey is intended to describe or measure.

Theory: is an organized body of information that explains a phenomenon

Treatment effect: The presence of differences in mean performance between treatment groups resulting from genuine differences in treatment effectiveness.

True treatment effect: The difference in the mean performance of two treatments that would be observed if the treatments could be administered to every individual in the population under study, expressed in standardized units (in other words, in terms of the population standard deviation).

Tukey's multiple comparison test: Test used as a sequel to a significant analysis of variance test, to determine which of several groups are actually significantly different from one another. It has built-in protection against an increased risk of a type I error.

Two-tailed testing: A test procedure that evaluates the possibility that the general alternative hypothesis is true.

Type I error: Being misled by the sample evidence into rejecting the null hypothesis when it is in fact true.

Type II error: Being misled by the sample evidence into failing to reject the null hypothesis when it is in fact false.

Variable: Any measurement that can take a range of possible values

Variance: A measure of the extent of the variation present in a set of data. It is obtained by taking the average of the sum of squares (dividing the sum of the squares by the degrees of freedom) and hence is measured in squared units.

Yate's correction: An amendment to a Chi squared statistic that allows for the fact that some inherent disagreement between (discrete) observed values and (continuous) expected values is inevitable.

Note : Some of the terms in the glossary may not appear in this chapter. These terms have been explained as they are frequently used in the science of statistics.

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TABLE OF t

df	p = 0.1	p = 0.05	p = 0.02	p = 0.01	p =0.005	p = 0.002	p = 0.001
1	6.314	12.706	31.821	63.657	127.320	318.31	636.62
2	2.920	4.303	6.965	9.925	14.089	22.327	31.598
3	2.353	3.182	4.541	5.841.	7.453	10.214	12.924
4	2.132	2.776	3.747	4.604	5.598	7.173	8.610
5	2.015	2.571	3.365	4.032	4.773	5.893	6.869
6	1.943	2.447	3.143	3.707	4.317	5.208	5.959
7	1.895	2.365	2.998	3.499	4.029	4.785	5.408
8	1.860	2.306	2.896	3.355	3.833	4.501	5.041
9	1.833	2.262	2.821	3.250	3.690	4.297	4.781
10	1.812	2.228	2.764	3.169	3.581	4.144	4.587
11	1.796	2.201	2.718	3.106	3.497	4.025	4.437
12	1.782	2.179	2.681	3.055	3.428	3.930	4.318
13	1.771	2.160	2.650	3.012	3.372	3.852	4.221
14	1.761	2.145	2.624	2.977	3.326	3.787	4.140
15	1.753	2.131	2.602	2.947	3.286	3.733	4.073
16	1.746	2.120	2.583	2.921	3.252	3.686	4.015
17	1.740	2.110	2.567	2.898	3.222	3.646	3.965
18	1.734	2.101	2.552	2.878	3.197	3.610	3.922
19	1.729	2.093	2.539	2.861	3.174	3.579	3.883
20	1.725	2.086	2.528	2.845	3.153	3.552	3.850
21	1.721	2.080	2.518	2.831	3.135	3.527	3.819
22	1.717	2.074	2.508	2.819	3.119	3.505	3.792
23	1.714	2.069	2.500	2.807	3.104	3.485	3.767
24	1.711	2.064	2.492	2.797	3.091	3.467	3.745
25	1.708	2.060	2.485	2.787	3.078	3.450	3.725
26	1.706	2.056	2.479	2.779	3.067	3.435	3.707
27	1.703	2.052	2.473	2.771	3.057	3.421	3.690
28	1.701	2.048	2.467	2.763	3.047	3.408	3.674
29	1.699	2.045	2.462	2.756	3.038	3.396	3.659
30	1.697	2.042	2.457	2.750	3.030	3.385	3.646
40	1.684	2.021	2.423	2.704	2.971	3.307	3.551
60	1.671	2.000	2.390	2.660	2.915	3.232	3.460
120	1.658	1.980	2.358	2.617	2.860	3.160	3.373
∞	1.645	1.960	2.326	2.576	2.807	3.090	3.291

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TABLE OF χ^2

df	p = .100	p = .050	p = .025	p = .010	p = .005	p = .001
1	2.71	3.84	5.02	6.63	7.88	10.83
2	4.61	5.99	7.38	9.21	10.60	13.82
3	6.25	7.81	9.35	11.34	12.84	16.27
4	7.78	9.49	11.14	13.28	14.86	18.47
5	9.24	11.07	12.83	15.09	16.75	20.52
6	10.64	12.59	14.45	16.81	18.55	22.46
7	12.02	14.07	16.01	18.48	20.28	24.32
8	13.36	15.51	17.53	20.09	21.96	26.13
9	14.68	16.92	19.02	21.67	23.59	27.88
10	15.99	18.31	20.48	23.21	25.19	29.59
11	17.28	19.68	21.92	24.73	26.76	31.26
12	18.55	21.03	23.34	26.22	28.30	32.91
13	19.81	22.36	24.74	27.69	29.82	34.53
14	21.06	23.68	26.12	29.14	31.32	36.12
15	22.31	25.00	27.49	30.58	32.80	37.70
16	23.54	26.30	28.85	32.00	34.27	39.25
17	24.77	27.59	30.19	33.41	35.72	40.79
18	25.99	28.87	31.53	34.81	37.16	42.31
19	27.20	30.14	32.85	36.19	38.58	43.82
20	28.41	31.41	34.17	37.57	40.00	45.32
21	29.62	32.67	35.48	38.93	41.40	46.80
22	30.81	33.92	36.78	40.29	42.80	48.27
23	32.01	35.17	38.08	41.64	44.18	49.73
24	27.20	30.14	32.85	36.19	38.58	43.28
25	34.38	37.65	40.65	44.31	46.93	52.62
26	35.56	38.89	41.92	45.64	48.29	54.05
27	36.74	40.11	43.19	46.96	49.64	55.48
28	37.92	41.34	44.46	48.28	50.99	56.89
29	39.09	42.56	45.72	49.59	52.34	58.30
30	40.26	43.77	46.98	50.89	53.67	59.70
40	51.81	55.76	59.34	63.69	66.77	73.40
50	63.17	67.50	71.42	76.15	79.49	86.66
60	74.40	79.08	83.30	88.38	91.95	99.61
70	85.53	90.53	95.02	100.43	104.21	112.32
80	96.58	101.88	106.63	112.33	116.32	124.84
90	107.57	113.15	118.14	124.12	128.30	137.21
100	118.50	123.34	129.56	135.81	140.17	149.45

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RANDOM NUMBERS TABLE

= .001	12	67	73	29	44	54	12	73	97	48	79	91	20	20	17	31	83	20	85	66	
10.83	06	24	89	57	11	27	43	03	14	29	84	52	86	13	51	70	65	88	60	88	
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27.88	36	29	93	93	10	00	51	34	81	26	13	53	26	29	16	94	19	01	40	45	
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31.26	23	12	21	19	67	27	86	47	43	25	25	05	76	17	50	55	70	32	83	36	
32.91	77	58	90	38	66	53	45	85	13	93	00	65	30	59	39	44	86	75	90	73	
34.53	92	37	51	97	83	78	12	70	41	42	01	72	10	48	88	95	05	24	44	21	
36.12	28	93	48	44	13	02	49	32	07	95	26	47	67	70	72	71	08	47	16	018	
37.70	09	68	01	98	80	27	49	78	56	67	49	22	13	66	61	33	53	18	36	03	
39.25	61	73	92	33	89	48	20	42	32	33	79	37	68	88	44	59	35	17	97	61	
40.79	82	35	37	33	53	42	52	04	16	54	08	25	48	89	57	87	59	89	96	76	
42.31	39	20	77	72	55	19	66	58	57	91	38	43	67	97	52	66	45	29	74	67	
43.82	51	90	71	05	82	38	37	40	94	52	24	09	35	44	37	33	35	20	65	89	
45.32	97	09	53	79	17	25	02	65	77	70	88	45	53	51	63	30	89	66	42	03	
46.80	73	18	91	38	25	82	29	71	56	89	86	74	68	58	75	36	93	13	33	31	
48.27	17	79	34	97	25	89	01	17	67	92	62	25	54	70	52	88	28	05	61	17	
49.73	97	27	26	86	17	67	59	56	95	07	49	05	70	06	70	35	21	35	26	18	
43.28	56	06	63	00	07	40	65	87	09	49	70	34	67	02	33	39	04	40	01	51	
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Chapter 15

PLANNING AND EVALUATION

INTRODUCTION
USES OF PLANNING
TYPES OF HEALTH PLANNING
STEPS IN THE PLANNING PROCESS
EVALUATION
CONCLUSION

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INTRODUCTION

Planning is a systematic approach to defining the problem, setting priorities, developing specific goals and objectives and determining alternative strategies and methods of implementation. Planning results in the formulation of a plan.

E.C. Banfield has presented a basic definition of the term plan : "A plan is a decision about a course of action".

USES OF PLANNING

- To match the limited resources with many problems
- To eliminate wasteful expenditure or duplication of expenditure
- To develop the best course of action to accomplish a defined objective

TYPES OF HEALTH PLANNING (as outlined by Spiegel and associates)

1. Problem - solving planning
   It involves the identification and resolution of a problem.
   Eg: If there is a problem of dental fluorosis in a community, a plan formulated to solve this problem is called problem solving planning.
2. Program planning
   It entails designing a course of action for a circumscribed health problem.

Eg: Planning a school-based fluoride rinse program for reducing the prevalence of dental caries in a community.

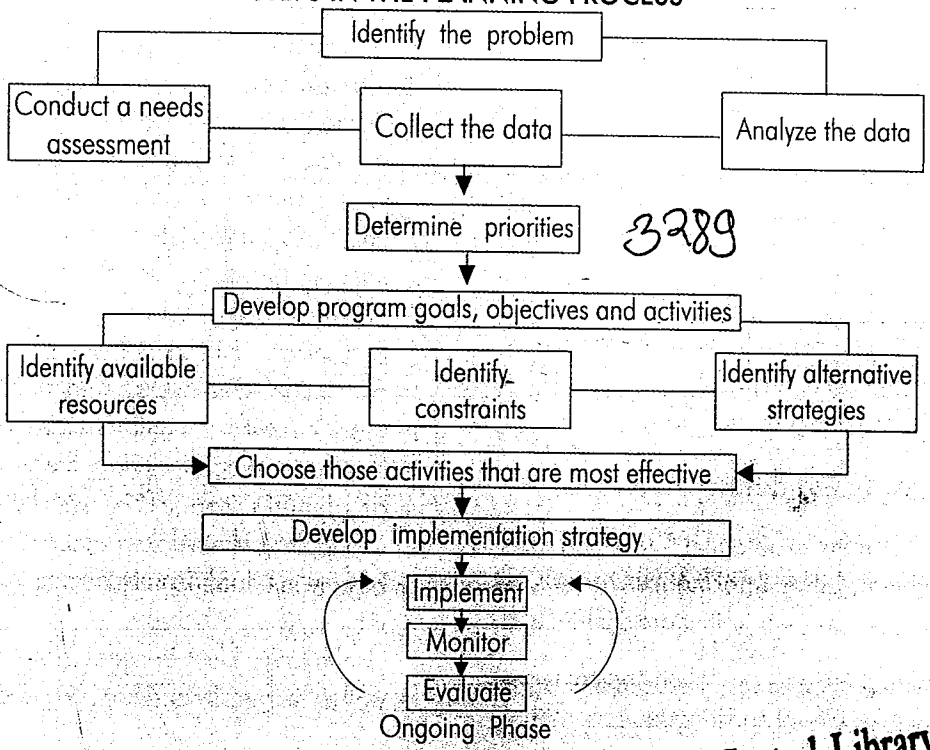
3. Coordination of efforts and activities planning
   It aims to increase the availability, efficiency, productivity, effectiveness, and other aspects of activities and programs.

Eg: Closing of obstetric and pediatric wards in hospitals located in areas with a declining birth rate.

4. Planning for the allocation of resources
   It involves selecting the best alternative to achieve a desired goal when the amount of resources is limited.

Eg: Planning to effectively utilize limited resources by replacing fluoride mouthrinse programs with sealant programs in areas with high prevalence of pit and fissure caries.

STEPS IN THE PLANNING PROCESS



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Steps in a planning process:

1. IDENTIFY THE PROBLEM:

Conducting a needs assessment ;

The reasons for conducting a needs assessment are,

- To ascertain the cause of the problem
- To identify the extent and severity of a problem
- To evaluate the effectiveness of a program by obtaining baseline information and measuring the amount of progress achieved in solving the specific problem.

The information required include

1. Number of individuals in the population
2. Geographic distribution of the population
3. The rate of growth
4. Population density and degree of urbanization
5. Ethnic background
6. Diet and nutritional levels
7. Standard of living
8. Health care facilities available
9. Public and private school system
10. General health profile
11. Patterns and distribution of dental disease
12. History and current status of dental programs
13. Fluoride content of water

Conducting a needs assessment can be a very costly endeavor with respect to funds, labor and time. The other options, therefore, are

- To co-ordinate with research activities of other health agencies.
- To investigate past surveys done.

Analysis of the data:

Once the data is obtained from the needs assessment, the information must be analyzed before the priorities are determined.

- Information on population indicates the possible cultural and language issues that need to be considered. The age distribution of a community is important to consider because it tells the planner where the target groups are and thus helps in setting up priorities.
- The educational status of a community provides two perspectives for planning. It first tells the educational level in years of schooling obtained by the majority of community members and second, it may indicate what the community's values are towards obtaining education. The planner can determine the number of schools, the enrollment for each and the distribution of children among the schools within the community. This information can assist the planner who is developing a school-based program in the community. Schools are the ideal settings for dental programs. They can also be a good meeting place to use to open communication channels with the families and offer support services when needed. However, planning a health awareness program centered around an educational institution would only be successful, if people are attending schools and value the information received there.
- Knowing the median income of a community is very important to a health planner because it indicates the population's ability to purchase health services. It is important to look into the socio-economic structure of the community and determine the type of employment that exists. If the area is an industrial area, there will be a high percentage of industrial workers. If they are union employees, they might be provided with a comprehensive health benefits package including the provision of dental care. This will provide information whether this population might be able to afford dental care through their jobs.
- Health care must be geographically as well as financially accessible if people are

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going to utilize it. A look into the community's public transportation system will provide the planner with information regarding a population's ability to get to health care services. This is especially true for rural communities where roads are unpaved and public transportation scarce.

- Looking at the health care facilities in the community will tell the planner what type of services are being provided, the amount of services and the cost of receiving those services. The dentist population ratio, however, does not give the planner a true picture of whether or not there is a sufficient number of dentists within the community to provide services to the population residing there. Although there may be an adequate number of dentists in the community, the planner must question whether or not the dentists are available for treatment. It is necessary to consider what types of services are being provided to whom as well as for what cost?
- Knowing the fluoride content of water is important for the planner so that he can decide whether a fluoride supplement program is necessary or not. If individual wells are being used, the planner should get a report on the fluoride status of each well. In order to avoid duplication of fluoride administration, information should also be obtained about the type of fluoride, if any, being administered to individuals in the private office, schools and health centers.
- Knowing the political status of a community is also essential for dental planning. In most cases, the politics of the community will determine the direction the program will take. A conservative government attempting to cut costs may be opposed to programs that provide prosthetic services to the medically indigent or elderly. Each local government's policies may also vary in its methods of instituting new programs, allocating funds, hiring personnel or setting priorities.

2. DETERMINING PRIORITIES

"Priority determination is a method of imposing people's values and judgements of what is important onto the raw data."

With limited resources, it becomes necessary to establish priorities so as to allow the most efficient allocation of resources. If priorities are not determined, the program may not serve those individuals or groups who need the care most.

A health advisory committee or task force representing consumers, community leaders and providers should be established to assist in the development of policies and priorities. Planning with community representation will aid in the program's implementation and acceptance.

When setting priorities for a community, the planner must ask,

- How serious is the problem?
- What percent of the population is affected by it?

The number of individuals affected most by the problem would be the group to which the program would be targeted.

Eg: If more number of children are affected by dental caries, then the priority will be to address the problem of dental caries. Then, the planner must look into those specific groups that are more susceptible to dental caries, such as pre-school and school-aged children, low income groups, etc. When the target group has been identified, the planner begins to set program goals and objectives.

3. DEVELOPMENT OF PROGRAM GOALS, OBJECTIVES AND ACTIVITIES

Program goals are broad statements on the overall purpose of a program to meet a

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defined problem. A goal is defined as the ultimate desired state towards which objectives and resources are directed. They are not constrained by time or existing resources nor are they necessarily attainable. Eg: "To improve the oral health of the school-aged children in community X."

An objective is precise. It is either achieved or not achieved. It is a planned end point of all activities. Program objectives are more specific than goals and describe in a measurable way, the desired end result of program activities. Objectives are also specific avenues by which goals are met.

Objectives should specify the following:

1. What: The nature of the situation or condition to be attained.
2. Extent: The scope and magnitude of the situation or condition to be attained.
3. Who: The particular group or portion of the environment in which attainment is desired.
4. Where: The geographic area of the program.
5. When: The time 'at' or 'by' which the desired situation or condition is intended to exist.

Eg: An objective might state

"By the year 2020, more than 90% of the population aged 6 to 17 years in community X will not have lost any teeth as a result of caries and at least 40% will be caries free."

There are 2 types of objectives:

1. Outcome objective
2. Process objective

The above example is an outcome objective. It provides a means by which to measure quantitatively the outcome of the specific objective. This approach helps the evaluator and the community know both where the program is and where it hopes to be with respect to a given health problem. It also aids in establishing a realistic timetable for reducing or preventing principal health problems.

Process objectives state a specific process by which a public health problem can be reduced and prevented.

Eg: "By the year 2020, at least 90% of the population aged 6 to 17 years in community X will be covered under the school fluoride mouthrinse program.

Once the problem has been identified and program goals and objectives have been established, the next step is to state how to bring about the desired results. This area of program planning is referred to as program activities and it describes how the objectives will be accomplished. The activities include 3 components --

1. What is going to be done?
2. Who will be doing it?
3. When will it be done?

4. RESOURCE IDENTIFICATION

The term resources implies the manpower, money, materials, skills, knowledge, techniques and time needed or available for the performance or support of action directed towards specified objectives.

The criteria used to determine what resources should be used are:

1. Appropriateness: The most suitable resources to get the job done.
2. Adequacy: The extent or degree to which the resources would complete the job.
3. Effectiveness: How capable the resources are at completing the job.(fulfilling the objective)
4. Efficiency: The cost in terms of money and the amount of time expended to complete the job.

5. IDENTIFYING CONSTRAINTS

When planning any program, there are

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usually many constraints or difficulties which might occur. What should be determined at this point are the most obvious constraints to meet program objectives. By identifying these constraints early in the planning, one can modify the design of the program, thereby creating a more practical and realistic plan.

Constraints may result from organizational policies, resource limitations or characteristics of the community. E.g. Lack of funding, labor shortages, restrictive governmental policies, inadequate transportation systems, negative attitudes.

One of the best ways to identify constraints is to bring together a group of concerned citizens who might in some capacity be involved in or affected by the project. A group that is familiar with local politics and community structures can not only identify the constraints but also offer alternative strategies and solutions for meeting the goals.

6. IDENTIFY ALTERNATIVE STRATEGIES

Being aware of the existing constraints and given the available resources, the planner should then consider alternative sources of action that might be effective in attaining the objectives. It is important to generate a sufficient number of alternatives. However, the planner must be aware of those alternatives that sound good on the surface but may have limitations when closely examined. He should choose the activity that is most effective.

Eg: In a rural setup where adequate transport facilities are not available, commuting to the dental clinic might be a constraint. Therefore a mobile dental clinic, in place of a fixed dental clinic, might be an alternative strategy.

7. DEVELOP IMPLEMENTATION STRATEGY

An implementation strategy for each activity is complete when the following questions are answered.

1. Why? The effect of the objective to be achieved
2. What? The activities required to achieve the objective
3. Who? Individuals responsible for each activity.
4. When? Chronological sequence of activities
5. How? Materials, methods, techniques to be used
6. How much? A cost estimate of materials and time.

To develop an implementation strategy, the planner must know what specific activity he/she wants to do. The most effective method is to work backwards to identify the events that must occur prior to initiating the activity.

8. IMPLEMENTATION

The process of putting the plan into operation is referred to as implementation.

Most health programs can be divided into four phases of implementation, which should occur in sequence:

- The pilot phase: Whose development proceeds on a trial and error basis.
- The controlled phase: Where a model of a particular program strategy is run under regulated conditions to judge its effectiveness.
- The actualization phase: Where a model of the program strategy is subjected to realistic operating conditions.
- The operational phase: Where the program is an ongoing part of the structure.
- The implementation process involves individuals, organizations and the community. Only through team work between the individual and the

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environment can implementation be successful.

9. MONITORING

There is considerable confusion about the use of the terms surveillance and monitoring.

The word surveillance in French literally means "watching over". Surveillance denotes the maintenance of an ongoing watch over the status of a group or community. It gives information about new and changing needs and provides a basis for appraising the effects of health care.

Eg: A watch may be kept on the health status in terms of mortality, morbidity and other factors that may affect health

Inbuilt surveillance is the term used if a health service has set up routine procedures for this purpose, such as the recording of births and deaths, with periodic analysis of these data.

Monitoring refers to the maintenance of an ongoing watch over the activities of a health service.

Eg: The provision of answers to questions such as, 'What are we doing at the present moment?', 'What does it cost in resources to do what for whom?'

Monitoring often denotes not only watching, but using the observations as a basis for continual modification of goals, plans or activities.

The data typically collected for monitoring include,

1. Input data:

Eg: Financial/budgetary reports, personnel available and vacancies existing, transportation records, equipment and supplies purchased.

2. Process data:

Eg: Specific activities carried out in completing the program, the sequence in which they are carried out and their timing.

3. Output data:

Eg: Services or goods provided (such as the proportion of target population served).

10. EVALUATION

"Evaluation measures the degree to which objectives and targets are fulfilled and the quality of the results obtained. It measures the productivity of available resources in achieving clearly defined objectives. It measures how much output or cost-effectiveness is achieved. It makes possible the reallocation of priorities and of resources on the basis of changing health needs."

- WHO 1967

Evaluation is defined as the collection and analysis of information to determine program performance. It is mostly concerned with the final outcome and the factors associated with it.

It is intended to determine the value of the program to see if it has been carried out as prescribed and to discover whether the required performance and objectives have been achieved.

Measurement of the results may be direct or indirect. Direct measures are those which assess changes in oral health due to the program being evaluated. The standard indices of dental health may be used.

Indirect measures are necessary where it is not practicable to measure directly any changes in health. Eg: When health education is undertaken with the aim of reducing tooth loss due to periodontal disease, the results of the program may not appear for a long time. In this situation, it is reasonable to assess knowledge and attitudes, the oral hygiene status or level of

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gingivitis. Indirect measures make assumptions about the relevance of the characteristic being measured and should be treated with caution.

Criteria used in the evaluation of dental services (WHO 1972)

1. Effectiveness: Have the stated objectives been achieved?
2. Efficiency: What has been the cost in manpower or finance in relation to the output of the program?
3. Appropriateness: Is the program acceptable to both consumers and providers and do the priorities reflect a proper interpretation of the needs of the population?
4. Adequacy: Has the intended coverage of the target population been achieved and are the services readily available?

Effectiveness:

It has been defined as "The ratio between the achievement of the program activity and the desired level which, during the planning process, the planners had proposed would result from the program." -- WHO 1974.

Three variables are useful in evaluating effectiveness:

1. Resources: are evaluated by dividing the actual expenditure of resources by the planned expenditure.
2. Activities: are evaluated by dividing actual performance by planned performance.
3. Objectives: are evaluated by dividing actual attainment of objectives by planned attainment.

Efficiency:

It has been defined as "The result that might be achieved through expenditure of a specific amount of resources and the result that might be achieved through a minimum of expenditure." -- WHO 1974.

It is a measure of the resources spent (money, men, material and time) in the process of providing a health care program. It expresses the relationship between the effect obtained and the resources spent. However, between these two end points is a third factor, the activities produced by the program. Thus, efficiency is an expression of the effects obtained in relation to activities undertaken and the resources spent.

Appropriateness:

The appropriateness of the program will be judged by lay decision makers. They will weigh up whether the problem defined by the program personnel is a problem for the community. The appropriateness of the strategy of the program should be evaluated because even though a program is effective, it may not be appropriate.

Evaluation of appropriateness can be carried out at 2 levels.

1. Whether the aims and objectives of the program are appropriate.
2. Whether the strategy of the program is appropriate.

Adequacy:

A measure of adequacy is the extent to which the population in need was covered by the services or the extent to which the services covered the various aspects of the underlying problem. It should be distinguished from effectiveness, which is concerned only with results of the program in those who were covered by it.

The population must be provided with dental health services that are appropriate, effective, efficient and adequate and that can cope with dental needs and demands in a comprehensive manner by the best utilization of resources within given constraints.

TYPES OF EVALUATION

There are different types of evaluation

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depending on the object being evaluated and the purpose of the evaluation. The most important basic types of evaluation are,

Formative evaluation:

It refers to the internal evaluation of a program. It is an examination of the activities of a program, as they are taking place. It is usually carried out to aid in the development of a program in its early phase.

Eg: A fluoride rinse program is initiated at a neighborhood health center in which paraprofessionals are trained to administer three types of fluoride rinses under a strict sequence of procedures. After 3 days of operation, the work of the paraprofessionals is observed to determine the extent to which the strict sequence of procedures is being adhered to. The observation and determination of correct or incorrect procedure sequence provide an example of examining the activities of a program as they are occurring. If the sequence is incorrect, formative evaluation allows the program to make remedial changes at that point, without waiting until the end of the program.

Formative evaluation is used primarily by the program developers as to whether they are workable or whether changes should be made to improve program activities.

Summative evaluation:

It judges the merit or worth of a program after it has been in operation. It is an attempt to determine whether a fully operational program is meeting the goals for which it was developed. Summative evaluation is aimed at program decision makers, who will decide as to a program's continuation or termination and also at decision makers from other programs who might be considering adoption of the program.

OTHER TYPES OF EVALUATION

1. Relevance evaluation
2. Process evaluation
3. Effectiveness evaluation
4. Impact evaluation
5. Efficiency evaluation

Relevance evaluation:

It refers to activities designed to determine whether the program is needed or whether the program is targeting its efforts at the individuals in need. The seven key questions around which relevance evaluations may be organized are:

1. What problem does the program address?
2. How adequate is the definition of the problem?
3. What is the level of need for services associated with the problem?
4. How accurate is the information about the problem?
5. How adequate is the definition of the program?
6. Is the program appropriate to the defined problem?
7. Are those identified to be in need of services receiving the program?

Process evaluation:

It refers to efforts made to assess the extent to which program implementation complies with the program plan. The assessment of whether a program is being provided in a fashion consistent with the planner's original intentions should be helpful to program managers in making early adjustments of the program and in making decisions concerning program continuation and expansion. This type of evaluation is a part of the management process.

Questions around which a process evaluation may be organized include;

1. Are the required personnel, equipment and financial resources in place at the times and locations necessary to meet program needs?
2. Do program activities clearly conform to

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the original plan?

3. Are there any unanticipated factors influencing program implementation?
4. Are the various activities or components of the program being provided to all program targets with uniform quality and quantity.

This type of evaluation is used early in the implementation of the health program. Four types of recommendations might logically follow from a process evaluation:

- Terminate the project
- Reorganize the project
- "Fine tune" the project
- Proceed with the project as it has been implemented.

Effectiveness evaluation:

It refers to whether program results meet predetermined objectives. Here, the emphasis is on immediate outcomes of program activities and whether these outcomes meet the activities specified by the program planners.

Questions answered by an effectiveness evaluation include:

1. Did the program meet its stated objectives?
2. Were the program providers satisfied with the effects of program activities?
3. Were program beneficiaries satisfied with the effects of program activities?
4. Is the problem reduced or eliminated as a result of the program?

Impact evaluation:

It refers to the long term outcomes of the program. It considers whether the intervention had any long lasting effects on the ultimate problems that the program is intended to remedy.

It is an expression of the overall effect of a program on health status and socio-economic development.

Efficiency evaluation:

It attempts to relate the results obtained from a specific program to the resources expended to maintain the program.

The types of question central to efficiency evaluation include:

1. Do program benefits exceed the costs incurred?
2. Are program benefits more or less costly per unit of outcome when compared to other programs designed to achieve the same objectives?

Dishonest evaluation can be of different types,

1. Eyewash - An appraisal limited to aspects that look good.
2. Whitewash - Covering up failure by avoiding objectivity, e.g. by soliciting testimonials.
3. Submarine - aimed at torpedoing a program, regardless of its worth.
4. A postponement ploy - noting the need to seek facts in the hope that the crisis will be over by the time the facts are available.

Guidelines which should be followed by the evaluator are,

1. Explore the motivations for evaluation.
2. The original objectives of the program and its rationale and procedures must be uppermost in the evaluator's mind.
3. Evaluation should be continuous and should start before vested interests have solidified and organizational inertia set in.
4. No evaluation should be conducted unless there is a strong likelihood that it can be done with scientific accuracy.
5. An assessment must be made as to whether it is possible to make changes in the program, if the evaluation suggests that these are desirable.
6. The results should be well presented and widely publicized.

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General steps of evaluation

1. Determine what is to be evaluated.
2. Establish standards and criteria.
3. Plan the methodology to be applied.
4. Gather information.
5. Analyze the results.
6. Take action
7. Re-evaluate.

1. Determine what is to be evaluated:

Generally speaking, there are 3 types of evaluation.

(a) Evaluation of structure:

This is evaluation of whether facilities, equipment, manpower and organization meet a standard accepted by experts as good.

(b) Evaluation of process:

The process of medical care include the problems of recognition, diagnostic procedures, treatment and clinical management, care and prevention. The way in which the various activities of the program are carried out is evaluated by comparing with a predetermined standard.

(c) Evaluation of outcome:

This is concerned with the end result, that is, whether persons using the services experience measurable benefits or not.

2. Establishment of standards and criteria:

Standards and criteria should be established, so that they can be compared against. This is necessary to determine how well, the desired objectives have been attained. Standards and criteria must be developed in accordance with the focus of evaluation.

- Structural criteria. Eg: Physical facilities and equipment
- Process criteria. Eg: Every school going child should receive dental check up once in 6 months.
- Outcome criteria. Eg: Alterations in health status [positive, negative] or behavior resulting from health care [satisfaction, dissatisfaction] or the educational process.

3.Planning the methodology:

A format must be prepared for gathering the desired information.

4.Gathering information:

The type and amount of information required will depend on the purpose of the evaluation.

5.Analysis of results:

The analysis and interpretation of data and feedback to all individuals concerned should take place within the shortest time feasible. Opportunities should also be provided for discussing the evaluation results.

6.Taking action:

For evaluation to be truly productive, actions designed to support, strengthen or otherwise modify the services involved, need to be taken.

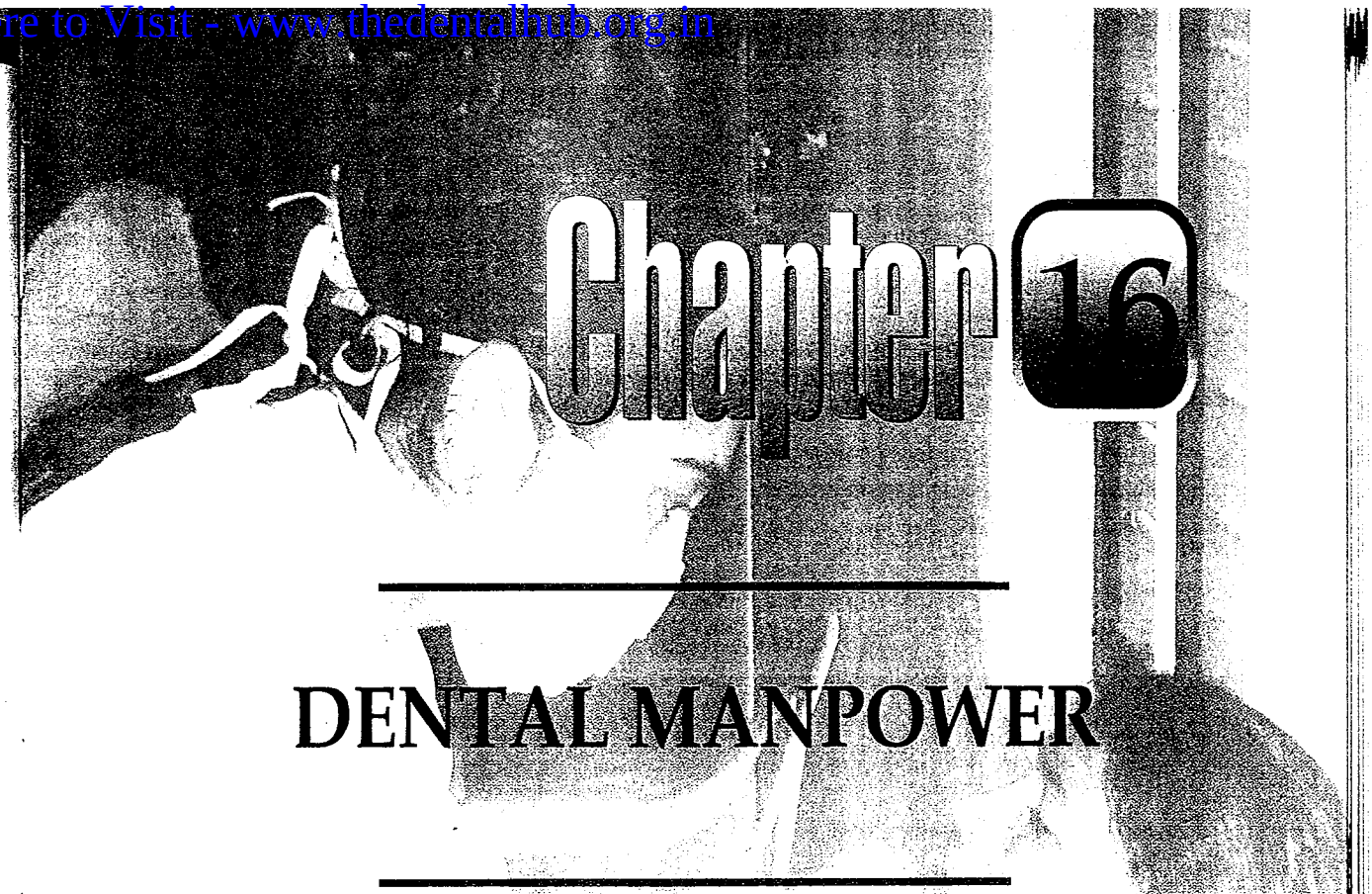
7.Re-evaluation:

Evaluation is an ongoing process aimed mainly at rendering health activities more relevant, more efficient and more effective.

CONCLUSION

A plan can play a vital role in helping to avoid mistakes or recognize hidden opportunities. Planning helps in forecasting the future, making the future visible to some extent. It bridges between where we are and where we want to go. Planning is looking ahead. However, planning is worthwhile only if change is seen to be necessary and if the plans are capable of being implemented.

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Chapter 16

DENTAL MANPOWER

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INTRODUCTION
DENTIST
DENTAL AUXILIARIES
- DENTAL SURGERY ASSISTANT
- DENTAL SECRETARY /RECEPTIONIST
- DENTAL LABORATORY TECHNICIAN
- DENTAL HEALTH EDUCATOR
- SCHOOL DENTAL NURSE
- DENTAL THERAPIST
- DENTAL HYGIENIST
- EXPANDED FUNCTION DENTAL AUXILIARIES

FRONTIER AUXILIARIES
NEW AUXILIARY TYPES
DEGREES OF SUPERVISION OF AUXILIARIES
DENTAL MANPOWER IN INDIA
CONCLUSION

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INTRODUCTION

Dental auxiliary is a generic term for all persons who assist the dentist in treating patients. In Britain, they have been known as "dental ancillaries". The word auxiliary means, being helpful, subsidiary; whereas ancillary means subservient, subordinate. The words dental auxiliary has found common usage.

DENTIST

A dentist is a person licensed to practice dentistry under the law of the appropriate state, province, territory or nation. These laws ensure that to become licensed, a prospective dentist must satisfy certain qualifications such as,

1. Completion of an approved period of professional education in an approved institution.
2. Demonstration of competence.

Dentists are concerned with the prevention and control of the diseases of the oral cavity and the treatment of unfavorable conditions resulting from these diseases, from trauma or from inherent malformations. They are legally entitled to treat patients independently, to prescribe certain drugs and to employ and supervise auxiliary personnel. Dentists must be registered.

Registration is the process by which, qualified individuals are listed on an official roster, maintained by a government or non-governmental agency.

After being trained for 4 years, followed by one year of paid rotating internship, the student is conferred the degree of Bachelor of Dental Surgery (BDS). The student has to register with the Dental Council of India (DCI) through the State Dental Council. He/She can then practice dentistry or can pursue post graduation in a speciality of his/her choice of subject, leading to a masters degree - Master of Dental Surgery (MDS).

The revised BDS course regulations given by the DCI wide notification dated 25th July 2007 states that the undergraduate dental training program leading to BDS degree shall be of 5 years duration with no internship program.

DENTAL AUXILIARY

A dental auxiliary is a person who is given responsibility by a dentist so that he or she can help the dentist render dental care, but who is not himself or herself qualified with a dental degree. The duties undertaken by dental auxiliaries range from simple tasks such as sorting instruments to relatively complex procedures which form part of the treatment of patients.

Classification by WHO (1967)

1. Non-operating auxiliaries

   a) Clinical : This is a person who assists the professional (dentist) in his clinical work but does not carry out any independent procedures in the oral cavity.

   b) Laboratory : This is a person who assists the professional by carrying out certain technical laboratory procedures.

2. Operating auxiliary

This is a person who, not being a professional is permitted to carry out certain treatment procedures in the mouth under the direction and supervision of a professional.

Revised classification :

1. Non-operating auxiliaries
   - Dental surgery assistant.
   - Dental secretary /receptionist.
   - Dental laboratory technician.
   - Dental health educator.
2. Operating auxiliaries
   - School dental nurse.
   - Dental therapist.
   - Dental hygienist.
   - Expanded function dental auxiliaries.

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DENTAL SURGERY ASSISTANT

A dental assistant is a non-operating auxiliary who assists the dentist or dental hygienist in treating patients, but who is not legally permitted to treat patient independently. A dental assistant may only work under the supervision of a licensed dentist, carrying out duties prescribed by the dentist or by a dental hygienist employed by the dentist.

This category of auxiliary personnel has been called by various names in different countries. The commonly used ones include dental assistant, chairside dental assistant and dental nurse.

Dr. C. Edmund Kells of New Orleans (U.S.A.) in 1885 hired a woman as a "lady in attendance" so that ladies who needed dental treatment during these Victorian times were made to feel at ease. It was found that these individuals could be used to perform the routine 'housekeeping' chores in the operatory as well as the clerical procedures of the practice. There was a change in the degree of their utilization, when, due to a shortage of labor to meet the demand of the military service during World War II (1939-1945), these 'helpers' were trained to work at the chairside. There was a marked change during the 60's with the advent of fourhanded sit - down dentistry.

Four-handed dentistry

The term four-handed dentistry is given to the art of seating both the dentist and the dental assistant in such a way that both are within easy reach of the patient's mouth. The patient is in a fully supine position. The assistant will hand the dentist, the particular instrument he needs. She will also perform additional tasks such as retraction or aspiration. The dentist can thus keep his hands and eyes in the field of operation and work with less fatigue and greater efficiency.

Dentists who do not expect too much from their assistants prefer to train them on the job. Training courses do exist, extending over a period of one year to two years.

The duties of the dental assistants are:

1. Reception of the patient.
2. Preparation of the patient for any treatment he or she may need.
3. Preparation and provision of all necessary facilities such as mouthwashes and napkins.
4. Sterilization, care and preparation of instruments.
5. Preparation and mixing of restorative materials including both filling and impression materials.
6. Care of the patient after treatment until he or she leaves, including clearing away of instruments and preparation of instruments for reuse.
7. Preparation of the surgery for the next patient.
8. Presentation of documents to the dental surgeon for his completion and filing of these.
9. Assistance with x-ray work and the processing and mounting of x-rays.
10. Instruction of the patient, where necessary, in the correct use of the toothbrush.
11. Aftercare of persons who have had general anesthetics.

DENTAL SECRETARY /RECEPTIONIST

This is a person who assists the dentist with his secretarial work and patient reception duties.

DENTAL LABORATORY TECHNICIAN

A dental laboratory technician is a non-operating auxiliary who fulfills the prescriptions provided by dentists regarding the extra oral construction and repair of oral appliances and bridge-work.

This category of personnel have also been

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known as dental mechanics. As per the Indian Dentist Act of 1948, dental mechanic is a person who makes or repairs dentures and dental appliances. In some countries they have not been considered as auxiliaries because, in these places, their work is mostly performed in commercial laboratories and not in the dental practice setting.

Dental laboratory technicians receive their training through apprenticeship which is associated with formal training at a dental school or technical college. The formal training period covers two years.

Duties:

- casting of models from impressions made by the dentist
- fabrication of dentures, splints, orthodontic appliances, inlays, crowns and special trays.

Dental mechanic is a person, who makes or repairs dental appliances and dentures including inlay, crown and bridge work. He shall restrict his activities to purely mechanical laboratory work at the instance of the registered dental surgeon. He shall not do any chairside work. -The Dental Council of India

The Dental Council of India has prescribed that,

- The course of studies should extend over a period of two academic years and lead to the qualification of dental mechanic certificate.
- The candidate should be at least 15 years of age at the time of admission or within 3 months of it and should be medically fit.
- The candidate must have passed at least matriculation examination of a recognized university taking science subject or an equivalent recognized qualification.

Denturist

Is a term applied to those dental laboratory technicians who are permitted to fabricate dentures directly for patients without a dentist's prescription. They may be licensed or registered.

The desire for autonomy among dental laboratory technicians led to the formation of 'denturists'. Their craft is called 'denturism'. According to that, if the patient is in need of a denture, the process of fabricating a denture, from the impression onwards, is done by the technician in direct relationship with the patient. The ADA defines 'denturism' as the fitting and dispensing of dentures illegally to the public.

Several countries have allowed laboratory technicians to work directly with the public. Tasmania, a state in Australia, was the first place where technicians were legally permitted to provide a prosthetic service. Denmark uses the term 'Denturist' to describe a special category of dental technician who sits at an examination, to enable him to prescribe, make and fit removable dentures without supervision. In the state of Maine, denturists are permitted to take impressions and fit dentures but only under the directions of a dentist.

The ADA has vigorously opposed the denturist movement at the political level. The Association's principal argument is that denturists are unqualified to treat patients and that poor-quality care and even actual harm could result to patients. The WHO Expert Committee on Auxiliary Dental Personnel (1959) has recommended that only qualified dentists may work directly on patients.

DENTAL HEALTH EDUCATOR

This is a person who instructs in the prevention of dental disease and who may also be permitted to apply preventive agents intra orally.

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In a few countries, the duties of some dental surgery assistants have been extended to allow them to carry out certain preventive procedures. In Sweden, two additional weeks of training are given, after which auxiliaries are allowed to conduct fluoride mouthrinsing programs to groups of school children. They are, however, not allowed to undertake any intra oral procedures.

SCHOOL DENTAL NURSE

This is an operating auxiliary, who is permitted to diagnose dental disease and to plan and carry out certain specified preventive and treatment measure, including some operative procedures in the treatment of dental caries and periodontal disease in defined groups of people, usually school children.

Interest in an organized plan to improve dental conditions among children in New Zealand first became evident in 1905. Treatment of these children were particularly difficult on account of the distance, which often separated small communities. Also, dentists were in short supply during World War 1 (1914-18) and treatment of young children were not as accepted an area of dental practice at that time.

The Dental Nurse Scheme was established in Wellington, New Zealand in 1921 due to the extensive dental disease found in army recruits during World War I. The man who influenced its formation was T.A. Hunter, a founder of the New Zealand Dental Association and a pioneer in the establishment of a dental school in New Zealand. The name of the school where they were trained was "The Dominion Training School for Dental Nurses".

The training extends to over a period of two years to cover both the reversible and irreversible procedures.

Upon completion of training, each school dental nurse is assigned to a school where she is employed by the government to provide regular dental care for between 450 and 700 children.

Each school which takes more than 100 children has its own dental clinic. When a school dental nurse is assigned to a school, she is accepted as a member of the staff in the same way as are the teachers.

In New Zealand, the dental nurses are predominantly in the school-based salaried service and are expected to provide care for the children at nearly 6-month intervals. They are under general supervision of a district principal dental officer. The dental nurse inspector who is delegated certain responsibilities visits these school dental clinics about twice as often as the principal dental officer.

Duties:

1. Oral examination.
2. Prophylaxis.
3. Topical fluoride application.
4. Advice on dietary fluoride supplements.
5. Administration of local anesthetic.
6. Cavity preparation and placement of amalgam filling in primary and permanent teeth.
7. Pulp capping.
8. Extraction of primary teeth.
9. Individual patient instruction in tooth brushing and oral hygiene.
10. Classroom and parent-teacher dental health education.
11. Referral of patient to private practitioners for more complex services, such as extraction of permanent teeth, restoration of fractured permanent incisors and orthodontic treatment.

Because this system works well in New Zealand it does not mean that it would work for every other country because New Zealand is a small country and one with advanced social services.

Operating auxiliaries with functions similar

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to those of the New Zealand School Dental Nurse are employed in a number of other countries, many of which have started their own training schools.

In Britain, the first operating auxiliaries based on the New Zealand school dental nurse model graduated in 1962. They were generally known as, 'New Cross' Auxiliaries, because the one training school was located in the New Cross area of South London. They are not trained to work as independent operators.

Other countries, that utilize dental nurses, include Malaysia, Singapore, Thailand, South Vietnam, Myanmar, Indonesia, Hong Kong, Australia (where they are called as 'therapists'), parts of Africa and South America.

In Saskatchewan, a Canadian province and the only place in North America where someone other than a dentist may legally drill and fill the teeth, the nurses receive direct supervision during the first two months and then work with a more experienced dental nurse for the third month. If their performance is found to be satisfactory, then they work without direct supervision. The dentist does the initial examination and meets each nurse at least once a week.

Dental nurses are presumed to provide care more cheaply than dentists. They are less expensive to train than dentists and their salaries are similar to those of physical therapists and school teachers.

DENTAL THERAPIST

This is an operating auxiliary, who is permitted to carry out to the prescription of a supervising dentist, certain specified preventive and treatment measures including the preparation of cavities and restoration of teeth.

In the United Kingdom, dental dressers (as the equivalents of therapists were called) came into being because of a shortage of dentists to work in the school dental service. The auxiliaries based on the New Zealand type graduated in 1962 from the Erstwhile training school, which was in the New Cross area of London. Hence, they were known as "New Cross Auxiliaries". In 1979, in the U.K., the name auxiliary was changed to therapist. In Australia, therapists-the personnel categories who are derivatives of the New Zealand Dental Nurse model - have been in service since 1966. They are like New Zealand type school dental nurses but their role is quite different, as they are not permitted to diagnose and plan dental care. They are permitted to work based on the written treatment plans devised by the supervising dentists. The operative procedures they are entitled to carry out are similar to those of the New Zealand School Dental Nurses, including the administration of local infiltration analgesia. The supervising dentist gives nerve-block analgesia when it is required. In the U.K., dental therapists may only work in the local authority and hospital services and they are required to carry out their duties under the direction of a registered dentist. The directing dentist is responsible for determining the degree of supervision required in each individual case, according to the capacity and experience of the therapist concerned.

The training of dental therapists is for about a period of two years involving both the reversible and irreversible procedures. The functions of a therapist vary. Their duties include,

- Clinical caries diagnosis,
- Cavity preparation in deciduous and permanent teeth,
- Vital pulpotomies under rubber dam in deciduous teeth
- Extraction of deciduous teeth under local anaesthesia.

They have little training in interpretation of X-rays. They often take radiographs at the

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request of the supervising dentist. They are not trained to provide endodontic care.

Apart from Australia and United Kingdom, other countries using the services of therapists include Hongkong, Singapore, Vietnam and Tanzania.

DENTAL HYGIENIST

A dental hygienist is an operating auxiliary licensed and registered to practice dental hygiene under the laws of the appropriate state, province, territory or nation. The dental hygienist works under the supervision of dentists.

> Dental hygienist is a person, not being a dentist or a medical practitioner; who does oral prophylaxis, gives instructions in oral hygiene & preventive dentistry, assists the dental surgeon in chairside work and manages the office. He/She shall work under the supervision of the dental surgeon. - The Dental Council of India

C.M.Wright in 1902, suggested the formation of a subspeciality of the dental profession.

However Wright never carried out his suggestions. The man who put such ideas into practice was Dr. Alfred Civilian Fones of Bridge port, Connecticut.

In 1905, Fones trained Mrs. Irene Newman in the procedures of dental prophylaxis. In 1906, she was at work in Dr. Fones office and became the first dental hygienist.

Dr. Fones is considered as the 'father of dental hygiene'. He is often credited with the first training school for dental hygienists, in November 1913. The duration of the course was for a period of about seven months.

The Dental Council of India has prescribed that,

- The course of studies should extend over a period of two academic years and lead to the qualification of Dental Hygeinist Certificate.
- The candidate should be at least 15 years of age at the time of admission or within 3 months of it and should be medically fit.
- The candidate must have passed at least matriculation examination of a recognized university taking science subject or an equivalent recognized qualification.

Duties:

1. Cleaning of mouths and teeth with particular attention to calculus and stains.
2. Topical application of fluorides, sealants and other prophylactic solutions.
3. Screening or preliminary examination of patients as individuals or in groups, such as school children or industrial employees, so that they may be referred to a dentist for treatment.
4. Instruction in oral hygiene.
5. Resource work in the field of dental health.

Countries where hygienists work include USA, UK, Canada, India, Nigeria, China, Japan, Korea and Poland.

Independent contractual practice of dental hygiene :

Normally, hygienists are required to work under the supervision of a dentist. In independent contracting, the hygienists have a formal agreement regarding supervision with a dentist and often, even a financial arrangement. Hygienists may practice in an office adjacent to the dentist's office, collecting their own fees from patients.

Linda Krol of USA started Independent Contractual Practice of Dental Hygiene in 1976. Sweden is another country where since 1991 hygienists have been allowed to practice dental hygiene independently.

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EXPANDED FUNCTION DENTAL AUXILIARY (EFDA)

They have been referred to as expanded function dental assistant, expanded function dental hygienist, expanded function auxiliary, technotherapist, expanded duty dental auxiliary.

An EFDA is a dental assistant or a dental hygienist in some cases, who has received further training in duties related to the direct treatment of patients, though still working under the direct supervision of a dentist.

They undertake reversible procedures - that is which could be either corrected or redone without undue harm to the patient's health. They do not prepare cavities or make decision as to pulp protection after caries has been excavated, but work along side the dentist and take over routine restorative procedures, as soon as the cavity preparation and base have been completed.

Duties:

- Placing and removing rubber dams.
- Placing and removing temporary restorations.
- Placing and removing matrix bands.
- Condensing and carving amalgam restoration in previously prepared teeth.
- Placing of acrylic restorations in previously prepared teeth.
- Applying the final finish and polish to the previously listed restorations.

The EFDA seats a patient, performs initial inspection and then with X-rays available, calls for the dentist. The dentist examines the patient, performs diagnosis and specifies a plan for treatment. The dentist gives local anesthesia and prepares a group of cavities, inserting pulp protection and cement bases. The EFDA helps him in a four handed relationship. The assistant thus sees and participates in all initial discussions and operations on the case. The assistant then completes the restoration. If problems arise, the dentist can be called back for consultation. The first large scale service applications of the expanded duty principle were made in Philadelphia. They were called "Technotherapists".

Development in the training and duties of EFDA's in the Canadian providence of Ontario, during the1970's provide an example of an attempt to build a logical career structure for assistants and hygienists. Four levels of training and qualification were recognized,

1. Certified dental assistant
2. Preventive dental assistant
3. Dental hygienist
4. Dental hygienist with expanded duties.

Certified dental assistant:

The training course is of 8 months duration. The assistant was taught traditional chairside duties. The only intraoral duty was exposing radiographs.

Preventive dental assistant:

The trainee had to be a certified dental assistant. Full time courses were of three to six weeks lengths. They were permitted to :

- Polish the coronal portions of teeth without instrumentation.
- Make impressions for study models.
- Topically apply caries preventive agents.
- Place and remove rubber dams
- Maintain a patients oral hygiene.

Dental hygienist:

A student had to be a certified or a preventive dental assistant. The eight month training program allowed them to,

- Carry out scaling
- Conduct a preliminary examination of the oral cavity including taking a case history, a periodontal examination and recording clinical findings.
- Provide a complete prophylaxis including

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scaling, root planing and polishing of fillings.
- Apply and remove a periodontal pack.
- Apply fissure sealants.

Dental hygienist with expanded duties:

Training of 4 months duration was given to dental hygienists who had atleast one year's practical experience. They were allowed to carry out,

- Removing sutures
- Placing, finishing and polishing restorations of amalgam and resin.
- Placing and removing matrix bands.
- Placing cavity liners
- Retracting gingiva for impression making.
- Fitting and removing orthodontic bands.
- Separating of teeth prior to banding by a dentist.
- Cementing temporary crowns previously fitted by a dentist.
- Placing temporary fillings

FRONTIER AUXILIARIES

In developed countries, dentists remain in the urban centers and a large number of areas are too distant from public or private dental offices for the inhabitants to receive regular comprehensive care or emergency pain relief.

Nurses and former dental assistants can in such areas, provide valuable service with the minimum of training. Simple dental prophylaxis can be performed, basic dental health education can be provided, dental first-aid can be rendered in cases with pain and patients can be referred to the nearest dentist more intelligently than would be possible by untrained people. They can also organize fluoride rinse programs and perform simple denture repairs.

In 1981, a one-week training program was conducted for frontier auxiliaries in Alaskan communities, 40 or more miles from the nearest dentist. Two years later, case reports from two of the communities showed that a large variety of simple dental problems had been solved and intelligent references had been made to urban dentists for elective work.

NEW AUXILIARY TYPES

The expert committee on auxiliary dental personnel of the WHO (1959) has suggested two new types of dental auxiliaries:

- The dental licentiate
- The dental aide.

Dental licentiate :

He is a semi-independent operator, trained for 2 years to perform.

- Dental prophylaxis.
- Cavity preparations and fillings of primary and permanent teeth.
- Extractions under local anesthesia
- Drainage of dental abscesses.
- Treatment of the most prevalent diseases of supporting tissues of the teeth.
- Early recognition of more serious dental conditions.

They are responsible to the chief of the regional or local health service. Their service would probably occur in rural or frontier areas and so, supervision and control would probably be remote.

Dental aide :

This type of auxiliary personnel performs duties which include, elementary first - aid procedures for the relief of pain, including :

- Extraction of teeth under local anesthesia
- Control of hemorrhage
- Recognition of dental disease which is important enough to justify transportation of the patient to a center where proper dental care is available.

They would operate only within a salaried health organization and be under supervision, the closer the better, particularly at first. The formal training extends from 4 to

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6 months, followed by a period of field training under direct and constant supervision.

These new auxiliaries are particularly useful in some countries, having acute dentist shortage, with no facilities for training dentists.

DEGREES OF SUPERVISION OF AUXILIARIES

ADA (1975) defined four degrees of supervision of auxiliaries, with the assumption that ultimate responsiblity was assumed by the licensed dentist.

1. General supervision :

The dentist has authorized the procedures and they are being carried out in accordance with the diagnosis and treatment plan completed by the dentist.

2. Indirect supervision :

The dentist is in the dental office, authorizes the procedure and remains in the dental ofice while the procedures are being performed by the auxiliary.

3. Direct supervision :

The dentist is in the dental office, personally diagnoses the condition to be treated, personally authorizes the procedure and before dismissal of the patient, evaluates the performance of the dental auxiliary.

4. Personal supervision :

The dentist is personally operating on a patient and authorizes the auxiliary to aid treatment by concurrently performing supportive procedures.

DENTAL MANPOWER IN INDIA

Poised to become the world's most populous nation by 2040, India faces daunting challenges - huge burdens of disease, lack of needed medical care in many regions, and a dearth of public health professionals.

India has about 272 dental institutions, producing 25,000 to 30,000 BDS graduates every year. In 2004, the dentist to population ratio in India was 1:30,000. But with a significant geographic imbalance among dental colleges, there has been a great variation in the dentist to population ratio in rural and urban areas.

India (in 2004) had one dentist for 10,000 persons in urban areas and about 2.5 lakh persons in rural areas. Almost three-fourths of the total number of dentists are clustered in the urban areas, which houses only one-fourth of the country's population. This is in great contrast to the physician population ratio, which was 1:2,400 in 2000 and 1:1,855 in 2004.

In 1990 there were 3,000 registered hygienists and 5,000 laboratory technicians in India. This implies that the service of one hygienist was available to seven dentists, and one laboratory technician renders service to four dentists, whereas it should ideally be a 1:1 ratio.

CONCLUSION

India is the seventh largest country of the world. The population has risen from 850 million in 1990 to 1,148 million in 2008. At this point of time, it is worth-while to assess the ability of the dental workforce in India to adequately and efficiently provide dental care to a population growing in size and diversity. The need of the hour is to develop an effective dental care delivery system which is equitably distributed, with a well - qualified, dedicated work force.

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Chapter 17

FINANCE IN DENTAL CARE

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INTRODUCTION

MECHANISM OF PAYMENT FOR DENTAL CARE

- PRIVATE FEE - FOR - SERVICE
- POST PAYMENT PLANS
- PRIVATE THIRD - PARTY PREPAYMENT PLANS
  - COMMERCIAL INSURANCE COMPANIES
  - NON PROFIT HEALTH SERVICE CORPORATIONS
  - PREPAID GROUP PRACTICE
  - CAPITATION PLANS
- SALARY
- PUBLIC PROGRAMS

PAYMENT FOR DENTAL HEALTH SERVICES IN INDIA

CONCLUSION

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INTRODUCTION

Health care services traditionally have been provided on a fee-for-service basis whereby the patient receives specific services and pays the provider for them directly. As the costs of health care continue to rise, the majority of the people cannot afford dental treatment, especially when it is being provided on a fee-for-service basis. Methods have to be sought to ease costs either by legislation or by the development of a variety of funding approaches. Dental personnel owe it to themselves and to their patients to develop the clearest possible understanding of the social forces at work in this complex situation.

MECHANISM OF PAYMENT FOR DENTAL CARE

The mechanisms by which dental practitioners receive payment for their services can be grouped into,

1. Private fee - for - service
2. Post payment plans
3. Private third - party prepayment plans
   a) Commercial insurance companies
   b) Non profit health service corporations
      E.g. Delta dental plans
      Blue cross / Blue shield
   c) Prepaid group practice
   d) Capitation plans
4. Salary
5. Public programs

PRIVATE FEE - FOR - SERVICE

Private fee-for-service, the two-party arrangement, is the traditional form of reimbursement for dental services. Dentists overwhelmingly prefer to practice under this arrangement and this is considered as the most efficient way of providing dental care. Fee-for-service care is an integral part of private practice as a delivery method.

Advantages :

1. It is culturally acceptable.
2. This system is flexible - Fees can be changed in accordance with market conditions and the dentist is also able to practice what is called "price discrimination".
3. It is administratively simple - Since dentists need not keep a written list of fees for procedures.
4. It is the only system under which some form of dental care likely will ever be provided.

However, despite the flexibility and price discrimination, there are still some potential patients who cannot afford dental care. These persons would thus be unable to receive dental care if private - fee - for - service were the only financing mechanism available for dental care.

POST PAYMENT PLANS

Post payment or budget payment plans are mechanisms for the individual purchase of service. While dentists have frequently arranged to allow payment for dental care to be made at intervals over a period of time, the first step to offer this service through an organized dental society plan were taken in the late 1930's by local dental societies in Pennsylvania and Michigan.

Under the budget payment plan, the patient borrows money from a bank or finance company to pay the dentist's fee. After the application is approved by the lending institution, the dentist is paid the entire fee. The patient then repays the loan to the bank in budgeted amounts.

At the time that they had been developed, it was hoped that this plan would benefit large segments of the population, but they have not done so. This plan was used primarily by people in the middle income group rather than in the lower income group. The problems were associated with defaulted loans and low income patients would also have more difficulty being accepted as credit worthy by lending institutions.

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PRIVATE THIRD PARTY PREPAYMENT PLANS

It is defined as "payment for services by some agency rather than directly by the beneficiary of those services". The dentist and the patient are the first and second parties and the administrator of finances is the third party, defined as the party to a dental prepayment contract that may collect premiums, assume financial risk, pay claims and provide administrative services. The third party is also known as the carrier, insurer, underwriter or administrative agent. Usually the term "third party" refers to a private carrier such as an insurance company.

Insurance principles and dental care

Earlier dental care was considered uninsurable by carriers. This reasoning was based on the assumption that the very nature of dental need violated the basic principles of insurance. To be insurable, a risk must,

1. Be precisely definable
2. Be of sufficient magnitude that if it occurs, it constitutes a major loss
3. Be infrequent
4. Be of an unwanted nature
5. Be beyond the control of the individual
6. Not constitute a "moral hazard".

All health insurance violates some of these principles, since illness is not predictable for the individual and health care is usually a wanted service.

Insurance company have found that dental insurance can be made more feasible by:

1. Have patient share the cost
2. Limit the range of services available
3. Offering services only to groups
4. Include "waiting period" after enrollment before benefits become payable
5. Use preauthorization and annual expenditure limits

Preauthorization is a process wherein the dentist is required to submit the treatment plan to the insurer for review before the treatment begins. This helps in certifying that the patient's insurance covers the planned treatment. It also helps the dental consultant of the company to review the appropriateness of the proposed treatment.

Different types of payments offered by the insurer are,

- Deductible
- Co - insurance
- Group insurance

Deductible :

It is a stipulated flat sum that the patient must pay toward the cost of treatment before the benefits of the program go into effect. It is sometime called "front-end-payment".

Co - Insurance :

It is also called as "co-payment". It means that the patient pays a percentage of the total cost of treatment. Insurance carriers limit the range of health care services covered. This is termed, "limitation of benefits". Co-insurance helps keep premiums down.

Co-insurance is defined as "an arrangement under which a carrier and the beneficiary are each liable for a share of the cost of the dental services provided"

E.g.: A patient has to pay 20% of the cost of hospital care, the remaining 80% will be paid by the insurance company.

Group Insurance :

This is health insurance offered only to groups. This is because illness experience is reasonably predictable in a group. The probability of adverse selection is also reduced by the use of waiting periods after enrollment before any benefits become available. The waiting period ensures that

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persons with existing disease are not simply going to use the plan to have that disease treated and then drop out.

Reimbursement of dentists in prepayment plans

The ADA has consistently supported the concept of Usual, Customary and Reasonable (UCR) fee as the preferred method for reimbursement for dentists in prepayment plans. Apart from UCR fees, the only other form of payment plans is the table allowances.

- **Usual fee :** The fee usually charged for a given service by an individual dentist to private patients i.e., his or her usual fee.
- **Customary fee :** A fee is customary when it is in the range of the usual fee charged by dentists of similar training and experience for the same service within the specific and limited geographic area.
- **Reasonable fee :** A fee is reasonable if it meets the above two criteria or if it is justifiable considering the special circumstances or the particular patient in question.
- **A table of allowances :** is defined as a list of covered services that assigns to each service a sum that represents the total obligation of the plan with respect to payment for such service but that does not necessarily represent a dentist's full fee for that service. If the dentist's fee becomes more than that assigned to that service by the carrier, the remainder will be collected by the dentist from the patient. This method of reimbursement is not entirely satisfactory because the patients are often unaware that the plan may not cover them in full for dental care.

COMMERCIAL INSURANCE COMPANIES

Characteristics :

- They can be more selective about the group to which it chooses to offer dental insurance.
- They claim no obligation toward the dental health of the community.
- They sometimes arrange an indemnity program that provides specific cash payment reimbursement for specified covered services.
- Commercial insurance companies organize their levels of reimbursement differently.
- Commercial companies do not conduct fee audits and post treatment dental examinations

Commercial insurance companies can compete successfully because their expertise in promotion and marketing allows them to present attractive total health package plans to potential purchasers. Their large financial reserves also allow them, if necessary, to offer a reduced dental premium to a particular group as a "loss-leader" in order to get a toe hold on the market. However, since they operate for profit, they charge higher premiums.

Commercial insurance companies in India have now started providing insurance for dental procedures which do not require hospitalization.

NON PROFIT HEALTH SERVICE CORPORATIONS

Delta Dental Plans

Delta dental plan is synonymous with Dental Service Corporation. A dental service corporation is a legally constituted non-profit organization incorporated on a state-by-state basis and sponsored by a constituent dental society to negotiate and administer contracts for dental care. They are usually subject to the

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insurance laws of the state in which they are constituted.

The National Association of Dental Service Plans (NADSP) was formed in June 1966 with the help from ADA. The NADSP changed its name to Delta Dental Plans Association in April 1969.

The underlying philosophy of the Delta dental plans is that the dental practitioners can adapt their traditional patterns of practice to meet the demand for group purchase of dental care. The majority of the board of directors of Delta plans are dentists. Other board members represent the worlds of finance, insurance and consumer groups.

Delta plans have specific approaches to ensure the quality of care provided and to keep a program's cost within its limits. Quality of care is monitored to ensure that,

- The care claimed and paid for has in fact been provided.
- It is of "acceptable" quality.

Reimbursement of dentists in Delta plans :

Delta dental plans almost exclusively use the UCR concept. The way in which a dentist is reimbursed depends on whether the dentist is participating or non-participating in the plan. A participating dentist is defined as any duly licensed dentist with whom a Delta plan has a contractual agreement to render care to covered subscribers.

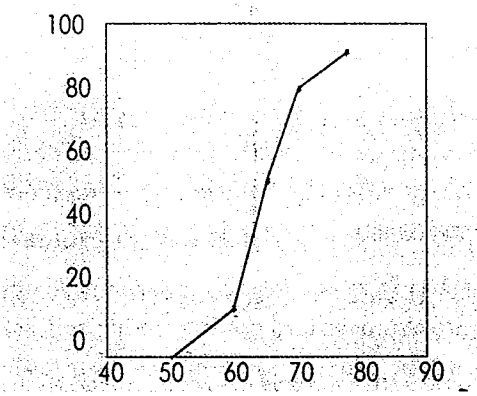
Dentists participating in the plan have to agree to the following conditions,

1. Pre-filing of their usual and customary fees.
2. Acceptance of payment for their services at 90th percentile of fees as payment in full.
3. Fee audits by auditors from Delta plan, who may check their office records from time to time. The purpose is to ensure that the dentists are indeed charging their Delta plan patients the same fees as they charge their other patients.
4. Post-treatment inspection of randomly chosen patients to monitor the quality of care.
5. The withholding of a small amount of each fee to go into the Delta capital reserve fund.

Non-participating dentists can also treat patients covered under Delta dental plan. They are paid at a considerably lower percentile than the 90th, often at the median or 50th percentile. They however do not need to prefile their fees and are not subject to fee audits.

The 90th percentile:

Suppose in an area there are1000 participating dentists. Their fees range from Rs. 50 - Rs. 90 for an oral prophylaxis. Then we plot a graph with the fees in the X- axis and the percentiles in the Y-axis. The percentiles of a data set divide the total frequency into hundredths, so that 90th percentile is that value below which 90% of the observations lie.



The figure shows
About 10% of dentists charge Rs.60 or less
About 50% of dentists charge Rs.65 or less
About 80% of dentists charge Rs.70 or less
About 90% of dentists charge Rs.78 or less

When payment is made at the 90th percentile, it means that a payment of Rs. 78 or their actual fee (whichever is less) is paid to the participating dentists. A dentist charging

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more than Rs. 78 will get only Rs. 78.

When payment at 50th percentile is made to the non-participating dentists, it means that the dentists get Rs. 65 or their actual fee whichever is less.

In comparison to the giants of the commercial insurance world, the Delta plans are small. Yet they have managed to grow to a healthy state and to compete successfully in a highly competitive market place.

Blue Cross / Blue Shield

These non profit health service corporations have for years offered limited dental coverage as a part of medical policies. Dental coverage was usually limited to services provided in a hospital. Health service corporations showed no enthusiasm for going any further into dental prepayment on the grounds that it was a poor insurance risk, but their attitude changed once dental prepayment was shown to be feasible.

Blue Cross / Blue Shield dental plans have adopted many of the cost control features pioneered by Delta plans.

PREPAID GROUP PRACTICE

It is the term given to a group practice that provides dental services on a prepaid basis. Such groups are now generally regarded as open panels.

ADA (1969) has defined group practice as "Group practice is that type of dental practice in which dentists, sometimes in association with the members of other health professions agree formally between themselves on certain central arrangements designed to provide efficient dental health service".

Types of group practice:

- General practice groups composed entirely of general practitioners.
- Single speciality groups where all members of the group are of the same speciality.
- Multi- speciality groups where certain practitioners in two or more speciality fields of practice.

The advantages for the dentist who practices in a group are,

1. It provides better ways of organizing one's life i.e., vacations and continuing education can be planned more readily because colleagues in the practice can temporarily care for a dentist's patients during that time.
2. There is less disruption in the practice caused by illness to a dentist.
3. Quality of care is said to be improved because of the built-in peer review.
4. Financial fringe benefits such as sick leave and pension plans can be built into a group organization more readily, thus easing the day-to-day economic concerns of dental practice.

Most group practices treat patients on the traditional fee-for-service basis and only a few administer prepaid programs. Some of these group practices operate as closed panels.

Closed-panel practice under a prepayment plan is defined by the ADA as existing if patients eligible for dental services in a public or private program can receive these services only at specified facilities from a limited number of dentists.

It has been charged that closed-panel clinics are unethical and that they deliver care of inadequate quality. However, others are of the opinion that dentistry's opposition to closed panels is because dentists are more concerned about the possible loss of their patients to the closed panel.

Health Maintenance Organizations (HMO)

An HMO is defined as " a legal entity which provides a prescribed range of health services

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to each individual who has enrolled in the organization, in return for a prepaid, fixed and uniform payment".

The four principles that characterize an HMO are,

(1) An organized system of health care that accepts the responsibility to provide or otherwise assure the delivery of (2) an agreed-upon set of comprehensive health maintenance and treatment services for (3) a voluntarily enrolled group of people in a geographical area and (4) is reimbursed through a pre-negotiated and fixed periodic payment made by or on behalf of each person or family enrolled in the plan.

An organized system :

An HMO must be capable of bringing together, directly or arranging for, the services of physicians and other health professionals with the services of inpatient and outpatient facilities for preventive and other care as well as any other health services that a defined population might reasonably require. The system promises continuity for the enrolled population through linkages between the components of organization.

Comprehensive health maintenance and treatment services:

The HMO must be capable of providing or organizing for the provision of the health services that a population might require including primary care, emergency care, hospital care and rehabilitation. Primary care, one of the keystones of the HMO, emphasizes those services aimed at preventing the onset of illness or disability, at the maintenance of good health and at the continuing evaluation and management of early complaints, symptoms, problems and the chronic aspects of disease. Primary care may be more graphically described as, "personal physician care or the entry point into the system, from which referrals to specialists are made.

The consumers and the HMO agree on which services will be purchased from the HMO in return for the prepayment figure.

An enrolled group :

Members of the HMO are those people who voluntarily join the HMO through a contract arrangement in which the enrolled agrees to pay the fixed monthly or other periodic payment to the HMO. Enrollees agree to use the HMO as their principal source of health care if they become ill or need care.

Reimbursement:

HMO's use a prepaid capitation system of financing medical services. Only a small proportion of HMO's offers dental services.

Dental Personnel in HMO's :

1. The staff model.
2. The group model.
3. The independent practice association (IPA).
4. The primary care capitated network or direct contract model.

The Staff Model :

In this model, dentists, dental hygienists and dental assistants are salaried employees of the HMO. There may or may not be a dental director.

The Group Model :

Here the HMO contracts directly with a group practice, partnership or corporation for the provision of dental services. The group concerned receives a regular capitation premium from the HMO. The payment to the individual dentists is usually not affected by the HMO contract, though the amount may be.

The Independent Practice Association (IPA) :

It is an association of independent dentists or

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physicians that develops its own management and fiscal structure for the treatment of patients enrolled in an HMO. The IPA can also contract with other prepaid agencies such as Delta Plans, to provide dental services to specific groups on a capitation basis. The ADA considers the IPA to be an open panel, since all dentists in a community are supposedly free to join. However, in practice, the IPA may be selective. Dentists remain in their own offices and continue to treat their patients. The IPA receives its capitation premium from the HMO or any other prepayment agency and in turn reimburses the individual dentists on either a modified fee-for-service basis or a capitation basis. In many instances, the dentist is "at risk" to provide the specified services.

Primary Care Capitated Network :

The network is similar to IPA, except that the HMO contracts directly with the individual provider for provision of service. The provider again is 'at risk'.

CAPITATION PLANS

The basis of capitation is that the contracting provider, whether an HMO, group practice, IPA or individual dentist receives an established, negotiated sum on a monthly or yearly basis for each eligible patient. The money is paid regardless of whether the patients utilize care or not. In return, the patient is entitled to receive a prescribed set of services over a specified period.

Apart from the development of HMO's, other third-party carriers and even private entrepreneurs are becoming involved in the marketing of capitation plans. Some have 'open enrollment' meaning that plans are not purchased by specified groups but that an individual can 'buy in'. Many of these plans offer only limited services (such as examination, prophylaxis, radiographs and treatment plan) and may be more saleable to participating dentists because the risk assumed is low. In areas where there is a real or perceived oversupply of dentists, these capitation plans could be attractive to both purchaser and provider.

SALARY

Dentists in some group practices, those in the armed forces and those employed by public agencies are salaried.

Advantages :

- It allows a dentist to be largely free of the business concerns of running a practice, thereby allowing the dentist to concentrate on clinical matters.
- Fringe benefits are also often attractive.

Disadvantages :

- There could be a lack of financial incentive that some dentists need to be highly productive.

PUBLIC PROGRAMS

Private practice is usually not able to meet the dental demands of all the people. There are therefore a number of public programs aimed at meeting the needs of specific groups of recipients in this diverse society. The public programs are sponsored by the government and also include community health centers.

Public financing of dental care :

A) Medicare.
B) Medicaid.
C) National Health Insurance.

Medicare

In the USA, title XVIII of the Social Security Amendments of 1965 is the program known as "Medicare". This program removed all financial barriers for hospital and physician services for all persons aged 65 and over, regardless of their financial means. By the mid-1970's, Medicare had two parts,

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Part A: Hospital Insurance.

Part B: Supplemental Medical Insurance.

Both parts contain a highly complex series of service benefits available and both parts also require some payment by the patient.

Medicare was brought into being because the voluntary health insurance system was unable to provide adequately for persons over age 65. The health insurance industry primarily operates for profit and those over 65 are a high-risk group in terms of general health care needs. Because the income of persons aged 65 and older is considerably less, they have limited funds to spend on health care.

The dental segment of Medicare is limited to those services requiring hospitalization for treatment, usually surgical treatment for fractures and cancer and hence constitutes a negligible proportion of the program.

Medicaid

It is the name given to title XIX of the United States Social Security Amendments of 1965. The original intent of the program was to provide funds to meet the health care needs of all indigent and medically indigent persons.

Medicaid is a joint federal state program covering at least these basic services,

- Inpatient hospital care.
- Outpatient hospital care.
- Laboratory and X-ray services.
- Skilled nursing facility services.
- Home health services for individuals aged 21 years and older.
- Early and periodic screening, diagnosis and treatment (EPSDT) program for individuals under 21 years.
- Family planning services.
- Physician services.

Dental care is not a mandatory service, except for persons under 21years of age (part of the EPSDT program). The ADA supported the EPSDT program, enacted into law in 1968, because for the first time a federal program mandated dental care for indigent children. EPSDT therefore had the potential for bringing into the dental care system, millions of indigent children and youth.

Medicaid is an extremely complex program. The application process to determine eligibility for Medicaid is complicated and confusing to many people. Although the program has reached a large number of people, inevitably there are loopholes. Certain groups such as widows under 65 and families without children have been identified as not being eligible for the benefits of Medicaid. Therefore many needy persons are unable to receive dental care under Medicaid.

National Health Insurance (NHI)

The National Health Insurance was introduced by Bismarck in Germany in the 1880's and in Britain by Lloyd George in 1910. While humanitarianism was a factor in their development, a more powerful stimulus was probably the awareness that a healthy and secure society led to political stability and greater economical and industrial strength.

The NHI is primarily a financing mechanism by which health care services are paid for from a publicly organized fund.

PAYMENT FOR DENTAL HEALTH SERVICES IN INDIA

The different forms of payment for dental health service in India are

1. Fee-for service

A majority of dentists in India provide dental services on a fee for service basis.

2. Dental Insurance

Insurance companies have now started offering dental insurance, which covers not only those dental treatments which require

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hospitalization, but also covers dental check ups, oral prophylaxis, restorations and dental extractions. The premium however, varies with the coverage.

3. Government schemes

Various Government schemes help in providing dental / medical services to Government employees.

Employees State Insurance Scheme (ESI)

In 1948, a scheme by the act of the parliament for the health insurance of factory workers was set in called the ESI act. This was extended to the whole of India covering all industrial employees whose monthly salary does not exceed Rs. 3000/ per month. This provides monetary and medical benefits to industrial employees in case of illness, accidents, occupational injury and maternity benefits. About 85 lakhs of industrial workers are covered under this scheme.

Financing :

1. Employees contribute 1.5% of their salaries
2. Employer contributes 4% of the wage bill of the employees
3. Grant from the state government
4. Grant from the Government of India.

The chairman is the Union minister of labor. The administration is by the ESI corporation. Sometimes the services can be made available from the private medical practitioners called "insurance medical practitioners". Benefits like medical care benefits, sick leave benefits, maternity benefits, disablement benefits, funeral benefits are covered in this scheme.

Central government health scheme (CGHS)

This scheme was established in 1954. Based on the principle of co-operative effort by the employees and the employer for their mutual benefits.

Benefits:

1. Central government employees and families
2. Central government pensioners
3. Member of parliament
4. General public living in vicinity of CGHS dispensaries

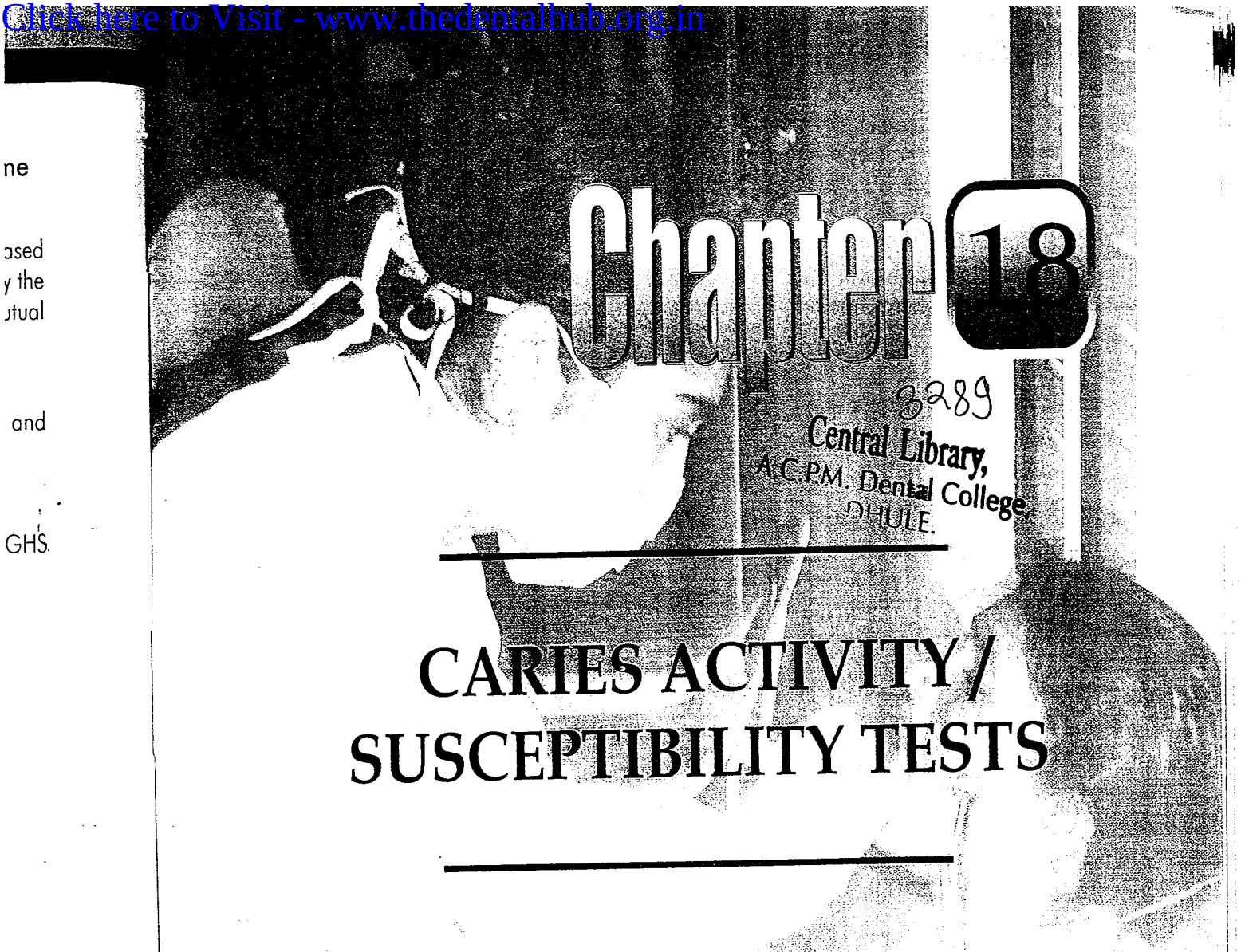
Services offered:

1. Out patient services
2. Lab services
3. Domiciliary services
4. In patient services
5. Specialist services
6. Pediatrics like immunization
7. Emergency
8. Family planning
9. Optical and dental aids

CONCLUSION

The financing of dental care is well developed and well practiced in the developed countries like the U.S. However, In India, fee-for-service is still the most prevalent form of availing dental services. Although free dental services are provided by the government at some of the health centers, it is scarce and inefficient. Dental insurance is in its infancy and with the very high premiums, dental service is still very far from the reaches of the indigent.

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CARIES ACTIVITY / SUSCEPTIBILITY TESTS

INTRODUCTION

IDEAL REQUISITES OF A CARIES ACTIVITY TEST

SOME CARIES ACTIVITY / SUSCEPTIBILITY TESTS

- LACTOBACILLUS COLONY COUNT TEST
- COLORIMETRIC SNYDER TEST
- THE SWAB TEST
- STREPTOCOCCUS MUTANS LEVEL IN SALIVA
- DIPSLIDE METHOD FOR S. MUTANS COUNT
- SALIVARY BUFFER CAPACITY TEST
- SALIVARY REDUCTASE TEST
- ALBAN TEST
- STREPTOCOCCUS MUTANS SCREENING TEST
- FOSDICK CALCIUM DISSOLUTION TEST
- ORA TEST

CONCLUSION

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INTRODUCTION

Caries activity tests have been used in dental research for many years, and some tests have been adapted for routine use in the dental office. "To run a caries preventive program without using microbiological methods, is like running a weight-control program without a scale."

Caries activity refers to the increment of active lesions (new and recurrent lesions) over a stated period of time. Caries activity is a measure of the speed of progression of a carious lesion.

Caries susceptibility refers to the inherent tendency of the host and target tissue, the tooth, to be afflicted by the caries process. This is the susceptibility (or resistance) of a tooth to a caries-producing environment.

Caries activity tests measure the degree to which the local environmental challenge (e.g. dietary effect on microbial growth and metabolism) favours the probability of occurrence of carious lesions.

A caries activity test helps to:

1. Identify high-risk groups and individuals.
2. Determine the need for personalized preventive measures and motivate the individual.
3. Monitor the effectiveness of oral health education programs by establishing an initial baseline level of cariogenic pathogens as a basis for future evaluation
4. Ensure a low level of caries activity before starting any extensive restorative procedure
5. Serve as an index of the success of therapeutic measures by monitoring patient behavior towards reducing the number of S. Mutans and Lactobacilli as part of counseling to curtail sucrose intake.

In a public health program, contrasted to private practice, caries activity tests allows the targeting of those presumed at greatest risk as well as those at least risk.

IDEAL REQUISITES OF A CARIES ACTIVITY TEST: Given by Snyder

1. Should have a sound theoretical basis
2. Should show maximum correlation with clinical status.
3. Should be accurate with respect to duplication of results
4. Should be simple
5. Should be inexpensive
6. Should take little time

SOME CARIES ACTIVITY AND SUSCEPTIBILITY TESTS:

1. LACTOBACILLUS COLONY COUNT TEST

This caries activity test was introduced by Hadley in 1933.

Principle involved:

This test estimates the number of acidogenic and aciduric bacteria in the patient's saliva by counting the number of colonies appearing on tomato peptone agar plates (pH 5.0) after inoculation with a sample of saliva. A selective media favoring the growth of aciduric lactobacilli is the basis for the test.

Procedure:

- The patient chews a small piece of paraffin, before breakfast in the morning. Saliva accumulated in the following 3-min period (5-10 ml) is collected in a sterile container and shaken for 2 minutes to mix it
- Saliva sample is diluted to 1:10 dilution by pipetting 1 ml of the saliva sample into a 9 ml tube of sterile saline solution and shaken
- It is again diluted (1:100) by pipetting 1 ml of the 1:10 dilution into another 9 ml tube of sterile saline solution and mixed thoroughly
- 0.4 ml of each dilution is spread on the

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surface of an agar plate and incubated for 3-4 days at 37°C

- The number of lactobacillus colonies that develop are counted using a colony counter with bright lights and a large magnifying glass or the Quebec counter.

The number of lactobacilli/ml saliva is calculated by multiplying the number of colonies on the plate by the dilution factor of its inoculums.

The Lactobacilli colony counts in saliva as related to caries susceptibility is shown in the table.

0-1000	Little or no activity
1000-5000	Slight activity
5000-10,000	Moderate activity
> 10,000	Marked activity

Disadvantages

1. Inaccurate for predicting the onset of caries.
2. It does not completely exclude the growth of other relatively aciduric organisms.
3. Requires relatively complex equipment
4. It only takes few minutes to do the test, but the results are not available for several days.
5. Counting is a tedious procedure.

2. COLORIMETRIC SNYDER TEST

Snyder devised this Colorimetric caries activity test in 1951.

Principle:

It measures the ability of salivary microorganisms to form organic acids from a carbohydrate medium. The medium contains an indicator dye, Bromocresol green. This dye changes color from green to yellow in the range of pH 5.4 to 3.8. Indirectly this test is also a measure of acidogenic and aciduric bacteria.

Procedure:

- Saliva is collected by chewing paraffin before breakfast in the morning. A tube of Snyder glucose agar is melted and then cooled to 50°C. It is then shaken and 0.2 ml of saliva is pipetted into the tube and thoroughly mixed. The agar is allowed to solidify and then incubated at 37°C

Amount of acid produced by acidogenic organisms is detected by changes in the pH indicator and compared to an uninoculated control tube against a white background after 24, 48 and 72 hours of incubation. The rate of color change from green to yellow is indicative of the degree of caries activity.

The color observations in Snyder's tests is as shown in Table

	Time		
	24 hours	48 hours	72 hours
Color	Yellow	Yellow	Yellow
Caries Activity	Marked activity	Definite activity	Limited activity
Color	Green	Green	Green
Caries Activity	Continue test	Continue test	Inactive

This test essentially estimates the number of both aciduric and acidogenic organisms in saliva because it relies on production of additional acid under already acidic culture condition

Advantages:

1. Relative simple to carry out
2. Cost is moderate

Disadvantages:

1. Time consumed is more.
2. Sometimes the color changes are not very clear.
3. Measures acidogenic potential but is limited in predictive value because these

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salivary microorganisms may not be representative of those in plaque

Snyder's test uses Bromocresol green as indicator, which is blue-green at pH 5.4 or above and turns yellow at pH 3.8 or less. The "critical pH" for enamel dissolution is 5.4 5.5. Therefore, it would be more appropriate to use an indicator such as Bromocresol purple which is purple at pH 6.8 and yellow at pH 5.2.

3.THE SWAB TEST

Grainger et al developed this test in 1965. It has an advantage over other tests in that no collection of saliva is necessary. So it is valuable in evaluating caries activity in very young children.

Principle:

It is based on the same principle as the Snyder's test.

Procedure:

- The oral flora is sampled by swabbing the buccal surfaces of the teeth with a cotton applicator,
- It is subsequently incubated in the medium.

The change in the pH following a 48 hour incubation period is read on a pH meter or the color change is read by the use of a color comparator.

Interpretation :

pH	Caries activity
≤ 4.1	Marked caries activity
4.2 to 4.4	Active
4.5 to 4.6	Slightly active
>4.6	Caries inactive

Advantages:

- The test is of value in predicting caries increments, particularly in children with low or no previous caries experience.
- No collection of saliva is required.

4. S. MUTANS LEVEL IN SALIVA

Principle:

The test measures the number of S. Mutans colony forming units (CFU)/unit volume of saliva by culturing the plaque samples from discrete sites (occlusal fissure/proximal area) for detecting and quantitating S. mutans colonized on teeth. Incubation is done on Mitis Salivarius Agar (MSA) selective streptococcal medium with addition of high concentration of sucrose (20%) and 0.2 U bacitracin/ml (MSB) which suppresses the growth of most non-S.Mutans colonies.

Procedure:

- The sample of organisms is obtained by the use of tongue blades (wooden spatulas)
- They are then pressed against Streptococcus Mutans selective MSB (Mitus Salivarius Bacitracin) Agar in special petri dishes.
- The agar plates are incubated at 37°C for 48 hrs in 95% at 5% CO_2 gas mixture.

Interpretation:

- Levels of Streptococcus Mutans > 10^5 / ml of saliva = unacceptable.
- Colonization of a new surface does not occur readily unless the level of S.Mutans reaches 4.5 x 10^4/ml for smooth surface and 10^3/ml for occlusal fissures.

Advantage:

Since the frequency of isolation of S. Mutans is high prior to initiation of lesions as contrasted to Lactobacilli, this test can be utilized as an adjunct in caries management.

Disadvantages:

- Difficulty of distinguishing between a

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carrier state and cariogenic infection.

- S. Mutans may constitute less than 1 % of total flora of plaque.
- S. Mutans tends to be located at specific sites only.
- Plates have a shelf life of only about a week, therefore not convenient for chairside tests

5. DIP SLIDE METHOD FOR S. MUTANS COUNT

This method was devised for the estimation of Streptococcus Mutans levels in saliva.

Procedure:

- Undiluted paraffin stimulated saliva is poured on a special plastic slide that is coated with MSA (Mitis Salivarius Agar) containing 20% sucrose.
- The agar surface is thoroughly moistened and excess saliva is allowed to drain off.
- Two discs containing 5 µg of Bacitracin are placed on the agar 20 mm apart.

The slide is tightly screwed into a cover tube after inserting a CO_2 tablet and incubated at 37°C for 48 hours in a sealed candle jar.

Evaluation for Dip Slide Method		
1	Low	The colonies are discrete and could be readily counted at 15X magnification with the total count of CFU inside the inhibition zones less than 200
2	Medium	The colonies are discrete and the number in the zone of inhibition is more than 200 at 32 X magnification.
3	High	The colonies are tiny and almost completely or totally cover the inhibition zone with the number of colonies uncountable even with 32 X magnification.

6. SALIVARY BUFFER CAPACITY TEST

Principle:

Buffer capacity can be quantitated using either a pH meter or color indicator. This test measures the number of milliliters of acid required to lower the pH of saliva through an arbitrary pH interval, such as from pH 7.0 to 6.0, or the amount of acid or base necessary to bring color indicators to their end point.

Equipment: The needed equipments include a pH meter, titration equipment, 0.05 N lactic acid, 0.05 N base, paraffin, and sterile glass jars containing a small amount of oil.

Procedure:

- Ten ml of stimulated saliva is collected under oil at least 1 hour after eating
- 5 ml of this is measured into a beaker. After correcting the pH meter to room temperature, the pH of saliva is adjusted to 7.0 by addition of lactic acid or base.
- Lactic acid is then added to the sample until a pH of 6.0 is reached.
- The amount of lactic acid needed to reduce the pH from 7.0 to 6.0 is a measure of buffer capacity. This number can be converted to milli equivalents per litre.

Evaluation:

There is an inverse relationship between buffering capacity of saliva and caries activity. The saliva of individuals whose mouths contain a considerable number of carious lesions frequently have a lower acid-buffering capacity than the saliva of those who are relatively caries free.

Advantage:

Simple to carry out

Disadvantage:

Does not correlate adequately with caries activity

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7. SALIVARY REDUCTASE TEST:

Principle:

This test measures the activity of the reductase enzyme present in salivary bacteria.

Procedure:

- Saliva is collected by chewing paraffin and expectorated directly into the collection tube
- The sample is then mixed with the dye Diazo-resorcinol
- The "Caries Conduciveness" reading or color change is done after 15 minutes. No incubation procedures are required.

Evaluation:

The evaluation is based on the color change and the caries conduciveness is related to as mentioned below.

Advantages:

- No Incubation required
- Quick results

Disadvantage:

- Test results vary with time after food intake and after brushing

8. ALBAN TEST

It is a simplified substitute for the Snyder test.

Main features :

1. Use of a somewhat softer medium that permits the diffusion of saliva and acids without the necessity of melting the medium.
2. Use of a simpler sampling procedure in which the patient expectorates directly into tubes that contain the medium.

- To prepare the Alban test medium, the following materials are required:
- Snyder test agar
- A small scale to measure 60 grams.
- A 2 litre Pyrex glass to melt the medium.
- A funnel to dispense the medium into test tubes.
- Hundred 16 mm test tubes with screw caps.

Procedure:

- 60 grams of Snyder test agar is placed in 1 liter of water and the suspension is brought to a boil over a low flame.
- When thoroughly melted, the agar is distributed using about 5 ml per tube.
- These tubes should be autoclaved for 15 minutes, allowed to cool and stored in a refrigerator.
- 2 tubes of Alban medium are taken from the refrigerator and the patient is asked to expectorate a small amount of saliva directly into the tubes.
- The tubes are labeled and incubated at 98.6°F (37°C) for up to 4 days.

The tubes are observed daily for:

1. Change of color from bluish green (pH 5) to definite yellow (pH 4 or below).
2. The depth in the medium to which the change has occurred.

Blue	15 minutes	1	nonconducive
Orchid	15 minutes	2	slightly conducive
Red	15 minutes	3	moderately conducive
Red	immediately	4	highly conducive
Pink/White	immediately	5	extremely conducive

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The daily results collected for a 4 day period should be recorded on the patient's chart. The following method is used for final recordings, after 72 or 96 hours of incubation:

1. Readings negative for the entire incubation period are labeled " negative "
2. All other readings are labeled " positive " whether +, + +, + + + or + + + +.
3. Slower change or less color change (compared to previous test) is labeled " improved ".
4. Faster change or more pronounced color change (compared to previous test) is labeled " worse ".
5. When consecutive readings are nearly identical, they are labeled " no change ".

Scale for Scoring :

No color change	¾
Beginning color change	+
(from top to medium down) One half color change	++
(from top down) Three fourths color change	+++
(from top down) Total color change to yellow	++++

Advantages:

1. Simple
2. Low cost
3. Diagnostic value when negative results are obtained.
4. Its motivational value (ideal for education).

Disadvantages:

1. More armamentaria required
2. Based on subjective evaluation of a color change that may not be clear cut

Composition of media used for Snyder and Alban tests:

- Bacto peptone 20 gms
- Dextrose 20 gms
- Sodium chloride 5 gms
- Agar 16 gms
- Bromocresol green 0.02 gms

9. STREPTOCOCCUS MUTANS SCREENING TEST

A. Plaque / tooth pick method:

Action:

The test involves a simple screening of diluted plaque sample streaked on a selective culture media.

Equipment:

Sterile tooth picks, Sterile Ringer's solution (5ml), Platinum Loop, Mitis Salivarius Agar plates (MSA) containing sulphadimetine, incubator

Procedure:

- Plaque samples are collected from the gingival thirds of buccal tooth surfaces one from each quadrant and placed in Ringer's solution.
- The sample is shaken until homogenized.
- The plaque suspension is stretched across MSA plates.
- After aerobic incubation at 37°C for 72 hours, cultures are examined and total colonies in 10 fields are recorded.

This test is an attempt to semi-quantitatively screen the dental plaque for a specific group of caries inducing Streptococci Mutans.

B. Saliva / Tongue blade method

Action:

This test estimates the number of S. Mutans in mixed paraffin-stimulated saliva when cultured in Mutans Salivarius Bacitracin (MSB) agar. This was developed for use in large number of school children.

Equipment:

Paraffin wax, sterile tongue blades,

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disposable contact Petri dish containing MSB agar, incubator.

Procedure:

- The subjects chew a piece of paraffin wax for one minute to displace plaque microorganisms, thereby increasing the proportions of plaque microorganisms in saliva.
- Sterile tongue blades are then rotated in the patients' mouth 10 times so that both the sides are thoroughly inoculated by the oral flora.
- It is then pressed onto MSB agar in a disposable contact petri dish.
- Incubation is done at 37°C. For field studies, the plates can be plastic bags containing expired air, which are then sealed and incubated at 37°C.

Counts of more than 100 colony forming units by this method are proportional to greater than 10 colony forming units of S. Mutans per ml of saliva by conventional methods.

Advantages:

- This is a simplified and practical method for field studies
- Avoids the necessity of collecting saliva.
- It requires no transport media/dilution steps.

10. FOSDICK CALCIUM DISSOLUTION TEST

Principle:

This test measures the milligrams of powdered enamel dissolved in 4 hours by acid formed when the patient's saliva is mixed with glucose and powdered enamel.

Procedure:

- Saliva is stimulated by having the patient chew gum or paraffin. 25 ml of this saliva is collected and part of it is analyzed for calcium content.
- The remaining saliva is placed in an 8-inch sterile test tube with about 0.1 gm of powdered human enamel.
- The tube is sealed and shaken for 4 hours at body temperature, after which it is again analyzed for calcium content.

The chewing of gum to stimulate the saliva produces sugar. If paraffin is used, a concentration of about 5% glucose is added. The amount of dissolution increases as the caries activity increases.

Advantages:

- In limited studies, the correlation reported is good.

Disadvantages:

- The test is not simple and requires complex equipment.
- The test is expensive and requires trained personnel.

11. ORA TEST

This test was developed by Rosenberg et al in 1989 for estimating oral microbial levels.

Principle:

It is based on the rate of oxygen depletion by microorganisms in expectorated milk samples. In normal conditions the bacterial enzyme, aerobic dehydrogenase transfers electrons or protons to oxygen. Once oxygen gets utilized by the aerobic organisms, methylene blue acts as an electron acceptor and gets reduced to leucomethylene blue. This reflects the metabolic activity of the aerobic organisms.

Equipment:

Sterile beakers, sterilized milk, screw cap test tubes, 0.1% aqueous solution of methylene blue, 10ml disposable syringes, pipette,

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mirror, stopwatch and test tube stand

Procedure:

- Mouth is rinsed vigorously with 10 ml of sterile milk for 30 seconds and the expectorate is collected
- 3 ml of this is transferred to the screw cap tube with the help of a disposable syringe.
- To this, 0.12 ml of 0.1 % methylene blue is added, thoroughly mixed and placed on a stand in a well illuminated area
- The tubes are observed every 10 minutes for any color change at the bottom using a mirror.
- The time taken for the initiation of color change within 6 mm ring is recorded.

The higher the infection, lesser was the time taken for the change in color of the expectorate reflecting higher oral microbial levels.

Advantage:

- Less time consuming
- Economic
- Non-toxic vehicle
- Can be easily learnt by auxiliary personnel

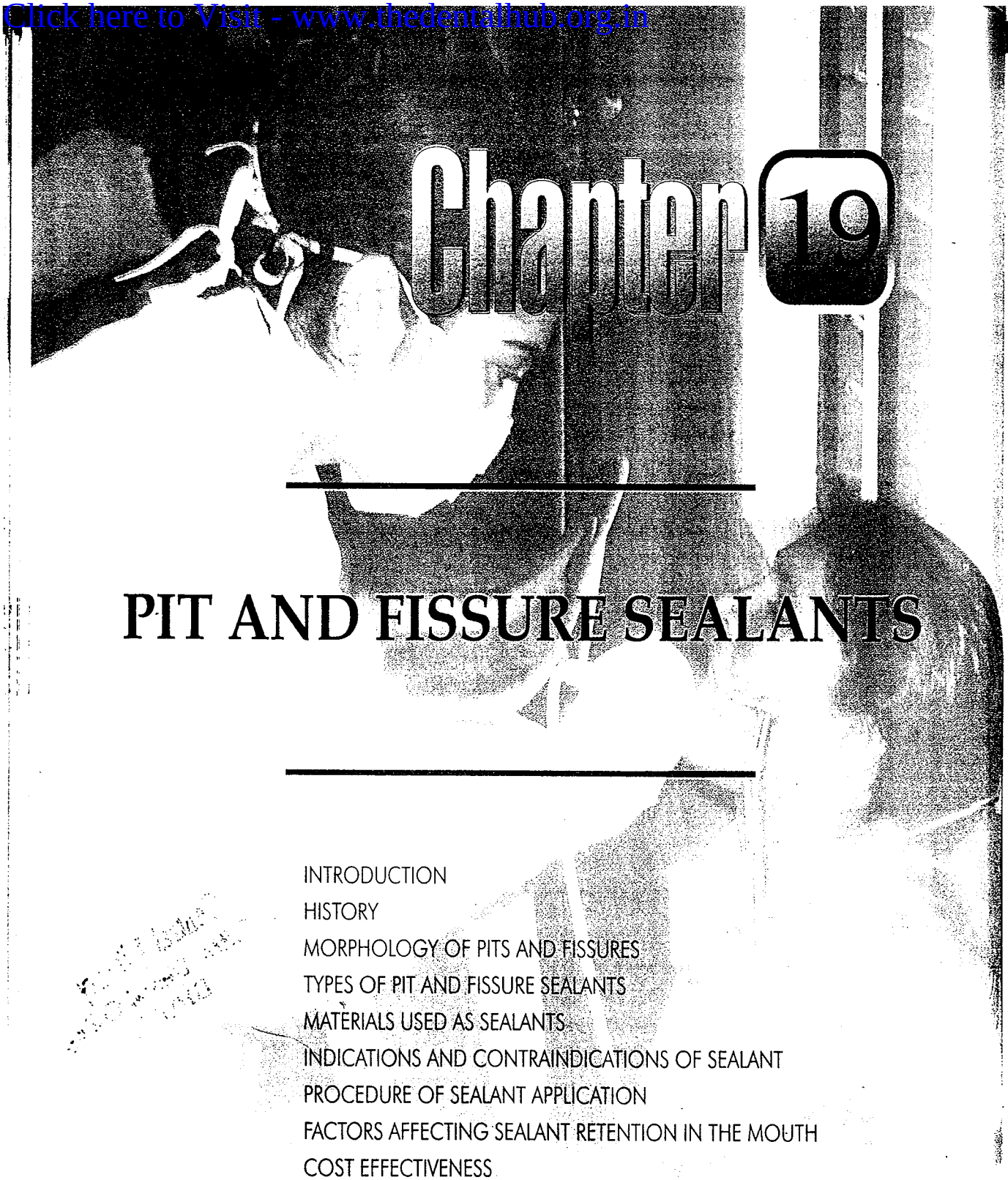
Disadvantage:

Lack of specificity

CONCLUSION

None of the tests are highly reliable as indicators of expected caries increments. This is not unexpected since caries activity tests measure a single parameter such as acid produced or colony counts of bacterial species. However, dental caries is a multi-factorial disease and caries predictive tests do not encompass all those factors involved in determining caries resistance such as fluoride exposure, maturation of enamel or immune protection. The limitations inherent in a single functions caries activity tests are clear. This is the reason why the best predictor of expected caries activity has resulted from the combined use of several selected tests.

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Chapter 19

PIT AND FISSURE SEALANTS

INTRODUCTION
HISTORY
MORPHOLOGY OF PITS AND FISSURES
TYPES OF PIT AND FISSURE SEALANTS
MATERIALS USED AS SEALANTS
INDICATIONS AND CONTRAINDICATIONS OF SEALANT
PROCEDURE OF SEALANT APPLICATION
FACTORS AFFECTING SEALANT RETENTION IN THE MOUTH
COST EFFECTIVENESS
PREVENTIVE RESIN RESTORATIONS (PRR)
CONCLUSION

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INTRODUCTION

For the past several decades, a significant decline in the prevalence of dental caries in children in the developed countries has been well documented. Although only 12.5 percentage of all tooth surfaces are occlusal, these surfaces develop more than two-thirds of the total caries experience of children. Caries potential is directly related to the shape and depth of the pits and fissures. The success of fluorides in caries prevention on smooth tooth surfaces has made caries primarily a disease of pits and fissures of teeth. Narrow isolated crevices and grooves that harbour food and microorganisms are the most important anatomical features leading to the development of occlusal caries.

HISTORY

Attempts to prevent caries attack have been reported from the beginning of the 20th century,

1905: Application of silver nitrate by Miller

1922: Hyatt advocated the term 'Prophylactic Odontotomy' and published the same in 1923. He advocated filling the fissures of teeth with silver or copper oxyphosphate cement as soon as the teeth erupted and then later, when they were fully into the mouth preparing a small occlusal cavity and filling it with silver amalgam.

1929: Bodecker suggested widening the fissures mechanically so that they would be less retentive to food particles and called it as 'Fissure Eradication'.

1955: Buonocore introduced a method of adhering resin to an acid-etched enamel surface.

1962: Bowen and associates developed the Bis-GMA resin, which is the chemical reaction product of Bisphenol A and Glycidyl methacrylate.

MORPHOLOGY OF PITS AND FISSURES

Pits and fissures are enamel faults; narrow shafts or cracks at some length whose blind ends are directed more or less towards the DEJ.

Pits are small pin point depressions located at the junction of developmental grooves or at terminals of those grooves whereas fissures are long clefts between cusps or ridges.

Pits and fissures are of two types: a shallow, wide V-shaped fissure and a deep, narrow I shaped fissure, that is quite constricted and may resemble a bottle neck as it extends towards the dentino-enamel junction. These fissures may also have a number of different branches.

Types of fissures,

1) V Type & U Type

- Are shallow and wide and tend to be self cleansing and somewhat caries resistant.
- Non invasive technique is recommended.

2) I Type

- Is deep, narrow and quite constricted, resembling a bottle neck.
- Are caries susceptible
- Requires invasive technique

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TYPES OF PIT AND FISSURE SEALANTS

1. Based on curing method

First generation - polymerized with ultra violet light of 350 nm wave length. Absorbs U.V light excessively and prevents complete polymerization of the sealant. Light intensity varies from lamp to lamp

Second generation - self cured or chemically cured. Most of them were unfilled. Can be transparent, opaque or tinted. Filled show increased wear and abrasion resistance than unfilled

Third generation - visible light cured of

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430-490 nm wave length. May be unfilled (usually white) or filled (usually clear)

Fourth generation - with addition of fluoride for added benefit

2. Based on presence of filler
   - Unfilled - better flow
   - Semifilled - strong and resistant to wear
3. Based on color
   - Tinted - for easy identification
   - Clear - difficult to detect
   - Opaque - for easy identification
   - Pink (Fuji VII, G.C Company) - better fluoride release

MATERIALS USED AS SEALANTS

a) Cyanoacrylates:

- Discovered in late 1950's
- Used as surgical adhesive and tooth sealants
- In presence of traces of moisture they polymerize rapidly to hard and brittle polymers on etched tooth surface.
- Mechanical durability is not satisfactory and they are not biodegradable. Hydrolysis to potentially toxic materials occurred, as initially methyl cyanoacrylate was used. This was later replaced by butyl and isobutyl ester which was found to be more stable.

b) Poly urethanes:

Eg: Epoxylite (contain 10% sodium mono fluoro phosphate with liquid polyurethane and utilizes citric acid as etchant).

Not regularly used due to poor mechanical properties and oral durability and toxicity

c) Dimethacrylates:

- Methyl Methacrylate (MMA) is highly volatile and lacks penetration
- Enamite, a new sealant utilizes MMA-PMMA (Poly Methyl Methacrylate) system initiated by butyl boron. It binds better and is less affected by immersion in water
- BISGMA is a viscous amber liquid of low volatility diluted with MMA (Ratio of 3: 1) for use as sealant.

d) Glass ionomer:

- Developed by Mc Lean and Wilson
- Hydrophilic, good adhesion, biocompatible, fluoride release
- Used for fissure whose orifice exceeds 100μm.

Pit & Fissure Sealant Products:

- Alpha-Dent Light Cure Pit and Fissure Sealant
- Baritone L3
- Concise Light Cure White Sealant
- Concise White Sealant
- Helioseal F
- Helioseal
- Prisma Shield Compule Tips Tinted Pit and Fissure Sealant
- Prisma Shield VLC Filled Pit and Fissure Sealant
- Seal-Rite
- Seal-Rite Low Viscosity

PROCEDURE OF SEALANT APPLICATION

1. Polish the tooth surface:

It is absolutely necessary to remove plaque and debris from the enamel and the pits and fissures of the tooth. Any debris that is not removed will interfere with the proper etching process and the sealant penetration into the pits and fissures. Polishing can be carried out by using prophylaxis cup & pumice.

2. Isolate and dry the tooth surface:

Rubber dam provides the best isolation. However, it may be impractical to apply it in all circumstances. Whatever method the operator chooses to employ, it is absolutely imperative to keep the tooth free from salivary contamination.

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INDICATIONS AND CONTRAINDICATIONS OF SEALANT

Surface diagnosis	Clinical consideration	Do Seal	Don't Seal
Carious	Occlusal anatomy	If pits and fissures are separated by transverse ridge, a sound pit or fissure may be sealed	Carious pits and fissure
Questionable	Status of proximal surface	Sound	Carious
	General caries activity	Many occlusal lesions, few proximal lesions	Many proximal lesions
Sound	Occlusal morphology	Deep, narrow pit and fissure	Broad, well coalesced pit and fissure
	Tooth age	Recently erupted teeth	Teeth caries free for 4 years or more
	Status of proximal surface	Sound	Caries

3. Acid etching:

Removes organic material and debris from the surface and produces micro pores into which the monomer can penetrate. Degree of etching depends on nature and concentration of acid, duration of exposure, composition and site of enamel. 30-50% Ortho phosphoric acid is used in liquid form for 30-60 seconds using sable hairbrush. Liquid must be replenished every 30 seconds. This allows sealant to penetrate about 50μm of enamel depth.

4. Rinse the tooth:

The tooth should be rinsed for approximately 30 seconds.

5. Isolate and dry the tooth:

The tooth should be dried with compressed air. It is necessary to make sure that the 3-way syringe is free of oil and water. The tooth is dried until it has a chalky, frosted appearance. If it does not, the tooth should be re-etched. Remember that it is imperative to avoid salivary contamination. There is agreement that moisture contamination at this stage of the process is the most common cause of sealant failure.

6. Material application:

The sealant material is then applied to the tooth according to the manufacturer's directions and polymerized. Be careful not to incorporate air bubbles in the material.

7. Evaluate the sealant:

The sealant should be evaluated visually and tactically. Take the explorer and attempt to dislodge it. If there are any deficiencies in the material, more sealant material should be applied.

8. Check occlusion:

Check for occlusal high points and if present correct them. Studies have shown that filled sealants are more likely to require adjustment than unfilled sealants.

9. Retention and periodic maintenance:

It is necessary to re-evaluate the sealants at recall visits. At these visits the integrity of the sealants are evaluated. If there has been any sealant loss, new sealant can be applied over the old material.

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Pit and fissure sealants require:

- Good moisture control when being placed
- Clean surfaces
- Appropriate etching and drying time
- Appropriate coverage of the surface
- Checking occlusion for interferences
- Regular monitoring and maintenance after placement.

The sealant restoration should be:

- Provided to patients with continuing caries risk who have fissure caries just into dentine
- Preferred to amalgam placement as it requires less loss of tooth structure and provides full occlusal protection against caries
- Placed over glass ionomer cement within cut fissures if space allows and monitored and maintained for retention.

FACTORS AFFECTING SEALANT RETENTION IN THE MOUTH

1. Type of sealants
   Studies have shown that the second generation sealants provide superior retention and caries protection than first generation sealants.
2. Position of teeth in the mouth
   Better sealant retention has been reported more for the anterior and in mandibular than maxillary arch
3. Clinical skill of the operator
   More skilled and/or clinically experienced operators also produced better sealant retention
4. Age of the child
   Retention is also compromised in younger children due to difficulties in maintaining a dry field resulting from behavior problems and depending on the eruption status of teeth
5. Eruption status of teeth
   Studies have shown that sealants placed on molars early in eruption were far more likely to require replacement within 3 years.

Sealants will be long-lasting if:

- The case is selected correctly
- The tooth is selected correctly
- An appropriate placement technique is followed
- Adequate maintenance is provided

COST EFFECTIVENESS

The fact that sealants save surfaces from becoming carious if the sealant stays in place is very clear. But the number of sealants that need to be placed in order to prevent one surface restoration is important to keep in mind. In a population with average caries rate, it has been calculated that 5 - 10 sealants must be placed to save one molar surface from becoming carious.

Although several studies have addressed cost-effectiveness, it should not be the sole factor to determine whether or not sealants are used for a particular patient. The use of sealants must be related more to the preventive philosophy and conservation of tooth structure than to absolute cost-benefit ratio.

Cost of the treatment can be minimized by the following measures:

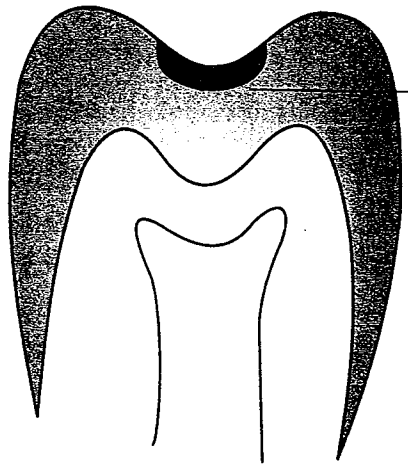
1. Selective application on teeth with the greatest caries risk.
2. Delegating treatment to auxiliary personnel where legally permitted.
3. Selecting commercial products that have the highest proved success rates and are approved by statutory organizations.
4. Following meticulous application protocol.
5. Applying sealants in conjunction with optimal fluoride therapy.

Thus improvement in the cost effectiveness

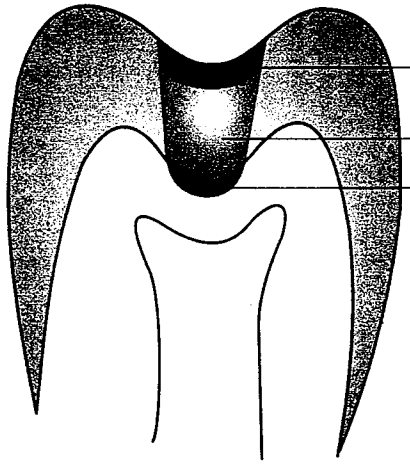
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Preventive Resin Restoration (PRR)

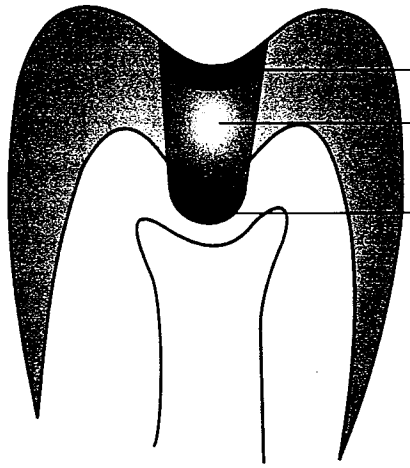
Type A



Type B



Type C



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will make sealants affordable by all, irrespective of their socioeconomic status.

PREVENTIVE RESIN RESTORATIONS (PRR)

- are a natural extension of the use of occlusal sealants.
- integrates the preventive approach of the sealant therapy for caries susceptible pit & fissure with therapeutic restoration of incipient caries with composite resin that occur on the same occlusal surface.
- are the conservative answer to conventional "extension for prevention" philosophy of Class I amalgam cavity preparation.

There are three types of preventive resin restoration based on the extent & depth of carious lesion as determined by exploratory preparation.

Simonsen (1978) has classified them as :

TYPE A

- Suspicious pits & fissures where caries removal is limited to enamel.
- Local anesthesia is not required.
- A slow speed ¼ or ½ round bur is used to remove decalcified enamel.
- Sealant is placed.

TYPE B

- Incipient lesion in dentin that is small & confined.
- No local anesthesia is needed.
- An appropriate base is placed in areas of dentin exposure, composite resin is placed & the remaining pit & fissure are covered with a sealant.

TYPE C

- More extensive dentinal involvement & requires restorations with posterior composite material.
- Appropriate base is placed over dentin.
- Pits & fissures are covered with a sealant.
- Local anesthesia is required.

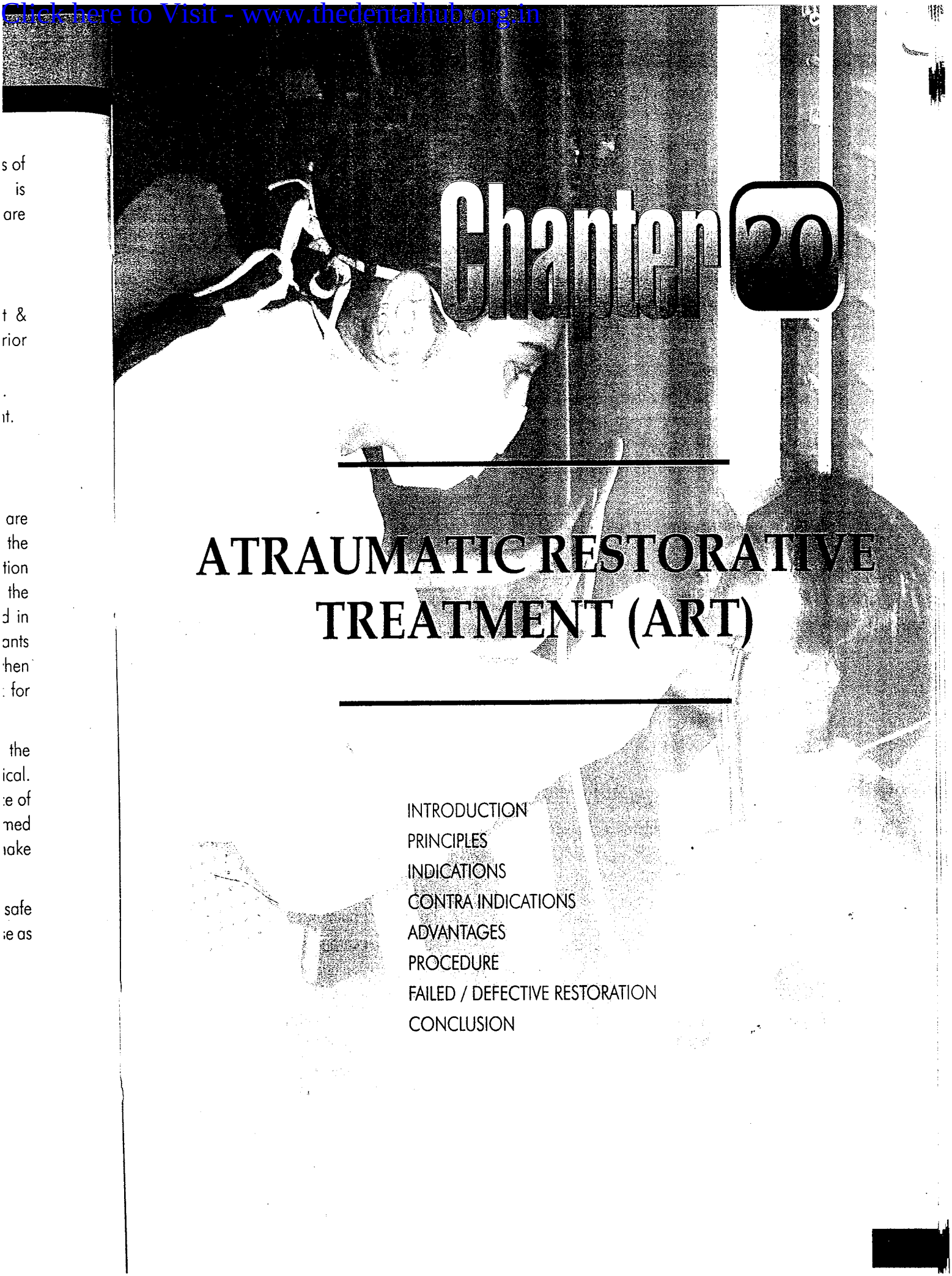
CONCLUSION

The cariostatic properties of sealants are attributed to the physical obstruction of the pits and fissures. This prevents the penetration of fermentable carbohydrates and so the remaining bacteria cannot produce acid in cariogenic concentrations. Dental sealants are cost effective treatment modalities when placed on teeth of children at high risk for dental caries

Educating parents and patients on the importance of dental sealants is critical. Parents are often unaware of the existence of dental sealants. Parents need to be informed about dental sealants before they can make an educated choice for their children.

The fact that pits and fissure sealants are safe and effective should justify their routine use as a preventive measure.

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Chapter 20

ATRAUMATIC RESTORATIVE TREATMENT (ART)

INTRODUCTION
PRINCIPLES
INDICATIONS
CONTRA INDICATIONS
ADVANTAGES
PROCEDURE
FAILED / DEFECTIVE RESTORATION
CONCLUSION

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INTRODUCTION

The Atraumatic Restorative Treatment (ART) is based on modern knowledge about minimal intervention, minimal invasion and minimal cavity preparation for carious lesions. It is a procedure based on removing carious tooth tissues using hand instruments alone and restoring the cavity with an adhesive restorative material. Because it is such a friendly procedure, there are great potentials for its use in children as well as in fearful adults. It also provides a restorative option for special groups in the community, such as the physically or mentally handicapped, people living in nursing homes and the home bound elderly.

The ART approach was pioneered in Tanzania in the mid 1980s which was then followed by several community field trials conducted in Thailand and Zimbabwe in 1991 and 1993 respectively. Results of the studies in Thailand and Zimbabwe have shown that 71% and 85% respectively of the ART restorations remained in the teeth after 3 years.

PRINCIPLES

The two main principles of ART are:

1. Removing carious tooth tissues using hand instruments only
2. Restoring the cavity with a restorative material that sticks to the tooth.

The reasons for using hand instruments rather than electric rotating handpieces are:

- The use of a biological approach, which requires minimal cavity preparation that conserves sound tooth tissues and causes less trauma to the teeth,
- The low cost of hand instruments compared to electrically driven dental equipment,
- The limitation of pain that reduces the need for local anesthesia to a minimum and reduces psychological trauma to patients,
- Simplified infection control. Hand instruments can easily be cleaned and sterilized after every patient.

Currently, ART is performed using glass-ionomer as the restorative material.

The reasons for using glass-ionomer are:

- As the glass-ionomer sticks chemically to both enamel and dentine, the need to cut sound tooth tissue to prepare the cavity is reduced,
- Fluoride is released from the restoration which will prevent and arrest caries and,
- It is rather similar to hard oral tissues and does not inflame the pulp or gingiva.

INDICATIONS

ART is carried out

- Only in small cavities (involving dentin)
- In those cavities that are accessible to hand instruments.
- Public health programs

CONTRA INDICATIONS

ART should not be used when:

- There is presence of swelling (abscess) or fistula (opening from abscess to the oral cavity) near the carious tooth,
- The pulp of the tooth is exposed,
- Teeth have been painful for a long time and there may be chronic inflammation of the pulp,
- There is an obvious carious cavity, but the opening is inaccessible to hand instruments,
- There are clear signs of a cavity, for example in a proximal surface, but the cavity cannot be entered from the proximal or the occlusal direction.

ADVANTAGES

- ART is a biological approach that requires

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minimal cavity preparation that conserves sound tooth tissues and causes less trauma to teeth.

- As ART is painless the need for local anesthetics are reduced and so is the psychological trauma to patients.
- Simplifies infection control as hand instruments can easily be cleaned and sterilized.
- No electrically driven and expensive dental equipment needed which enables ART to be practiced in remote areas and in the field.
- This technique is simple enough to train non - dental personnel or primary health care workers.
- ART approach is very cost effective.
- Since it is a friendly procedure, there are great potentials for its use among children, fearful adults, physically and mentally handicapped and the elderly.
- It makes restorative care more accessible for all population groups.

PROCEDURE

1.ARRANGE A GOOD WORKING ENVIRONMENT

A. OUTSIDE THE MOUTH

The correct positioning of both the operator and patient is essential to achieve good quality care.

The operator's work posture and position

The work posture and position of the operator should provide the best view of the inside of the patient's mouth. At the same time, both patient and operator should be comfortable. The operator sits firmly on the stool, with straight back, thighs parallel to the floor and both feet flat on the floor. The head and neck should be still, the line between the eyes horizontal and the head bent slightly forward to look at the patient's mouth. The height of the stool must then be adjusted so that the operator can see the patient's teeth clearly. The distance from the operator's eye to the patient's tooth is usually between 30 and 35 cm. It is important that the stool is adjusted to the correct height for the eye focus of each operator. The operator should be positioned behind the head of the patient. The exact position will depend on the area of the patient's mouth to be treated. If the patient's mouth is considered to be at the center of a clock face, the range of positions from which the operator can perform all tasks lies on an arc from 10 to 1 on the clock. The direct rear position i.e. at 12 o'clock and the right rear position i.e. at 10 o'clock are the most commonly used positions.

Assistance

When treating children using ART, it is a great advantage if another person can mix the glass-ionomer. This allows the operator to concentrate on the cavity and maintain effective saliva control.

The assistant works at the left side of a right-handed operator and does not change position. The assistant should sit as close to the patient as possible, facing the patient's mouth. The assistant's head should be 10 - 15 cm higher than the operator, so that the assistant can also see the operating field and can pass the correct instruments when needed. The assistant needs a flat stable surface i.e. a table for holding instruments and materials.

Working alone

Oral care is best provided by a team consisting of an operator and an assistant. However, assistants may not always be available. In such a situation the operator will have to provide oral care alone. The operator sits in the appropriate position behind the patient. A small table for holding the instruments and materials is either placed at the head end of the patient or on the right-

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hand side of the operator close to the patient's body

Patient position

A patient lying on the back on a flat surface will provide safe and secure body support and a comfortable and stable position for lengthy periods of time. A head rest made of firm foam or a rubber ring with a cover, both stabilizes the patient's head in the desired position and improves the comfort of the patient. In areas where a dental chair is not available, a very acceptable patient position is created by attaching a head support to the end of the table. The patient is positioned so that the saliva collects in the back of the oral cavity. The operating field is now over the operator's lap at the height of the operator's chest.

Patient's head position

The patient can assist the operator by tilting, turning the head and opening the mouth wide enough to provide access to the area of operation. These three movements are needed so that the operator has good access and vision during oral care.

1. Tilting the head
   a. Backward tilt lifting the chin for access to upper teeth.
   b. Forward tilt dropping the chin for access to lower teeth.
2. Turning the head
   a. Central position
   b. Left turn
   c. Right turn
3. Mouth opening
   a. Fully open.
   b. Partly closed, to relax the cheek muscles for better access to buccal surfaces. The mirror is then used to hold the cheek away from the buccal surfaces.

Operating Light

The light source can be the sun (natural) or artificial. Artificial light is more reliable and constant than natural light and can also be focused on a particular spot. Therefore, in a field setting a portable light source is recommended e.g. a headlamp, glasses with a light source attached or a light attached to the mouth mirror.

B. INSIDE THE MOUTH

A very important aspect for the success of ART is control of saliva around the tooth being treated. Cotton wool rolls are quite effective at absorbing saliva and can provide short-term protection from moisture/saliva.

2. HYGIENE AND CONTROL OF CROSS INFECTION

Universal infection control procedures should be followed.

In a field situation,

1. Place all instruments in water immediately after use.
2. Remove all debris from the instruments by scrubbing with brush in soapy water. If an autoclave is not available,

- Prepare fire using the fuel available like wood, gas, charcoal, solar energy.
- Put the clean instruments in a pressure cooker and add clean water to a depth of 2-3 cm from the bottom.
- Place the pressure cooker on the stove and bring to boil. When the steam comes out from the vent, put the weight in place. If available, set a timer for 15 minutes.
- Continue heating the pressure cooker on low heat for a minimum of 15 minutes. Ensure that steam continues to be released from the pressure cooker during this time. If this stops, there may be no water left in the pressure cooker anymore. If this happens remove the pressure cooker from the heat, add water and repeat the cycle.
- Remove the pressure cooker from stove

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after 15 minutes, and leave it to cool.

- Take care when opening the pressure cooker. Release the pressure first.
- Take instruments out of pressure cooker with instrument forceps and dry them with a clean towel. Store them in a covered, preferably, metal box

3. RESTORING THE CAVITY

- To start with, place cotton wool rolls alongside the tooth to be treated. This will absorb saliva and keep the tooth dry.
- Remove plaque from the tooth surface with a wet cotton wool pellet, and then dry the surface with a dry pellet. The extent of the caries can now be judged better.

Caries removal

- If the cavity opening in the enamel is small, widen the entrance. Do this by placing the blade of the dental hatchet into the cavity and turning the instrument forward and backward like turning a key in a lock. This movement chips off small pieces of carious enamel.
- If the cavity is very small, place a corner of the blade of the dental hatchet in the cavity first and then turn.
- Carious dentine can now be removed with the excavators. The small excavator is used for small cavities, the bigger one for larger cavities. Soft caries is removed by making circular scooping movements around the long axes of the instrument.
- It is important to remove all the soft caries from the enamel-dentin junction before removing caries near the pulp. Removing soft caries from the enamel-dentin junction may leave enamel that is unsupported with dentin.
- The overhanging of enamel can break very easily and must be removed. This is done with the blade of the dental hatchet. Place the instrument at the edge of the enamel and fracture off small pieces. Repeat this until all the thin unsupported enamel has been removed and no caries is left in the remaining enamel.
- Ensure that the dental hatchet is well supported with your fingers. As a result of removing unsupported enamel, visibility and accessibility of the cavity is improved.
- Excavation is easier done when the tooth is dry. Therefore, change saturated cotton wool rolls for dry ones.

Particular care is needed when removing carious dentin from two places in the cavity:

1. The enamel-dentin junction

   This part of the dentin is close to the surface of the tooth. It is also the part where the restoration must stick very well to the tooth. If caries is not completely removed at the junction, a good join is not made. Then bacteria will be able to penetrate in the gap between the restoration and the cavity wall and caries will develop further.

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2. The floor in deep cavities

   When removing carious dentin near the pulp there is a risk of damaging or exposing the pulp. So it is important to remove no more dentin than is really essential, in the deepest part of a cavity. If during cavity preparation the pulp is exposed there will be bleeding in most cases, in the bottom of the cavity. Then special treatment of the pulp may be required.

3289

After all caries is removed, the cavity is cleaned with wet cotton wool pellets. Then the patient is asked to bite the upper and lower teeth together. This will show how the tooth to be restored fits together with the opposing tooth which will help in trimming of excess restorative material later. Cavity preparation is then completed by drying the cavity with dry cotton wool pellets.

In a multi surface cavity, a plastic strip is then placed between the teeth and this is used to make the correct tooth contour of the

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ESSENTIAL INSTRUMENTS FOR ART

INSTRUMENT	USE / DESCRIPTION
MOUTH MIRROR	This instrument is used to reflect light onto the field of operation, to view the cavity indirectly and to retract the cheek or tongue, as necessary.
EXPLORER	This instrument is used to identify the soft carious dentin. Do not poke the point into very small carious lesions. This may destroy the tooth surface and the caries arrestment process. Also do not probe into deep cavities where you might damage or exposure the pulp.
PAIR OF TWEEZERS	This instrument is used for carrying cotton wool rolls, cotton wool pellets, wedges and articulation paper from the tray to the mouth and back.
SPOON EXCAVATOR	This instrument is used for removing soft carious dentin. There are three sizes **Small** - The diameter of the spoon is about 1 mm. An example is the Ash 153-154. This instrument is for use in small cavities and for cleaning the enamel / dentin junction. As the neck of the instrument is rather fragile, it can break if too much force is applied whilst excavating. **Medium** - The diameter of the spoon is about 1.5 mm. An example is the Ash 131-132. This instrument is mainly used for removal of soft caries from larger cavities. The rounded surface of the spoon can also be used to push mixed restorative material into small cavities. **Large** - The diameter is about 2 mm. An example is the Ash 127-128. This instrument can be used in large cavities and for removal of excess glass ionomer material from the restoration.
DENTAL HATCHET	This instrument is used for widening the entrance to the cavity, for slicing away thin unsupported and carious enamel left after carious dentin has been removed. The width of the blade of the instrument is approximately 1 mm. An example is the Ash 10-6-12.
APPLIER/CARVER	This double ended instrument has two functions. The blunt end is used for inserting the mixed glass ionomer into the cleaned cavity and into pits and fissures. The sharp end is designed to remove excess restorative material and to shape the glass ionomer. An example is the Ash 6 special.
MIXING PAD and SPATULA	These are necessary for mixing glass ionomer. There are two types of mixing pads, glass slab and disposable paper pad. The spatula is made of plastic. The spatula used must bend so that it is easy to mix the powder and liquid rapidly and correctly. Sometimes glass ionomer is supplied together with a plastic spatula and the paper pad.

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ESSENTIAL MATERIALS FOR ART

MATERIAL	USE / DESCRIPTION
COTTON WOOL ROLLS	These are used to absorb saliva so that the tooth to be treated is kept dry.
COTTON WOOL PELLETS	These are used for cleaning cavities. They are available in various sizes. The smallest, size 4, should be used for small cavities. Size 2 can be used for larger cavities.
PETROLEUM JELLY	This material is used to keep moisture away from the glass-ionomer restoration and to prevent the examination glove from sticking to the glass-ionomer as it sets hard.
PLASTIC STRIP	This material is used for contouring the proximal surface of multiple-surface restorations.
WEDGES	These are used to hold the plastic strip close to the shape of the proximal surface of a tooth so that restorative material is not forced between the gums and teeth. These wedges should be shaped from soft wood.
GLASS IONOMER CEMENT	The material is supplied as a powder and liquid that must be mixed together. The powder is a glass containing silicon-oxide, aluminium-oxide and calcium fluoride. The liquid is either polyacrylic acid or de-mineralized water. If de-mineralized water is the liquid component, polyacrylic acid is incorporated into the powder in a dry form.

proximal surface. A soft wood wedge is inserted between the teeth just at the gum margin to keep the plastic strip firmly in position.

Conditioning the prepared cavity

In order to improve the chemical bonding of glass-ionomer to the tooth structures, the cavity walls must be very clean. It is done using a chemical solvent. There are two possibilities:

- A dentin conditioner or tooth cleaner, especially developed for this purpose or
- The liquid supplied with the glass-ionomer itself.

The dentin conditioner is usually a 10% solution of polyacrylic acid.

- Apply one drop of the conditioner on a pad or the slab.
- Dip a cotton wool pellet in the drop and then clean the entire cavity and adjacent fissures for 10-15 seconds. Do this holding the cotton wool pellets with a pair of tweezers
- The glass-ionomer liquid can be used for cleaning the cavity if it contains the same acid as is used for conditioning.
- Usually the liquid is too strong and needs to be diluted. This is done by placing one drop of liquid on a pad or slab. Then moisten a cotton wool pellet by dipping it in water. Remove the excess water by lightly touching the pellet against a dry cotton wool roll, a tissue or gauze. Dip the moist pellet in the glass-ionomer liquid and then use it as a dentine conditioner.
- If the cavity is contaminated with blood, stop the bleeding by pressing with a cotton wool pellet on the wound. Wash the blood away with water and dry the cavity with

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cotton wool pellets. Place dry cotton wool rolls on both sides of the tooth to prevent recontamination. Then apply the conditioner in the cavity as described above. If a cavity becomes contaminated after having been conditioned, it is essential to wash, clean and recondition the cavity again.

Mixing

- Place a spoonful of powder on the glass slab or mixing pad.
- Use the spatula to divide the powder into two equal portions.
- Then dispense 2 drops of liquid (one for conditioning and one for mixing) next to the powder. Hold the liquid bottle horizontal for a moment to allow air to escape from the tip. Move it to a vertical position and allow the drop of liquid to fall onto the slab. Apply a little pressure if necessary, but do not squeeze the liquid out.
- First spread the liquid with the spatula over a surface of about 1.5 -2 cm.
- Start mixing by adding one half of the powder into the liquid using the spatula. Roll the powder into the liquid, gently wetting the particles without spreading them around the slab.
- As soon as all powder particles are wetted, the second portion is folded into the mix. Now mix firmly while keeping the mass together.

The mixing should be completed within 20-30 seconds. The final mixture should look smooth like chewing gum.

Precautions for Glass Ionomer material

- Dispense both powder and liquid onto the slab only when you have the cavity properly dried and protected from saliva.
- Replace the lid of powder and liquid bottle carefully back into position immediately after use. This prevents uptake of moisture from the air or evaporation of the water component from the liquid.
- Wipe the nozzle of the liquid bottle with a damp gauze if liquid remains on the outside.
- If more than 30 seconds are used for mixing and the mixture looks dry, do not use it, because there will be poor adhesion to the tooth structure. Throw it away.
- Scrape the slab and spatula clean and start mixing again with new powder and liquid. Remove all glass-ionomer from the dental instruments immediately after use before the material has hardened, or put the instruments in water for easy cleaning later.
- Each type of glass-ionomer may have its own specific needs. Therefore, follow the instructions of the manufacturers carefully.

Restoring the cavity

- After the cavity is conditioned, washed and dried, the glass-ionomer can be mixed.
- The mixture is inserted into the cavity in small amounts using the blunt end of the applier/carver instrument. This will avoid inclusion of air bubbles. Push the mixture into place with the round surface of a medium excavator. Make sure the mixture goes into small cavities and under any enamel overhanging. Also place a little extra material on the adjacent pits and fissures.
- Rub a small amount of petroleum jelly on the gloved index finger and press the soft restorative material firmly into the cavity and fissures. This is called 'the press-finger technique'. Remove the finger sideways after a few seconds. The time from the start of mixing until removal of finger should be no more than one minute.

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- Excess glass-ionomer material will be displaced by the press-finger technique towards the slopes of the cusps and between the cusps in the direction of buccal / lingual and proximal surfaces. Quickly and carefully remove any excess material with a medium or large excavator.
- Do not disturb the restoration during the hardening period and keep the tooth moisture free. After about 1 to 2 minutes (remove the strip and wedge in case of a multi surface cavity) check the bite.
- Place a piece of blue/red articulation paper on the restored tooth. Ask the patient to close the mouth and bite from side to side, check for high points and do the necessary corrections. Make sure that the patient does not bite on the cotton wool rolls. Ask the patient not to eat for one hour.

Failed or defective restorations

A restoration may not be acceptable or unsatisfactory if,

1. Restoration is completely missing

Some of the reasons for failure could be:

- Contamination with saliva or blood during the restorative procedure,
- Mix of material was too wet or too dry,
- Not all the soft caries had been removed,
- Thin undermined enamel had been left behind, and this later broke off.

Whatever the reason, clean the cavity completely, apply dentin conditioner and refill the cavity.

2. Part of the restoration has broken away

It is probable that

- The restoration was too high or
- Air bubbles were trapped in the material during placement of the restoration.

Whatever the reason,

- Clean the tooth surface and/or remaining restorative material with an explorer or small excavator and wet cotton wool pellets
- Condition the entire surface and material
- Fill the gap with a new mixture of glass ionomer and ensure that the restoration is not too high.

3. The restoration has fractured

This most commonly happens in a multiple surface restoration which is too high.

- The way to repair it very much depends on the location of the fracture line and the mobility of the fractured part.
- If the fractured part is loose and can be removed, repair the gap as described under point 2.
- If the fractured part cannot be removed, repair through ART is not possible and traditional treatment using a drill is needed.

4. The Restoration has worn away

Possible reasons for this are

- The patient eats very hard food frequently
- The patient clenches his/her teeth frequently
- The mixture had been too wet or dry.

Ensure that all the surfaces of the tooth and the remaining restoration are clean. Apply dentin conditioner over the glass ionomer and the cavity walls. Place a new layer of glass ionomer on top of the old one. Finish the restoration.

5. Caries has developed in the adjacent fissures or surface

Remove the soft caries. After all decay has been removed, clean and fill the new cavity adjacent to the restoration according to the standard procedures.

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CONCLUSION

Although dental caries has substantially decreased in the industrialized countries, it remains to be a widespread problem all over the world. Most of the carious teeth in the developing countries tend to go untreated to such an extent that the only treatment option available is extraction. The ART procedure has been developed to focus on such groups of people who are unable to obtain restorative dental care.

ART is a combined preventive and curative oral care procedure, which must be administered along with health promoting messages about a prudent diet, good oral hygiene, use of fluoride toothpaste and sealant application. ART is not a compromise but a perfect alternative treatment approach for developing countries and special groups in the industrialized world. It is a breakthrough towards achieving the goal of "Teeth for life" - that all people should retain as many teeth as possible, for a lifetime.

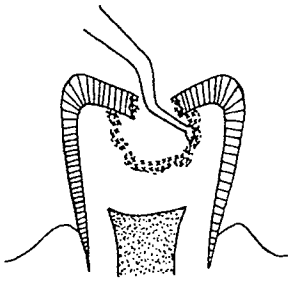


Fig.1: Circular scooping movements of the excavator

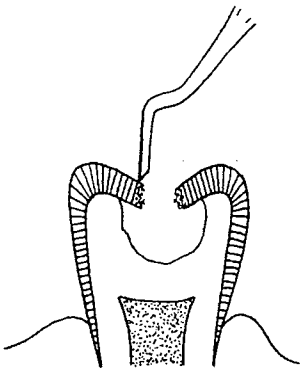


Fig. 2: Fracturing off unsupported enamel with a hatchet

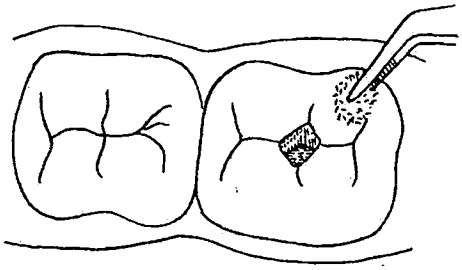


Fig. 3 : Application of dentine conditioner



Fig. 4: The cavity and adjacent pits and fissures are overfilled

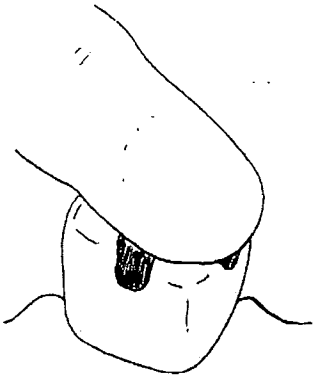


Fig. 5: Press the restorative material with gloved finger. Excess material is visible



Fig. 6: Removal of excess material by the carver blade of the applier/carver

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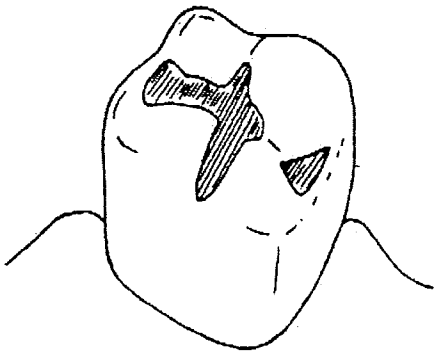


Fig. 7: A restored one-surface cavity.

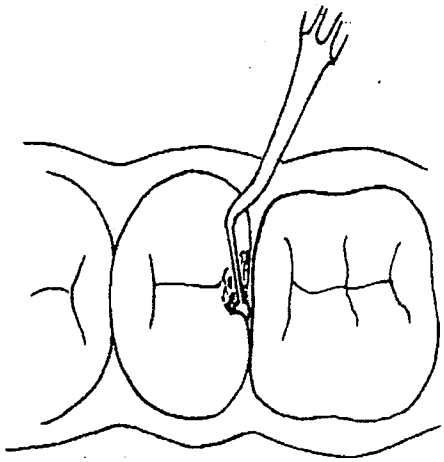


Fig. 8: Using the spoon excavator to remove carious dentine in a multiple-surface cavity

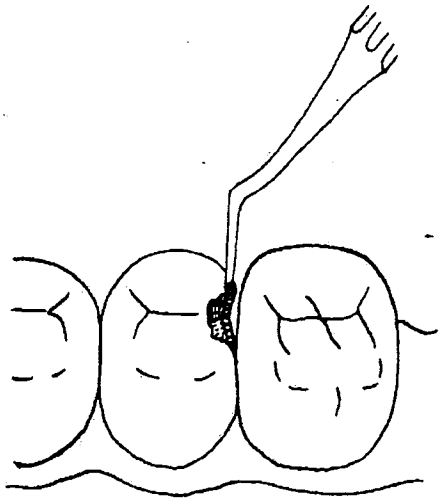


Fig. 9 : The position of the dental hatchet for smoothing the proximal outline

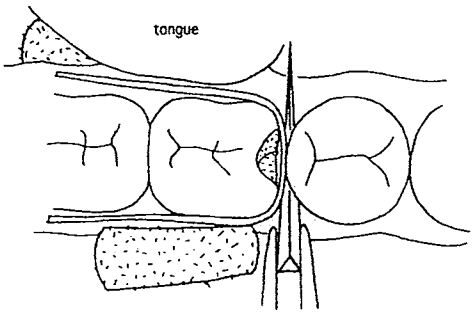


Fig. 10: Plastic strip and wedge in position

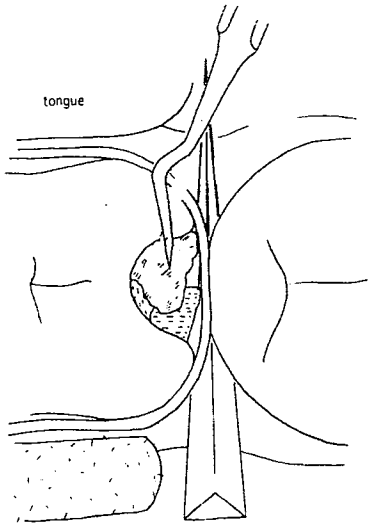


Fig.11 : Application of conditioner

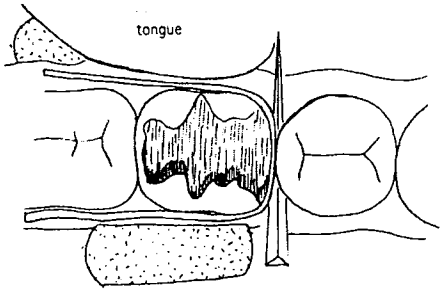


Fig. 12: Slightly overfilled sealed restoration

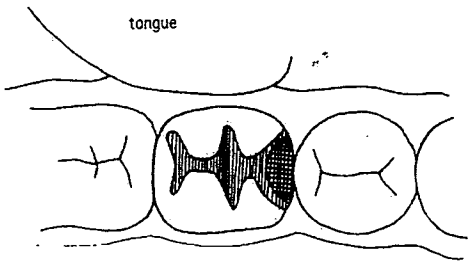


Fig. 13 : Finished sealed restoration

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Chapter 21

ENVIRONMENT AND HEALTH

INTRODUCTION

WATER

- USES OF WATER
- SOURCES OF WATER
- GUIDELINES FOR DRINKING WATER QUALITY
- PURIFICATION OF WATER

WASTE MANAGEMENT

- DISPOSAL OF SOLID WASTE
- DISPOSAL OF HEALTH CARE WASTE

CONCLUSION

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INTRODUCTION

The totality of influences which infringe upon man and affect his well-being is his environment. It comprises of the physical, biological, social and psychological dimensions. Disease arises when there is a maladjustment of the individual with his environment. On the other hand, human existence and activities always lead to changes in the environment and this in turn lead to effects on health. Environmental health is systematic conduct of a planned program designed to promote optimum health and comfort of the individual, family and community by modifying or controlling the environment, so as to prevent illness or disability caused by interrelationships with the environment.

The activities under environmental health includes control of air pollution, radiation control, noise control and solid waste management.

WATER

Good oral health requires a clean water supply, sufficient for brushing and cleaning teeth regularly from an early age. Poor oral hygiene may also result in periodontal problems since the dental plaque may induce gingival inflammation and deep pockets. While fluoride intake from drinking water and a balanced, low sugar diet are probably the most important factors in reducing dental caries, a lack of clean water for basic oral hygiene may tip the balance towards earlier and more severe patterns of caries.

Potable water:

Water intended for human consumption should be both safe and wholesome. Potable water has been defined as water that is.

a. Free from pathogenic agents
b. Free from harmful chemical substances
c. Pleasant to taste, i.e.. free from color and odor
d. Useful for all domestic needs.

It must be available close to the people. The process of transporting the water might result in pollution and because of the difficulty in getting the water from a far away source, people might start using water from other sources which may not be potable.

The basic requirement of drinking water has been estimated at about 2 litres per head per day, just for survival. However, a daily supply of 150-200 litres per capita is considered adequate to meet the domestic needs of the urban population.

Uses of water

- Domestic uses - drinking, cooking
- Public purposes - cleaning streets and fire protection
- Industrial uses - factories
- Agricultural purposes - irrigation

Sources of water

1.RAIN

Rain is the main source of all water. It is the purest form of water in nature. It is soft water containing only traces of dissolved solids. Although rain water is free from pathogenic agents it tends to become impure as it passes through the atmosphere from where it picks up suspended impurities.

A part of the rain water sinks into the ground to form ground water and a part of it evaporates back into the atmosphere. Some of the water in the soil is taken up by the plants and is evaporated in turn by the leaves. These events form the "water cycle".

2. SURFACE WATER

A part of the rain water runs off to form streams and rivers which follow ultimately into the sea. This is called surface water. The types are

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Impounding reservoirs

These are artificial lakes or constructed dams used to store large qualities of surface water. The area draining into the reservoir is called "catchment area". One disadvantage of this is the growth of algae and other microscopic organisms, which impart bad tastes and odours to water. It is also necessary to keep the catchment area free from human or animal intrusion.

Rivers and streams

Although rivers furnish a dependable supply of water, it is usually grossly polluted and unfit for drinking without treatment.

Ponds and lakes

They are natural excavations in which surface water is stored. They are recipients of contamination of all sorts.

Sea water

It contains 3.5 percent of salts in solution. Desalting and demineralization process is used in places where sea water is the only source of drinking water.

3. GROUND WATER

Rain water percolating into the ground constitutes ground water. It is the most economical and practical means of providing water to small communities. It is superior to surface water, since the ground itself provides an effective filtering medium.

The usual ground water sources are wells and springs.

- Shallow wells
- Deep wells
- Springs

Shallow wells tap the water from above the first impervious layer in the ground. They yield limited quantities of water and the water is moderately hard and often contaminated.

Deep wells tap water from below the first imperious layer. They provide a constant supply of purer water, as compared to shallow wells, but are much harder.

Tube wells: They can be shallow tube wells or deep tube wells (bored wells). Although they are costly to construct or operate, they yield good quantity and quality of water.

A spring is ground water which has come to the surface and flows freely under natural pressure. Springs may be of two types shallow springs and deep springs. Since the water is exposed, it gets contaminated easily.

GUIDELINES FOR DRINKING WATER QUALITY

The guidelines for drinking water quality recommended by WHO (1993 and 1996) relate to the following variables,

1) ACCEPTABILITY ASPECTS

Physical parameters:

Drinking water

- should be free from turbidity. Water with turbidity of less than 5 nephelometric turbidity units (NPU) is acceptable.
- should be free from color. The guideline value is up to 15 true color units.
- Should be free from taste and odor. No health based guideline value is proposed for taste and odor.

Inorganic constituents:

- Chlorides: The standard prescribed for chloride is 200 mg/litre. The maximum permissible level is 600 mg/litre. Any excess over the normal range should arouse suspicion of water contamination.
- Hardness: Drinking water should be moderately hard. 1-3 mEq./L (50-150 mg/per litre).
- Ammonia: Natural levels in ground and surface waters are usually below

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0.2mg/litre. Anaerobic ground waters may contain up to 3mg/litre. Ammonia in water is an indicator of possible bacterial sewage and animal waste pollution.

- pH: An acceptable pH for drinking water is between 6.5 and 8.5.
- Hydrogen sulphide: The test and odour threshold of hydrogen sulphide in water are estimated to be between 0.05 and 0.1mg/litre.
- Iron: Anaerobic ground water may contain ferrous ion at concentration up to several mg/litre without discoloration or turbidity in water. However, on exposure to the atmosphere, the ferrous ion oxidizes to ferric ion, giveng a reddish brown color to the water. Iron also promotes the growth of iron bacteria.
- Sodium: The taste threshold concentration of sodium in water depends on the associated anion and the temperature of the solution. At room temperature, the average taste threshold for sodium is about 200 mg/litre.
- Sulphate: The presence of sulphate in drinking water can cause noticeable taste. Taste impairment is minimal at levels below 250mg/litre.
- Total dissolved solids: The palatability of water with total dissolved solids (TDS) level of less than 600 mg/litre is generally considered to be good. Water with extremely low concentrations of TDS may be unacceptable because of its flat, insipid taste. Drinking water becomes increasingly unpalatable at TDS levels greater than 1200 mg/litre.
- Zinc: It imparts an undesirable astringent taste to water. The threshold concentration is 4mg/litre.
- Manganese: Concentrations below 0.1mg/litre are usually acceptable. At levels above 0.1 mg/litre, manganese causes an undesirable taste in beverages.
- Dissolved oxygen: Depletion of dissolved oxygen in water supplies can encourage microbial reduction of nitrate to nitrite and sulphate to sulphide, giveng rise to odour problem.
- Copper: The presence of copper above 1 mg/litre may interfere with the intended domestic uses of water.
- Aluminium: The concentration should not exceed 0.2 mg/litre.

2) MICROBIOLOGICAL ASPECTS

Bacteriological indicators:

Ideally, drinking water should not contain any pathogenic microorganisms. It should also be free from bacteria indicative of pollution with excreta.

The primary bacterial indicators recommended for this purpose are

- Coliform organisms: The coliform group includes both faecal and non-faecal organisms. Example of the faecal group is E. coli and of the non-faecal group, Klebsiella aerogens. From a practical point of view it is assumed that all coliforms are of faecal origin unless a non faecal origin can be proved. The coliform organisms are constantly present in great abundance in the human intestine. They are foreign to potable waters and hence their presence in water is looked upon as evidence of faecal contamination.
- Faecal streptococci: Faecal streptococci regularly occur in faeces, but in much smaller number than E. coli. The finding of faecal streptococci in water is regarded as important confirmatory evidence of recent faecal population of water.
- Clostridium perfringens: They occur regularly in faeces and its presence in natural water suggests that faecal contamination has occurred at some remote time.

Virological aspects:

It is recommended that to be acceptable,

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drinking water should be free from any virus which is infectious to man.

Biological aspects:

- Protozoa: Drinking water should not contain any pathogenic intestinal protozoa.
- Helminthes: A single mature larva or fertilized egg can cause infection and such infective stages should be absent from drinking water.
- Free living organisms: Free living organisms that may occur in water are fungi and algae, which gives water a bad odor and taste.

3) CHEMICAL ASPECTS

The presence of certain chemicals in excess of prescribed limits may make water non potable.

Inorganic constituents:

- Arsenic: The provisional guideline value for arsenic in drinking water is 0.01 mg/litre.
- Cadmium: A guideline value for cadmium is established at 0.003 µg/litre.
- Chromium: The guideline value for chromium is 0.05 mg/litre.
- Cyanide: The guideline value of 0.07 mg/litre is considered to be safe.
- Fluoride: The guideline value suggested is 1.5mg/litre
- Lead: The health based guideline value of lead is 0.01 mg/litre.
- Mercury: The guideline value for total mercury is 0.001mg/litre.
- Nitrate and nitrite: A guideline value of 3 mg/litre for nitrite and 50 mg/litre for nitrate has been proposed.
- Selenium: The guideline value is 0.01 mg/litre

Organic constituents:

- Polynuclear aromatic hydrocarbons : In situations where contamination of drinking water by polynuclear aromatic hydrocarbons (PAH) has occurred, the specific compounds present and the source of the contamination should be identified, as the carcinogenic potential of PAH compounds varies.
- Pesticides: The pesticides include chlorinated hydrocarbons and their derivatives. The DDT concentration in water should not exceed 2 µg/litre.

4) RADIOLOGICAL ASPECTS

The effects of radiation exposure are called somatic if they become manifest in the exposed individual and hereditary if they affect the descendants.

The activity of a radioactive material is the number of nuclear disintegration per unit of time. The unit of activity is a becquerel (Bq).

1 Bq = 1 disintegration per second.
The proposed guideline values are:
Gross alpha activity 0.1 Bq /L
Gross beta activity 1.0 Bq /L

HARDNESS OF WATER

Hardness is be defined as the soap destroying power of water.

Causes of hardness:

- Calcium bicarbonate
- Magnesium bicarbonate
- Calcium sulphate
- Magnesium sulphate.

Classification of hardness:

- Carbonate hardness or "temporary" hardness is due to the presence of calcium and magnesium bicarbonates.
- Non- carbonate hardness or "permanent" hardness is due to calcium and magnesium sulphates, chlorides and nitrates.

Hardness in water is expressed in terms of milliequivalents per litre (mEq/l). Drinking

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Classification	Level of Hardness (in gm/litre)
Soft Water	Less than 1 (<50 mg/L)
Moderately Hard	1-3 (50-150 mg/L)
Hard Water	3-6 (150-300 mg/L)
Very Hard	Over 6 (>300mg/L)

water should be moderately hard (1-3 mEq/ litre).

Disadvantages of hardness:

- Hard water consumes more soap and detergents
- When hard water is heated, the carbonates get precipitated and bring about furring or scaling of boilers leading to increased fuel consumption, loss of efficiency and sometimes boiler explosions
- It adversely affects cooking by altering its color and appearance
- Fabrics washed with hard water do not have a long life
- It is unsuited in many industrial processes and gives rise to economic losses It shortens the life of pipes and fixtures.

Removal of hardness:

Hardness can be removed by

Boiling

Boiling removes temporary hardness by expelling carbon dioxide and precipitating the insoluble calcium carbonate.

Addition of lime [$Ca(OH)_2$]

Lime removes temporary hardness by absorbing the carbon dioxide and precipitating the insoluble calcium carbonate.

Addition of sodium carbonate

Sodium carbonate removes both temporary and permanent hardness

Permutit process (Base exchange process)

It removes both temporary and permanent hardness. Sodium permutit is a complex compound of sodium, aluminum and silica. When hard water is passed through the permutit, the calcium and magnesium ions are entirely removed by base exchange and the sodium permutit is finally converted into calcium and magnesium permutit.

PURIFICATION OF WATER

It can be done

1. on a large scale.
2. on a small scale.

PURIFICATION OF WATER ON A LARGE SCALE

The components of a water purification system comprise of

1) Storage
2) Filtration
3) Chlorination

STORAGE

During storage, considerable amount of purification takes place by

- Physical action: About 90 per cent of the suspended impurities settle down in 24 hours by gravity. The water becomes clearer allowing penetration of light.
- Chemical action: The aerobic bacteria oxidize the organic matter present in the water with the help of dissolved oxygen reducing the content of free ammonia and increasing the concentration of nitrates.
- Biological: During storage the pathogenic organisms gradually die out. However, if the water is stored for long periods, there is likelihood of development of vegetable growths such as algae, which imparts bad smell and color to the water.

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FILTRATION

Filtration is the second stage in the purification of water.

The two types of filters used are,

- the biological or "slow sand" filters
- the rapid sand or mechanical filters.

SLOW SAND OR BIOLOGICAL FILTERS

Elements of a slow sand filter:

(1) Supernatant (raw) water

The depth of the supernatant water above the sand bed varies from 1 to 1.5 metres.

- It provides a constant head of water so as to overcome the resistance of the filter bed and thereby promote the downward flow of the water into the sand bed
- It provides waiting period of some hours for the raw water to undergo purification by sedimentation, oxidation and particle agglomeration.

(2) A bed of graded sand

The thickness of the sand bed is about 1 metre. The sand grains have an effective diameter between 0.2 and 0.3 mm. The sand bed is supported by a layer of graded gravel 30-40 cm deep which also prevents the fine grains being carried into the drainage pipes. Water percolates through the sand bed very slowly and as it does so, it is subjected to mechanical straining, sedimentation, adsorption, oxidation and bacterial action. The rate of filtration of water lies between 0.1 and 0.4 m^3/hour/per square meter of sand bed surface.

Vital layer:

The slimy growth covering the surface of the sand bed is known as"Schmutzdecke", vital layer, zoogleal layer or biological layer. This layer consists of threadlike algae, plankton, diatoms and bacteria. It may take several days for the vital layer to form fully and when fully formed it extends for 2 to 3 cm into the top portion of the sand bed. The formation of vital layer is know as "ripening" of the filter. The vital layer is the "heart" of the slow sand filter. It removes organic matter, holds back bacteria and oxidizes ammoniacal nitrogen into nitrates and helps in purifying the water. Until the vital layer is fully formed, the first few days filtrate is usually run to waste.

(3) An under drainage system

At the bottom of the filter bed is the under drainage system. It consists of perforated pipes which not only provides an outlet for filtered water but also supports the filter medium above.

Filter box:

The filter box is an open rectangular box, 2.5 to 4 metres deep and is built wholly or partly below ground. The walls may be made of stone, brick or cement. The filter box consists of,

Supernatant water	1 to 1.5 metres
Sandbed	1.2 metres
Gravel support	0.3 metres
Filter bottom	0.16 metres

(4) A system of filter control values

Filter control values are present to maintain a constant rate of filtration. The venturi meter is used to measure the bed resistance or loss of head. When the resistance builds up, the operator opens the regulating valve so as to maintain a steady rate of filtration.

Filter cleaning:

When the bed resistance increases to such an extent that the regulating valve has to be kept fully open, it is time to clean the filter bed. The supernatant water is then drained off and the sand bed is cleaned by scraping off the top

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portion of the sand layer to a depth of 1 - 2 cm. After 20 or 30 scrapings, the thickness of the sand bed will have reduced and a new bed is constructed.

RAPID SAND OR MECHANICAL FILTERS

The steps involved are,

1. Coagulation: the raw water is first treated with a chemical coagulant such as alum.
2. Rapid mixing: the treated water is then subjected to violent agitation in a "mixing chamber" for a few minutes. This allows a quick and through dissemination of alum throughout the bulk of the water.
3. Flocculation: this phase involves a slow and gentle stirring of the treated water in a "flocculation chamber" for about 30 minutes. This results in the formation of a thick, copious, white flocculent precipitate of aluminum hydroxide.
4. Sedimentation: the coagulated water is then led into sedimentation tanks where it is kept for 2-6 hours, when the flocculent precipitate together with impurities and bacteria settle down in the tank.
5. Filtration: the partly purified water is then subjected to rapid sand filtration.

Filter beds:

Each unit of filter bed has a surface of 80 to 90 m^2. Sand is the filtering medium. The effective size of the sand particles is between 0.4 -0.7 mm. The depth of the sand bed is usually about 1 metre. Below the sand bed is a layer of graded gravel, 30 to 40 cm deep. The gravel supports the sand bed and permits the filtered water to move freely towards the under drains. The depth of the water on the top of the sand bed is 1.0 to 1.5 m. The rate of filtration is 5-15 m^3/m^2/hour.

Filtration removes the remaining alum floc not removed by sedimentation. As filtration proceeds, the suspended impurities and bacteria clog the filters resulting in their reduced efficiency called "loss of head".

Back washing

Rapid sand filters need frequent washing daily or weekly, depending upon the loss of head. Washing is accomplished by reversing the flow of water through the sand bed, which is called "back washing". It helps in dislodging the impurities and cleaning up the sand bed. The washing is stopped when the wash water is sufficiently clean. The whole process of washing takes about 15 minutes.

ADVANTAGES

Slow sand filter	Rapid sand filter
It is simple to construct and operate	It can deal with raw water directly. No preliminary storage is needed
The cost of construction is cheaper	The filter beds occupy less space
The physical and chemical quality of filtered water is very high	Filtration is rapid, 40-50 times that of a slow sand filter
The total bacterial count is reduced by 99.9 to 99.99%	There is more flexibility in operation

CHLORINATION

Chlorination is a supplement and not a substitute to sand filtration. Its actions include,

- Chorine kills pathogenic bacteria, but is has no effect on spores and certain viruses except in high doses.
- It oxidizes iron, manganese and hydrogen sulphide
- It destroys taste and odour producing constituents
- It controls algae and slime organisms
- It aids coagulation

Action of chlorine:

when chlorine is added to water, there is formation of hydrochloric acid and

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hypochlorous acid. The hydrochloric acid is neutralized by the alkalinity of the water. The hypochlorous acid ionizes to form hydrogen ions and hypochlorite ions.

The disinfecting action of chlorine is mainly due to the hypochlorous acid. Chlorine acts best as a disinfectant when the pH of water is around 7 because of the predominance of hypochlorous acid.

Principles of chlorination:

- The water to be chlorinated should be clear and free from turbidity.
- The "chlorine demand" of the water should be estimated. The chlorine demand of the water is the difference between the amount of chlorine added to the water and the amount of residual chlorine remaining at the end of a specific period of contact at a given temperature and pH of the water
- The point at which the chlorine demand of the water is met is called the "break point". If further chlorine is added beyond the break point, free chlorine begins to appear in the water
- The free residual chlorine should be present for a contact period of at least one hour to kill bacteria and viruses
- The minimum recommended concentration of free chlorine is 0.5mg/litre for one hour. The free residual chlorine provides a margin of safety against subsequent microbial contamination which may occur during storage and distribution
- The sum of the chlorine demand of the water plus the free residual chlorine of 0.5mg/l constitutes the correct dose of chlorine to be applied.

METHOD USED

Chlorine is applied either as

- Chlorine gas: It is the first choice because it is economical, quick in action, efficient and easy to apply. However, it is an irritant to the eyes and poisonous.
- Chloramines: They are loose compounds of chlorine and ammonia. They have a less tendency to produce chlorinous taste and gives a more persistent type of residual chlorine.
- Perchloron: It is also called high test hypochlorite and is a calcium compound.

Break point chlorination

The addition of chlorine to water to a point at which free residual chlorine begins to appear is called breakpoint chlorination.

Superchlorination

Superchlorination comprises of the addition of large doses of chlorine to the water and removal of excess of chlorine by dechlorination. This method is used for heavily polluted river water.

Other agents used for water purification

- Ozonation: Ozone is a powerful oxidizing agent which has a strong virucidal effect. It eliminates undesirable odour, taste and color. The drawback of ozone is that there is no residual germicidal effect.
- Ultraviolet irradiation: It is effective against most microorganisms including viruses. The apparatus needed is expensive.

PURIFICATION OF WATER ON A SMALL SCALE

Household purification of water:

1. Boiling

- The water must be brought to a "rolling boil" for 5 to 10 minutes.
- It kills all bacteria, spores, cysts and ova.
- It removes temporary hardness.
- It offers no "residual protection"

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2. Chemical disinfection

- Bleaching powder or chlorinated lime is a white amorphous powder which contains about 33 percent of available chlorine.
- Chlorine solution is prepared by mixing 4 kg of bleaching powder with 20 liters of water to give a 5 percent solution of chlorine
- High test hypochlorite or perchloron is a calcium compound which contains 60 to 70 percent available chlorine.
- Chlorine tablets are good for disinfecting small quantities of water, but they are expensive.
- Iodine may be used for emergency disinfection of water. A contact time of 20 to 30 minutes is needed for effective disinfection. High cost is a major disadvantage.
- Potassium permanganate may kill cholera vibrios, but is of little use against other disease organisms. It also alters the color, smell and taste of water and therefore not used.

3. Filtration

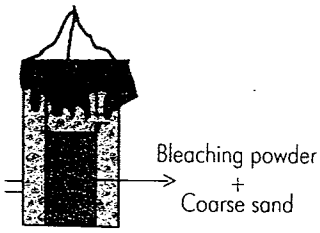
Water can be purified on a small scale by filtering through ceramic filters such as Pasteur Chamberland filter, Berkefeld filter and "Katadyn " filter. They are effective in purifying water.

DISINFECTION OF WELLS

Wells are the main source of water supply in the rural areas. The most effective and economical method of disinfecting well is by bleaching powder.

The double pot method

The double pot method has been devised by the National Environmental Engineering Research Institute, Nagpur, India. This method uses two cylindrical pots, one placed inside the other. The inside height and diameter of the outer pot are 30 cm and 25 cm respectively. A hole 1 cm in diameter is made in each pot. In the inner pot the hole is in the upper portion, near the rim and in the outer pot it is 4 cm above the bottom.



Mixture of 1 kg bleaching powder and 2 kg of coarse sand is prepared and slightly moistened with water. The inner pot is filled with this mixture up to 3 cm below the level of the hole. The inner pot is introduced into the outer one, and the mouth of the latter closed with polyethylene foil.

The double pot is lowered into the well by means of a rope. The pot should be immersed at least 1 m below the water level to prevent damage by the buckets used for drawing water. This method can be used satisfactorily for 2-3 weeks in a well containing about 4500 litres of water.

WASTE MANAGEMENT

Waste management is the collection, transport, processing, recycling or disposal of waste materials. The term usually relates to materials produced by human activity, and is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management can involve solid, liquid, gaseous or radioactive substances, with different methods for each.

Solid waste

The term "solid wastes" includes

- garbage (food wastes)
- rubbish (paper, plastics, wood, metal, throw-away containers, glass)
- demolition products (bricks, masonry, pipes)
- sewage treatment residue (sludge and solids from the coarse screening of domestic sewage)

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- dead animals
- manure and other discarded material.

Strictly speaking it should not contain nightsoil.

Sewage:

Waste water from a community containing solid and liquid excreta, derived from houses, street and yard washings, factories and industries.

Sullage:

Waste water which does not contain human excreta.

The health hazards of accumulated solid waste are,

- it decomposes and favors fly breeding
- it attracts rodents and vermin
- the pathogens present in the solid waste may be conveyed back to man's food through flies and dust.
- there is a possibility of water and soil pollution
- it is unesthetic and produces bad odours.

Storage

The first consideration to be given is to the proper storage of refuse, while awaiting collection. The dust bin should be large enough to cater to the requirements and should have a close fitting cover.

Collection

Waste can be collected from each house, which is the best method of collecting refuse. Another method is to have public bins in which waste can be collected.

Transport

Waste should be transported using enclosed vans to the area of disposal.

DISPOSAL OF SOLID WASTE

There is no single method of refuse disposal, which is equally suitable in all circumstances. The principal methods of are,

- Dumping
- Controlled tipping or sanitary land-fill
- Incineration
- Composting
- Manure pits
- Burial

Dumping

In this method, refuse is dumped in low lying areas. This is an easy method of disposal of dry refuse and is also suitable for reclamation of land. As a result of bacterial action, refuse decreases considerably in volume and is converted gradually into humus.

The drawbacks of open dumping are:

- the refuse is exposed to flies and rodents
- it is a source of nuisance because of the smell and unsightly appearance
- the loose refuse is dispersed by the action of the wind
- drainage from dumps contributes to the pollution of surface and ground water.

It is considered as the most unsanitary method of waste disposal.

Controlled tipping (sanitary landfill)

It is the most satisfactory method of refuse disposal where suitable land is available. It this method, the material is placed in a trench or other prepared area, adequately compacted, and covered with earth at the end of the working day.

Three methods are used in this operation, the trench method, the ramp method and the area method.

The trench method: This method is used where level ground is available. A long trench is dug out - 6-10 ft. deep and 12-36 ft. wide, depending upon local conditions. The refuse is compacted and covered with excavated earth.

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The ramp method: This method is used where the terrain is moderately sloping. Some excavation is done to secure the covering material.

The area method: This method is used for filling land depressions. The refuse is deposited and sealed on its exposed surface with a mud cover. This method has the disadvantage of requiring supplemental earth from outside sources.

Chemical, bacteriological and physical changes occur in the buried refuse. The temperature rises to over 60 deg. C within 7 days and kills all the pathogens and hastens the decomposition process. It takes 4 to 6 months for complete decomposition of organic matter into an innocuous mass.

Incineration

Refuse can be disposed off hygienically by burning or incineration. Incineration requires a preliminary separation of dust or ash from the refuse. Incineration involves heavy outlay and expenditure, besides manipulative difficulties. Further, disposal of refuse by burning is a loss to the community in terms of the much needed manure. Therefore, it has a limited application in refuse disposal and is mainly used for health care waste disposal.

Composting

It is a process of nature where matter breaks down under bacterial action resulting in the formation of a relatively stable humus-like material, called the compost which has considerable manurial value for the soil. The principal by-products are carbon dioxide, water and heat. The heat produced during composting 60° C or higher, destroys all pathogenic agents. The compost formed contains few or no disease producing organisms and is a good soil builder containing small amounts of the major plant nutrients such as nitrates and phosphates. The methods of composting are,

Bangalore method (hot fermentation process)

This anaerobic method was developed by the Indian Council of Agricultural Research at the Indian Institute of Science, Bangalore. Trenches are dug depending upon the amount of refuse and nightsoil to be disposed off. Depths greater than 3 ft are not recommended because of slow decomposition. The pits should be located at least 800 m away from the city limits. First a layer of refuse is spread at the bottom of the trench. Over this, nightsoil is added. Then alternate layers of refuse and nightsoil are added till the heap rises 1 ft above the ground level. The top layer should be of refuse, at least 9 inches in thickness. Then the heap is covered with excavated earth and compacted. Within 7 days as a result of bacterial action considerable heat (over 60°C) is generated in the compost mass. The intense heat which persists over 2 to 3 weeks, causes decomposition of the material. At the end of 6 months, decomposition is complete and the resulting material is a well decomposed, odourless, innocuous material with manurial value.

Mechanical composting

In this aerobic method, compost is manufactured on a large scale. The refuse is first cleared of salvageable materials such as rags, bones, metal, glass and other items which are likely to interfere with the grinding operation. It is then pulverized in a pulverizing equipment in order to reduce the size of particles to less than 2 inches. The pulverized refuse is then mixed with sewage, sludge or nightsoil in a rotating machine and incubated. The entire process of composting is complete in 4 to 6 weeks.

Manure pits

They are dug by individual householders to dump the garbage, cattle dung, straw, and leaves. They are covered with earth after each

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day's dumping. In 5 to 6 month's time, the refuse is converted into manure which can be returned to the field. This method of refuse disposal is effective and relatively simple in rural communities.

Burial

A trench is excavated, and at the end of each day the trench is filled with earth and compacted. This method is suitable for small camps.

DISPOSAL OF HEALTH CARE WASTE

Health care waste is defined as all the waste generated by health-care establishments, research facilities and laboratories. In addition, it includes the waste originating from 'minor' or "scattered" sources such as that produced in the course of health care undertaken in the home (dialysis, insulin injection etc.).

Waste produced in the course of health care activities carries a higher potential for infection and injury than any other types of waste. Inappropriate and inadequate handling of health care waste may have serious public health consequences and a significant impact on the environment. Wherever it is generated, safe and reliable methods for its handling are therefore essential.

Categories of health care waste:

1. Infectious waste: Waste suspected to contain pathogens. Eg. lab cultures, equipment that have been in contact with infected patients.
2. Pathological waste: Human tissues or fluids. Eg. body parts, blood
3. Sharps: Needles, blade
4. Pharmaceutical waste: Expired drugs
5. Genotoxic waste: Contains Genotoxic substances which may have carcinogenic properties. Eg. cytotoxic drugs, vomit or urine of patients using these drugs.
6. Chemical waste: Lab reagents, solvents, disinfectants
7. Wastes with high content of heavy metal : Mercury
8. Pressurized containers: Gas cylinders, aerosol cans
9. Radio active waste: Unused liquid from radiotherapy, contaminated glassware.

Handling, storage and transportation of health care wastes:

The key to minimization and effective management of health care waste is segregation and identification of the waste. The most appropriate way of identifying the categories of health care waste is by sorting the waste into color coded plastic bags or containers. The other practices recommended are,

1. Sharps should be collected together, regardless of whether they are contaminated or not. Containers should be puncture-proof, rigid, impermeable, tamper-proof and with covers. Where plastic or metal containers are unavailable, dense cardboard containers with a plastic lining are recommended (WHO 1997).
2. Bags and containers for infectious waste should be marked with the international infectious substance symbol.
3. Highly infectious waste should preferably be packaged in red bags and sterilized immediately by autoclaving.
4. Expired pharmaceuticals should be returned to the pharmacy for disposal.
5. The identity of the waste should be clearly marked on the container.
   Eg. 'Cytotoxic waste' or the name of the chemical in case of chemical waste.
6. Waste with a high content of heavy metals like cadmium or mercury should be collected separately.
7. Aerosol containers if empty may be collected with general health care wastes. They should not be incinerated.

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8. Low level radioactive wastes may be collected in yellow bags if destined for incineration.

Non hazardous waste should be handled in the same manner as domestic refuse and collected in black bags.

Collection:

The waste bags should be tightly closed or sealed when they are about three-quarters full. Light gauge bags can be closed by tying the neck but heavier gauge bags probably require a plastic sealing tag.

- Waste should not be allowed to accumulate at the point of production.
- Waste should be collected daily and transported to the storage site.
- No bags should be removed unless they are labeled.
- The bags and containers should be replaced immediately with new ones of the same type.

Storage:

The waste should be stored in a separate area, room or building of a size appropriate to the quantity of waste produced and the frequency of collection.

- The storage area should have an impermeable hard standing floor with good drainage. It should be easy to clean and disinfect.
- There should be a water supply for cleaning purposes.
- The storage area should allow easy access for staff.
- Easy access for waste collection vehicles is essential.
- There should be protection from the sun.
- It should be inaccessible for animals, insects and birds.
- It should have good lighting and ventilation.
- It should not be located close to food sources.

Transportation:

Wastes should be transported by means of wheeled trolleys, containers or carts that are not used for any other purposes. They should,

- be easy to load and unload
- have no sharp edges that could damage waste bags
- be easy to clean

The vehicles should be cleaned and disinfected daily.

Treatment and disposal technologies for health-care waste:

The choice of treatment system for health-care waste should be made carefully, on the basis of various factors, many of which depend on local conditions,

- Quantity of waste and disposal capacity of the system
- Type of waste
- Infrastructure requirements
- Training requirements for operation of the method
- Operation and maintenance considerations
- Available space
- Investment and operating costs
- Regulatory requirements

The treatment and disposal options are:

1. Incineration
2. Chemical disinfection
3. Wet thermal treatment
4. Microwave irradiation
5. Encapsulation
6. Safe burying
7. Inertization

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INCINERATORS:

Incineration is a high temperature dry oxidation process that reduces organic and combustible waste to inorganic, incombustible matter and results in a very

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significant reduction of waste volume and weight.

This process is usually used to treat wastes that cannot be recycled, reused or disposed off in a landfill site.

Types of incinerators:

1. Double - chamber pyrolytic incinerators
2. Single - chamber furnaces with static grate
3. Rotary kilns

1) Pyrolytic incinerators:

This is the most reliable and commonly used process for health-care waste. They are also called controlled air incineration or double - chamber incineration. The pyrolytic incinerators comprises of

- a pyrolytic chamber
- a post-combustion chamber

In the pyrolytic chamber, the waste is thermally decomposed through an oxygen deficient medium temperature combustion process [800 - 900° C] producing solid ashes and gases. The pyrolytic chamber includes a fuel burner, used to start the process. The waste is loaded in suitable waste bags or containers. The gases produced in this way are burned at high temperature [90 - 1200° C] by a fuel burner in the post-combustion chamber, using an excess of air to minimize smoke and odors.

The pyrolytic and post-combustion chambers should be of steel with an internal lining of refractory bricks, resistant to corrosive waste or gas and to thermal shock.

Pyrolytic incinerators are suitable for:

- Infectious waste [including sharps] and pathological waste
- Pharmaceutical and chemical residues.

They are inadequate for

- Non-risk health care waste
- Genotoxic waste
- Radioactive waste

Drawbacks:

- Relatively expensive equipment
- Expensive to operate and maintain
- Well-trained personnel are required.

Activities involved in operation of pyrolytic incinerators.

1. Removal of ashes left inside the pyrolytic chamber [after cooling down]
2. Loading of waste packages to be incinerated
3. Ignition of the pyrolytic fuel burner to start waste burning in the pyrolytic chamber
4. Ignition of fuel burner in post-combustion chamber
5. Monitoring high-temperature burning of gas inside post-combustion chamber.
6. Stopping the fuel burners after completion of waste and gas burning and letting the incinerator cool down

Incinerators must be located at a minimum distance of 500 meters from any human settlement.

2) Single - chamber incinerator:

This can be used for health-care waste if a pyrolytic incinerator cannot be afforded. This type of incinerator treats waste in batches. Loading and de-ashing operations are performed manually. The combustion is initiated by addition of fuel and should then continue unaided.

A 'drum' or 'field' incinerator is the simplest form of a single-chamber incinerator. It should be used only as a last resort as it is difficult to burn the waste completely without generating potentially harmful smoke.

A 210 litre steel drum is used, with both ends removed. This will allow the burning of one bag of waste at a time. A fine screen is placed on the top of the drum to prevent some of the ash or light material from blowing out.

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Another screen or fine grate is placed under the drum and a chimney is fitted on top. This type of incinerators can also be fabricated from sheet metal or clay. A good fire should first be established on the ground underneath the drum. One bag of waste should then be lowered into the drum. Wood should be added to the fire until the waste is completely burnt. After burning is complete, the ashes from both the fire and the waste itself should be collected and buried safely. A "brick incinerator" is used in similar circumstances and is built by constructing a closed area with brick or concrete walls.

Drawbacks:

- Chemical and pharmaceutical residues will persist if temperatures do not exceed 200°C.
- The process will cause emission of black smoke, fly ash and potentially toxic gases
- Exhaust gas cleaning is not practical - can cause air pollution

3) Rotary kiln:

A rotary kiln comprises of a rotating oven and a post-combustion chamber. The axis of a rotary kiln is inclined at a slight angle to the vertical [3 - 5° slope]. The kiln rotates 2 -5 times per minute and is charged with waste at the top. Ashes are evacuated at the bottom end of the kiln. The gases produced in the kiln are heated to high temperatures to burn off gaseous organic compounds in the post-combustion chamber and typically have a residence time of 2 seconds. Rotary kilns may operate continuously and are adaptable to a wide range of loading devices. Those designed to treat toxic wastes should preferably be operated by specialist waste disposal agencies and should be located in industrial areas.

Rotary kilns can be used for:

- Infectious waste [including sharps] and pathological waste
- All chemical and pharmaceutical wastes including cytotoxic waste.

Rotary kilns are inadequate for:

- Non-risk health-care waste: Incineration in rotary kilns would represent a waste of resources.
- Radio-active waste: Treatment does not affect radio-active properties and may disperse radiation.

Temperature of rotary kilns: 1200 - 1600° C
This allows decomposition of very persistent chemicals such as polychlorobiphenyls [PCBs]

Capacity of rotary kilns: Available capacities range from 0.5 - 3 tonnes/hour.

Disadvantages of rotary kilns:

- Well trained personnel are required
- Equipment and operation costs are high
- Energy consumption is high
- Highly corrosive waste and by-products damage the refractory lining of the kiln

CHEMICAL DISINFECTION:

In this method, chemicals are added to waste to kill or inactivate the pathogens. This method is most suitable for treating liquid waste such as blood, urine, stools or hospital sewage.

Solid wastes and highly hazardous health-care wastes may also be disinfected chemically, with the following limitations:

1. Shredding or milling of waste is usually necessary before disinfection
2. Powerful disinfectants are required which are themselves hazardous and should be used only by well-trained personnel.
3. Only the surface of intact solid waste will be disinfected.

The effectiveness of disinfection is estimated from the survival rates of indicator organisms in standard microbiological tests.

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Types of chemical disinfectants:

1. Formaldehyde

It has an inactivating effect against all microorganisms including bacteria, viruses and bacterial spores [contact time: 45 minutes]

Gloves and protective eye glasses should be worn during handling of formaldehyde to protect skin and eyes. In case of skin contact, the area should be rinsed abundantly with water. Formaldehyde has been classified as a probable human carcinogen by the International Agency for Research on Cancer. Therefore, formaldehyde is suitable for use as a chemical disinfectant only in situations in which a high level of chemical safety can be maintained.

2. Ethylene oxide

It inactivates all microorganisms including bacteria, viruses and spores. It can also disinfect solid wastes at temperatures of 37-55°C at 60 -80% humidity for 4-12 hours.

Liquid ethylene oxide and aqueous solutions are extremely irritant to skin and eyes.

Ethylene oxide has been classified as a human carcinogen by the International Agency for Research on Cancer. Protective measures are therefore necessary. The use of ethylene oxide is not recommended because of significant health hazards.

3. Glutaraldelhyde

It is active against both bacteria and parasite eggs. It should be used as 2% aqueous solution with acetate buffer.

Contact time: 5 minutes for disinfection of medical equipment 10 hours to kill spores. Since concentrated solutions are irritant to eyes and skin, gloves and protective eye glasses should be worn during handling.

Glutaraldehyde is suitable only in situations in which a high level of chemical safety can be maintained. Glutaraldehyde waste should never be discharged in sewers. It may be neutralized through careful addition of ammonia or sodium bisulfite. It may also be incinerated, after mixing with a flammable solvent.

4. Sodium hypochlorite:

It is active against most bacteria, viruses and spores but not effective for disinfection of liquids with high organic content such as blood or stools. Solutions should be protected from light, which accelerate its decomposition to sodium chlorate, sodium chloride and oxygen. It reacts with acids to produce hazardous chlorine gas.

Gloves and protective eye glasses should be worn. Although it is an irritant to skin, eyes and respiratory tract, sodium hypochlorite may be widely used because of relatively mild health hazards.

5. Chlorine dioxide

It is a reddish - yellow gas at ambient temperature. It will react with water or steam to produce corrosive fumes of hydrochloric acid. It is active against most bacteria, viruses and spores. It is an irritant to skin, eyes and respiratory tract. It is widely used in drinking water preparation, sanitation and waste water treatment.

WET THERMAL TREATMENT:

Wet thermal treatment or steam disinfection is based on exposure of shredded infectious waste to high-temperature, high-pressure steam. It inactivates most types of microorganisms.

This process requires that waste be shredded before treatment to increase disinfection efficiency. The process is inappropriate for the treatment of anatomical waste and animal carcasses.

The disadvantages are:

- The shredder is liable to mechanical

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failure and breakdown
- The efficiency of disinfection is very sensitive to operational conditions

The advantages are:

- Relatively low investment and operating costs
- The low environmental impact

Autoclaving is an efficient wet thermal disinfection process. They allow for the treatment of only limited quantities of waste and are therefore commonly used only for highly infectious waste, such as microbial cultures or sharps.

MICROWAVE IRRADIATION:

Most microorganisms are destroyed by the action of microwaves of a frequency of about 2450 MHz and a wavelength of 12.24 cm. The water contained within the wastes is rapidly heated by the microwaves and the infectious components are destroyed by heat conduction. Although this process is becoming increasingly popular, relatively high costs coupled with potential operation and maintenance problems mean that it is not yet recommended for use in developing countries.

ENCAPSULATION:

This procedure involves filling containers made of high density polyethylene or metal drums, with waste. These containers are then filled up with a medium of immobilizing material such as plastic foam, cement mortar or clay. After the medium has dried, the containers are sealed and disposed off in landfill sites. It is a simple, low-cost and safe method but not recommended for non-sharp infectious waste.

SAFE BURYING:

Safe burial of waste may be used when this is the only viable option available especially in establishments which use minimal programs for health care waste management. However, certain basic rules should be followed,

- Access to the disposal site should be restricted to authorized personnel only.
- The burial site should be lined with a material of low permeability like clay.
- Only hazardous health-care waste should be buried, so as to conserve space.
- Large quantities of chemical waste should not be buried at one time to avoid environmental pollution.
- The burial site should be covered with a layer of earth to prevent health hazards.

INERTIZATION:

This process involves mixing waste with cement and other substances before disposal in order to minimize the risk of toxic substances contained in the waste migrating into surface water or ground water. It is especially suitable for pharmaceuticals and for incineration ashes with a high metal content. This is a relatively inexpensive method of waste disposal but it is not applicable to infectious waste.

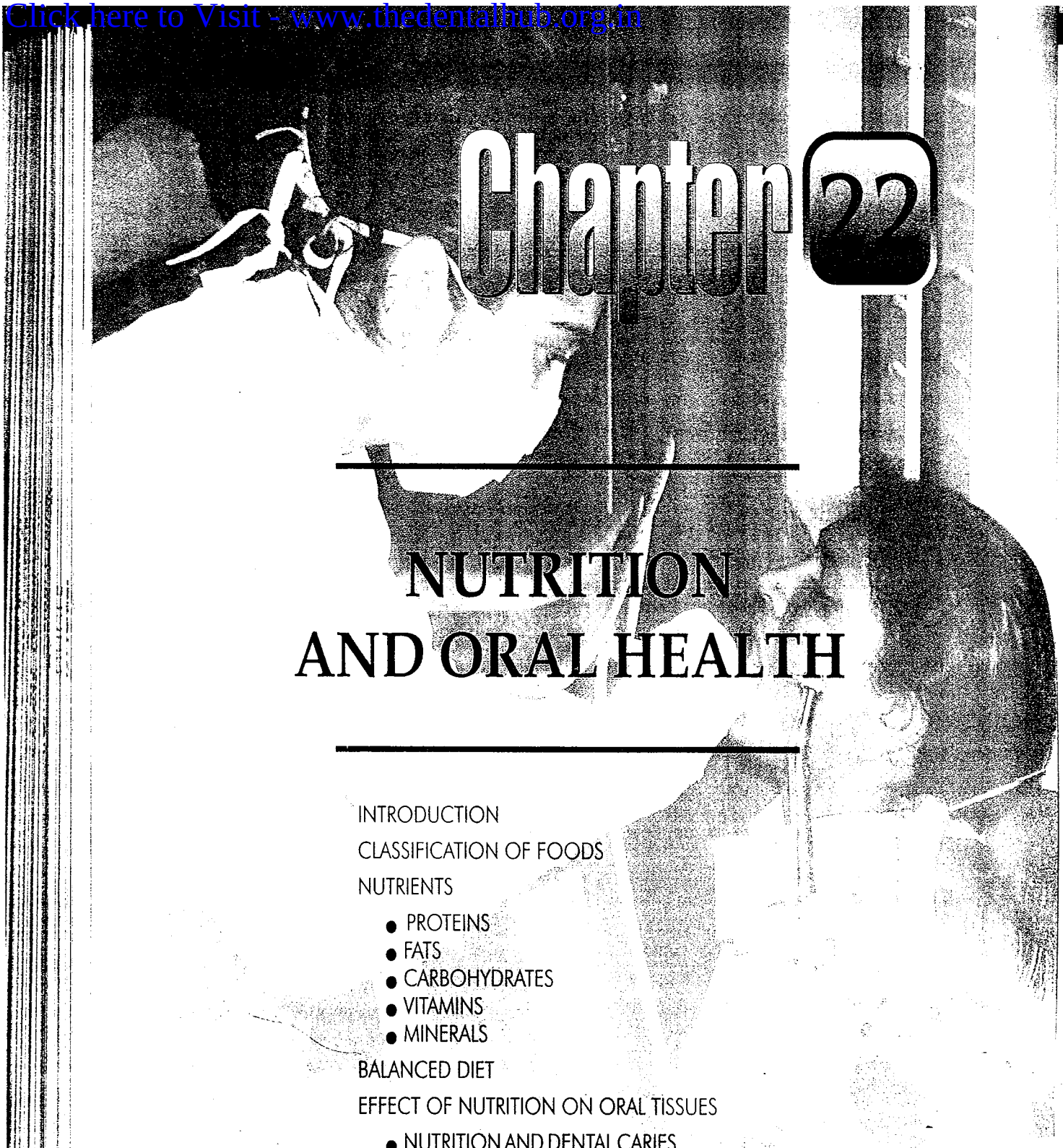
CONCLUSION

The key to man's health lies in his environment. Much of man's ill-health can be traced to adverse environmental factors such as water pollution, air pollution, poor housing conditions and presence of vectors of diseases which pose a constant threat to man's health. The purpose of environmental health is to create and maintain ecological conditions that will promote health and thus prevent disease.

International Infectious substance symbol



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Chapter 22

NUTRITION AND ORAL HEALTH

INTRODUCTION

CLASSIFICATION OF FOODS

NUTRIENTS

- PROTEINS
- FATS
- CARBOHYDRATES
- VITAMINS
- MINERALS

BALANCED DIET

EFFECT OF NUTRITION ON ORAL TISSUES

- NUTRITION AND DENTAL CARIES
- EFFECT OF MALNUTRITION ON MALOCCLUSION
- NUTRITION AND PERIODONTAL DISEASE
- NUTRITION AND ORAL CANCER

NUTRITION IN THE ELDERLY

PREVENTIVE AND SOCIAL MEASURES

CONCLUSION

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INTRODUCTION

Nutrition is an essential and continuing component in the complex process of maintaining optimal health throughout life. For proper function, even when no major stresses are present, every cell of each organ, tissue system and structure has a continuing demand for nutrients to perform its specialized dynamic and interrelated function.

DIET is defined as the types and amounts of food eaten daily by an individual (FDI, 1994)

Diet refers to the local action of foods on oral tissues and encompasses the composition of the food, its consistency and the pattern and frequency of eating. It encompasses the food as it is eaten regardless of its fate and exerts local/direct effect upon the dentition.

NUTRITION is defined as the sum of the processes by which an individual takes in and utilizes food (FDI, 1994)

Nutrition differs from diet in that it deals with those parts or elements of food that are absorbed through the intestinal tract and enter into a metabolic process of the body in the formation and replacement of tissue. It exerts systemic effects upon the dentition via the pulpal blood supply and the saliva.

Malnutrition: a pathological state resulting from a relative or absolute deficiency or excess of one or more essential nutrients.

It is a generic term given to the pathophysiological consequences of ingestion of inadequate or unbalanced amounts of essential nutrients (primary malnutrition), as well as the impaired utilization of these nutrients brought about by factors such as disease (secondary malnutrition).

Teeth are unusual in that nutritional influences are exerted solely during their formation. Unlike bone and the soft tissues of the mouth, which are constantly being renewed and respond readily to nutritional imbalance, dental tissues once formed are unaffected by systemic, nutritional and hormonal disturbances.

CLASSIFICATION OF FOODS

(a) By origin:

- foods of animal origin
- foods of vegetable origin

(b) By chemical composition:

- proteins, fats, carbohydrates, vitamins, minerals

(c) By predominant function:

- body-building foods - milk, meat, poultry
- energy-giving foods - cereals, sugars, roots
- protective foods - vegetables, fruits, milk

(d) By nutritive value:

- cereals and millets, pulses, vegetables, nuts and oilseeds, fruits, animal foods, fats and oils, sugar and jaggery

NUTRIENTS

Nutrients are organic and inorganic complexes contained in food. Each nutrient has specific functions in the body. They are divided into,

(a) Macronutrients- they form the main bulk of food

- Profeins	7 - 15 %
- Fats	10 - 30 %
- Carbohydrates	65 - 80 %

(b) Micronutrients - they are required in small amounts

- Vitamins
- Minerals

PROTEINS

They are complex inorganic nitrogenous compounds composed of carbon, hydrogen,

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oxygen, nitrogen and sulphur. Their major functions are,

1. Body building
2. Repair and maintenance of tissues
3. Synthesis of antibodies, plasma proteins, hemoglobin, enzymes and hormones
4. They supply energy (4kcal per 1 gram)

Proteins are obtained from animal sources (milk, meet, egg) and from vegetable sources (pulses, cereals, nuts). The Indian Council of Medical Research (ICMR) has recommended one gram protein/Kg body weight for an Indian adult.

FATS/LIPIDS

They are concentrated sources of energy. They are classified as,

- Simple lipids - Triglycerides
- Compound lipids - Phospholipids
- Derived lipids - Cholesterol

Almost 99% of body fats are in the form of triglycerides.

Their major functions are,

1. They supply energy (9 Kcal per 1 gram)
2. They carry flavor of food
3. They add satiety and variety to a meal
4. They are an integral part of cells and cell membranes (the essential fatty acid linoleic acid is necessary for healthy skin)
5. They carry the fat-soluble vitamins A, D, E and K
6. They may act to reduce dental caries by coating the plaque, thereby preventing fermentable carbohydrates from entering it.

Fats are obtained from animal sources (ghee, butter, cheese, egg, fat of meat and fish), vegetable sources (groundnut, coconut, mustard) and other sources (rice, wheat, jowar)

The Indian Council of Medical Research (ICMR) has recommended a daily intake of not more than 20 % of total energy intake through fats.

CARBOHYDRATES:

It is the third major component of food. It is found in cereals, fruits and vegetables and is essential in the diet as a source of both glucose and cellulose, the major source of energy.

Their major functions are,

1. They supply energy (4 kcal per 1 gram)
2. They are essential for the oxidation of fats
3. They are required for the synthesis of certain non-essential amino acids

The 3 main sources of carbohydrates are starches, sugars and cellulose. The carbohydrate reserve of a human adult is about 500 grams, which is rapidly exhausted when a person is fasting.

VITAMINS:

It is a substance which must be obtained by dietary means because of a lack of capacity in the human body to synthesize it.

They are part of the enzyme system (act either as coenzymes/catalysts for energy-releasing reactions from carbohydrates, lipids and proteins)

Classification of vitamins:

Fat-soluble -- A, D, E, K

Water-soluble -- B, C

Vitamin A:

It is widely distributed in animal foods (liver, eggs, butter, cheese, fish and meat), plant foods (green leafy vegetables like spinach, papaya, mango, carrots) and in fortified foods (vanaspati, fortified milk)

Its functions are:

1. It contributes to the production of retinal pigments. It is indispensable for normal vision
2. It is necessary for maintaining the integrity

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and normal function of the glandular and epithelial tissues
3. It supports skeletal growth
4. It is anti-infective
5. It may protect against some cancers

The recommended daily intake is 600 micrograms for adults. Deficiency causes night blindness, conjunctival xerosis, corneal ulceration and keratomalacia.

Vitamin D:

Recent advances have proposed that vitamin D should be regarded as "Kidney hormone" because it does not meet the classic definition of a vitamin (since it can be produced in the body in adequate amounts by simple exposure to sunlight even for 5 minutes per day).

It is synthesized by the action of ultraviolet rays on 7-dehydrocholesterol. Vitamin D is also found in foods of animal origin (liver, egg yolk butter, cheese)

Its functions are:
1. Promotes intestinal absorption and renal tubular reabsorption of calcium and phosphorous
2. Stimulates mineralization of bone and enhances bone resorption
3. Permits normal growth

The daily requirement is 2.5 microgram (100 IU) for adults. Deficiency causes rickets and osteomalacia.

Vitamin E: (Tocopherol)

It is a group of naturally occurring fat soluble compounds which are widely distributed in foods. The richest sources are vegetable oils, egg yolk and butter. Although there is no clear indication of vitamin E deficiency, it is required in the diet. The requirement of Vitamin E is 0.8 milligrams per gram of essential fatty acids.

Vitamin K:

It is a fat soluble vitamin which occurs in two forms, K_1 and K_2. Vitamin K_1 is present in fresh green leafy vegetables and cow's milk. Vitamin K_2 is synthesized by the intestinal bacteria. It is stored in the liver.

Its role is to stimulate production or release of coagulation factors. The requirement is 0.03 mg per kg for adults.

The B-complex vitamins:

Thiamine (Vitamin B1)

It occurs in whole grain cereals, wheat, gram, pulses and groundnuts. It is also present in milk, meat, fish and egg. The daily requirement is 0.5 mg per 1000 k cals of energy intake.

Deficiency causes

- Beriberi
- Wernicke's encephalopathy

Riboflavin (vitamin B2)

Its richest sources are milk, eggs, liver, kidney and green leafy vegetables. The daily requirement is 0.6 mg per 1000 kcal of energy.

Deficiency is associated with

- Angular stomatitis
- Cheilosis
- Glossitis

The deficiency is usually a part of a multiple deficiency syndrome.

Niacin (Nicotinic acid)

It is present in liver, kidney, meat, fish, legumes and groundnut. The daily requirement is 6.6 mg per 1000 kcals of energy.

It is required for the

- Metabolism of carbohydrate, fat and protein
- Normal functioning of the skin, intestinal and nervous systems

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Deficiency results in pellagra, characterized by the three D's,

- Diarrhoea
- Dermatitis
- Dementia

The other features are glossitis and stomatitis

Pyridoxine (vitamin B6)

It is widely distributed in foods, milk, liver, meat, egg yolk, fish, legumes and vegetables. The daily requirement is 2 mg. Deficiency is rare.

Pantothenic acid

All foods contribute to its dietary intake. The daily requirement is 10 mg. It plays a role in the biosynthesis of corticosteroids.

Folate (Folacin or Folic acid)

It is present in liver, meat, dairy products, egg, milk, fruits and cereals. The daily requirement is 100 micrograms for adults.

Deficiency is usually found during pregnancy and lactation, characterized by,

- Megaloblastic anemia
- Glossitis
- Cheilosis
- Diarrhoea

Vitamin B_{12}

It is a complex organo-metallic compound with a cobalt atom. The therapeutic preparation is called cyanocobalamine. The sources are liver, kidney, meat, fish, eggs, milk and cheese. It is not found in vegetables.It is also synthesized by bacteria in the colon. The daily requirement is 1 microgram per day for adults. Its deficiency is associated with megaloblastic anemia (pernicious anemia).

Vitamin C (Ascorbic acid)

- It is a water soluble vitamin which helps to maintain the cementing material that holds the body cells together. Its sources are fresh fruits, green leafy vegetables and germinating pulses. The daily requirement is 60 mg. Its deficiency results in scurvy which is characterized by,
- Swollen, bleeding gums
- Subcutaneous bruising or bleeding into the joints
- Delayed wound healing
- Anemia
- Weakness

It influences formation of hemoglobin and aids in the absorption of iron from the intestinal wall. The human body does not store vitamin C.

MINERALS:

Classification of minerals:

- Major minerals: Calcium, Phosphorous, Sodium, Potassium, Magnesium
- Trace elements: Iron, Iodine, Fluorine, Zinc, Copper, Cobalt, Chromium, Manganese, Molybdenum, Selenium, Nickel, Tin, Silicon, Vanadium
- Trace contaminants with no known function: Lead, Mercury, Barium, Boron, Aluminium

Only a few minerals are associated with recognizable clinical situations in man.

Calcium:

The best natural sources are, milk and milk products, eggs and fish.

Its functions are,

- Formation of bones and teeth
- Coagulation of blood
- Contraction of muscles
- Milk production
- Keeping the cell membranes intact
- Metabolism of enzymes and hormones

A daily intake of 400 to 500 mg is required for adults. No clear cut disease due to deficiency has been observed.

Phosphorous:

It is widely distributed in foodstuffs.. It is

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essential for the formation of bones and teeth. Although specific requirements have not been recommended, some researchers have suggested that its intake should be at least equal to calcium intake.

Iron:

It is found in meat, liver, fish, cereals, green leafy vegetables, nuts and dried fruits.

It is required for,

- Formation of hemoglobin
- Brain development and function
- Regulation of body temperature
- Muscle activity

A daily intake of 0.9 mg and 2.8 mg is required for adult males and females respectively. Deficiency is characterized by,

- Iron deficiency anemia
- Impaired cell-mediated immunity
- Reduced resistance to infection
- Increased morbidity and mortality
- Diminished work performance

Iodine:

The best sources are sea foods and cod liver oil. It is required for,

- Synthesis of the thyroid hormones.
- Normal growth and development

A daily intake of 150 microgram is required for adults.

The most obvious deficiency is goitre. The other features are,

- Hypothyroidism
- Retarded physical and mental development
- dwarfism

Fluorine: (Refer chapter 11)

BALANCED DIET

A balanced diet is one which contains a variety of foods in such quantities and proportions that the need for energy, amino acids, vitamins, minerals, fats, carbohydrate and other nutrients is adequately met for maintaining health, vitality and general well-being and also makes a small provision for extra nutrients to withstand short duration of leanness.

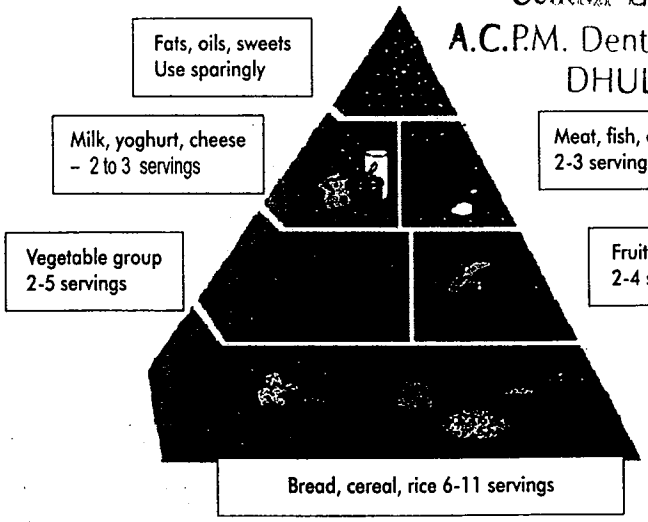
A balanced diet might be described as one providing each nutrient in the amount (neither deficiency nor excess) needed to maintain optimum health.

Protein	15-20%
Fat	20-30%
Carbohydrates	remaining part

Food pyramid:

The food guide pyramid can help to choose a variety of foods to help achieve a balanced diet. Selecting foods from each group will provide the many nutrients needed by the body.

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Recommended dietary allowance (RDA):

Recommended dietary allowance is the amount of nutrients sufficient for the maintenance of health in nearly all people.

The amounts recommended include:

- a minimal physiological requirement (lack of which would eventually cause deficiency disease), and
- a margin of safety of 30-50% above actual physiologic requirements to allow for individual variation and to provide body stores for times of stress.

The recommendations by the expert committee of WHO are,

- dietary fat should be 20-30% of total daily intake
- saturated fats-not more than 10% of total energy intake
- excessive consumption of refined carbohydrate to be avoided
- energy-rich sources such as fats and alcohols - consumption to be restricted
- salt intake reduced to not more than 5 gm/day
- protein - 15-20% of daily intake
- reduced consumption of colas, ketchups and other foods that supply empty calories

EFFECT OF NUTRITION ON ORAL TISSUES

The nutritional needs for maintaining the health of the oral structures are similar to those for the remainder of the body.

Nutrition and dental caries:

Pre-eruptive effects

The physical and chemical properties of enamel could be altered in the direction of increased dental caries susceptibility. Malnutrition can cause irreversible changes in the teeth that could predispose them to develop caries. Enamel maturation, physical and chemical composition, time of eruption, tooth morphology and size are all affected by pre-eruptive nutrient intake.

Mineral malnutrition may be due to inadequate quantities of calcium and phosphorus; another mineral showing signs of being an important factor in caries resistance is iron. The dental dysplasias associated with malnutrition are:

- An odontoclasia in the deciduous dentition,
- A "yellow teeth" condition seen in permanent teeth.
- "Infantile melanodontia" which has been observed in deciduous teeth.
- A linear hypoplasia of deciduous incisor teeth called Lesion Cauque which occurs due to a deficiency in ascorbic acid or vitamin A or neonatal infection.

These hypoplastic defects seen in malnourished populations are caused by interactions between nutrient deficiencies and the processes that occur during tooth development. Enamel hypoplasia (in situations where there are disturbances of calcium and/or phosphate homeostasis) is caused specifically by hypocalcemia.

In L-Ascorbic acid deficiency, the teeth are qualitatively and quantitatively deficient in dentin formation with atopic calcification or pulpal stone formation. In vitamin D deficiency, hypoplastic lesions of the enamel usually occur. These defects can lead to extensive dental caries.

Post-eruptive effects

The post-eruptive effects of malnutrition (particularly protein deficiency) lead to decreased salivary lysozyme and secretory IgA levels. Any alteration of salivary protein could have negative effects on the susceptibility to caries. Changes, for the negative, in salivary peroxidase, lactoferrin, lysozyme and other proteins can reduce the

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host defence mechanism to cariogenic organisms. In children with protein-calorie malnutrition, IgA is reduced in the secretions, thereby increasing caries susceptibility. However, underfed populations may lack the cariogenic challenge that is necessary for the disease to develop. Therefore, their dental caries prevalence may also be low. It is only upon exposure to cariogenic conditions that their teeth seem to "melt" or deteriorate.

NUTRITION AND MALOCCLUSION

Teeth differentiate early in development and undergo short critical periods of growth. Therefore, the ultimate genetically determined size is established early in the developmental process.

In contrast, jaw bones develop during an extended period of time, undergo a prolonged critical period and achieve their genetic size potential only after the teeth have developed. Because tooth sizes are determined genetically in a much shorter time span whereas jaw size determination takes longer, a chronic postnatal malnutrition would result in stunted jaw development after the teeth have differentiated. This may result in Class I type of malocclusions. Poor tooth alignment & crowding result in increased caries & periodontal disease.

NUTRITION AND PERIODONTAL DISEASE

When local factors are conducive to the production of periodontal disease in man, it is believed that the rapidity of the destructive process is determined to a considerable extent by constitutional factors, of which nutritional status may be an important factor.

Periodontal diseases involve episodic, progressive disruption of several different tissues. The different host factors are susceptible to nutritional influences acting systemically on structure, repair and defense. The main targets in nutritional deficiency are the epithelial barrier and attachment, periodontal ligament, gingival connective tissue, alveolar bone, cellular and humoral immune mechanisms, inflammatory response, composition of gingival fluid as also the crevicular epithelium (to invasion by antigenic or enzymatic irritants/toxins produced by bacteria). All these are susceptible to nutrient imbalance.

Iron:

It is an obligate factor in collagen metabolism. Due to its role in the movement of oxygen to cells and its role in cytochrome enzymes, it impacts both innate and adaptive immunity.

Deficiency

- Leads to impaired neutrophils' bactericidal activity, reduced lymphocyte proliferation and response to antigens, thus increasing risk and severity of infection.
- Causes reduced thickness of the oral epithelium, reduced size of its progenitor cells and delayed maturation of the epithelial barrier.

In iron deficiency anemia, gingiva is characteristically pale. An inverse correlation has been seen between tissue iron levels and sulcular epithelial permeability.

Protein:

Alveolar bone is sensitive to changes in protein metabolism. Deficiency causes increased susceptibility to periodontal infection while supplementation reduces inflammation and tooth mobility.

Vitamin C:

It gives tensile strength to the tissues and determines morphology. Gingivitis with hemorrhagic, enlarged bluish-red gingivae is a classic sign of scurvy, but gingivitis is not caused by lack of vitamin C per se. It is

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caused by local irritants plus the conditioning effect of the deficiency upon the gingival response to local irritation.

In severe ascorbic acid deficiency, teeth exfoliate (collagen regeneration fails, with the shedding of teeth and bone resorption being the ultimate results). Scurvy also results in a reduction in salivary flow.

Vitamin A:

It is important in the synthesis of proteoglycans, fibronectin and Type 1 procollagen, and in epithelial tissue differentiation. It acts on cells which have both a rapid turnover and the potential to differentiate in more than one direction. Deficiency causes decreased salivary flow, hyperkeratosis and gingival hyperplasia.

Vitamin B Complex:

It has a role in the division and growth of cells, particularly those with rapid renewal rate. Deficiency affects epithelium of mouth and lips. Niacin deficiency predisposes gingivae to Vincent's infection or ANUG.

Vitamin K:

Deficiency causes gingival bleeding and post-extraction haemorrhage.

Vitamin E:

It increases periodontal resistance to inflammatory-mediated tissue destruction and improves gingival health.

Calcium and phosphorous:

In those with low calcium intake, severe alveolar bone loss following tooth extraction is seen which is reduced by calcium supplements. Calcium decreases gingival inflammation, calculus formation, pocket depths and tooth mobility. A low calcium & low calcium-to-phosphate ratio is positively correlated with severe alveolar ridge resorption.

Amino acids:

- Linoleic acid deficiency causes dermatitis and impaired wound healing while excess acts as an immunosuppressant (stimulates suppressor T-cell activity).
- Arginine deficiency compromises cellular immune mechanisms, particularly T-cell function.
- Omega-3 fatty acid deficiency causes neurological deficits, dermatitis and immunological changes while excess improves cell-mediated immune responses and opsonic indices, increases splenic weight and inhibits production of immunosuppressive prostaglandins.

The role of nutrition in the management of gingival and periodontal disease is primarily that of prevention and maintenance.

The benefits from good nutrition are to

(1) resist infection

(2) strengthen and maintain the epithelial barrier

(3) promote repair of damaged periodontal tissues

A well-nourished state is optimal for wound healing; increases resistance to infection and hastens convalescence and recovery. Although periodontal disease is not a nutritional deficiency disease per se, malnutrition is likely to play a role in either predisposing the host to the progression of pre-existing periodontal lesions, influence the outcome of periodontal treatment, or both.

NUTRITION AND ORAL CANCER

Nutrition plays an important role in the etiology of oral and pharyngeal cancers. Malnutrition increases the susceptibility to cancer of the head and neck. Foods contain both initiators and modifiers of carcinogenesis. The modifiers may affect carcinogenesis by influencing the activity of

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carcinogen-metabolizing enzymes, hormonal status, or the immune response.

Most chemical carcinogens require enzymatic activation. The primary enzyme system responsible is the mixed-function oxidase system which is significantly influenced by the nutritional status and the levels of specific nutrients, e.g., by protein or fat intake. Specific nutrient deficiencies may depress these enzymes, thereby reducing the body's defense against chemical carcinogens.

High-protein diets are likely to contain large amounts of animal and other saturated fats, and calories (both associated with cancer). A minimal protein level of about 5% is necessary for good health and growth. High intakes of saturated animal fats are associated with an increased risk of cancer of the mouth and pharynx. Malnutrition or anaemia reduce the ability of the immune system to counteract neoplastic cells.

Nutritional factors protect against tumorigenesis by

- acting as blocking agents
- altering metabolism of the carcinogen through decreased activation
- increasing detoxification
- by scavenging the active molecular species of carcinogens to prevent their reaching or reacting with the target sites in the cell
- competitive inhibition

Vitamin A and retinoids (derivatives of vitamin A)

- inhibits chemically-induced tumors in various tissues
- consumption is linked to lower risk of various cancers in humans
- people with highest total carotenoid concentrations are 1/3 rd at risk for oral and pharyngeal cancer
- less toxic synthetic analogs, the retinoids, are effective in preventing carcinogenesis or in inducing regression of already formed tumors
- affects tumor latency by retarding growth of tumors
- have effects on protein kinase C, which influences epidermal growth factor receptors and DNA synthesis inhibition
- retinoids and analogues used topically and systemically have been successful in the treatment of oral leukoplakia. More impressive and safer treatment outcomes have been reported with β-carotenoid

β-carotene (which is metabolised to vitamin A)

- is an antioxidant and free radical scavenger
- is better than retinoids (lower toxicity)
- inverse relationship is seen between incidence of oral cancer and dietary availability of β-carotene/retlnoids and vitamin C
- micronuclei formation in (exfoliated) buccal cells is reversed by β-carotene supplementation
- patients with oral leukoplakia treated with all-trans-retinoic acid, 13-cis-retinoic acid or β-carotene showed reductions in lesion size or stabilization of the leukoplakia

Vitamin C

- is an antioxidant
- is negatively associated with risk for oral cancer
- inhibits formation of carcinogenic N-nitroso (nitrosamine) compounds and mutagenicity of certain direct-acting mutagens (β-propiolactone and methylnitrosoguanidine)
- combined vitamin A and C intake is inversely associated with the risk for oral cancer, vitamin A having a more significant impact than vitamin C

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- is an enhancer of immune responses through effects on phagocytes
- is an affecter of oxidases involved in detoxification of carcinogens

Vitamin E

- users have half the risk of developing oral cancer compared to non-users
- is an antioxidant
- is a free-radical scavenger and protects cell membrane from oxidative damage
- blocks nitrosamine formation
- influences humoral and cell-mediated immunity
- increases cell-repair capacity

Vitamin B complex:

Patients with cancer or precancerous lesions in the mouth display signs of vitamin B complex deficiencies (gross thiamin deficiencies and moderate riboflavin deficiencies).

Foodstuffs:

- Fruit intake has a protective effect. Risk of cancer of the mouth and pharynx is halved in those who eat fruit/vegetable daily (evidence is most consistent for carrots, citrus fruits and green vegetables).
- Fish, buttermilk, milk, dairy products, oranges, cabbage and seafood are protective against oral cancer. Frequent consumption of milk, eggs, meat or fish reduces the risk of oral carcinogenesis in smokers and betel-nut chewers.
- Increased oral cancer risk was observed for vegetable oil and excess animal fat.

Supplementation with iron and vitamins markedly reduced the incidence of cancers of the mouth, pharynx and oesophagus. Dietary iron is found mainly in meat. Deficiency may lead to a premalignant state in the oral mucosa (oral mucosal atrophy in iron-deficient states is a predisposing factor in the development of oral cancer).

NUTRITION IN THE ELDERLY

A major problem of many elderly persons is limited physiological capability to digest and absorb foods due to

- an inability to chew food thoroughly because of an inadequate/poorly functioning dentition
- appetite is diminished and appreciation of flavorful tastes is lacking which diminishes the food intake
- dental and medical infirmities that interfere with chewing, digestion or metabolism contribute to a poor nutritional status
- certain nutritionally related maladies (e.g., diabetes, obesity, cardiovascular disease, osteoporosis and cancer) require special dietary regimens that necessitate combined guidance and supervision of a team of specialists in medicine, dentistry, dietetics, sociology and psychology

Alveolar osteoporosis:

Alveolar bone participates in the maintenance of body calcium balance making it susceptible to osteoporosis. In the elderly, there is a relative increase in bone disease and resorption compared with deposition. With the loss of teeth, the alveolar process no longer serves its primary function of tooth support and is resorbed.

Therefore, the elderly need to supplement their diet (especially of women) with calcium and vitamin D (to retard alveolar bone loss), adequate polyunsaturated fats and low-cost proteins, fewer calories, increased vitamins C and B12, folic acid, iron and other vitamin B members to increase resistance of bone to mechanical and nutritional biochemical stresses.

PREVENTIVE AND SOCIAL MEASURES

The problem of malnutrition can be solved only by taking action simultaneously at

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various levels (family, community, national and international) levels along with a coordinated approach between many disciplines (nutrition, food technology, health administration, health education, marketing, etc.)

Action at the family level:

- through nutritional education about the selection of the right kind of foods and planning for nutritionally adequate diets
- identification and correction of harmful food taboos and dietary prejudices
- promotion of breast feeding; improvement in infant and child feeding practices
- promotion of a kitchen garden or keeping poultry
- community health workers and multipurpose workers can impart nutritional education to families

Action at the community level:

- analysis of the extent, distribution and types of nutritional deficiencies; population groups at risk; dietary and non-dietary factors contributing to malnutrition
- conduct of diet and nutrition surveys
- planning realistic and feasible approaches in developing countries, direct intervention measures to be started (temporary measures) supplementary feeding programs, midday school meals, vitamin A prophylaxis programs
- real solution can only be obtained through fundamental measures which correct the basic causes of malnutrition - increasing the quality and quantity of available foods

Action at the national level:

- by rural development
- increasing agricultural production
- stabilization of population,
- nutritional intervention programs (iodized salt, iron and folic acid tablets for anaemia, vitamin A for blindness)
- nutrition-related health activities (Malaria Eradication Program)

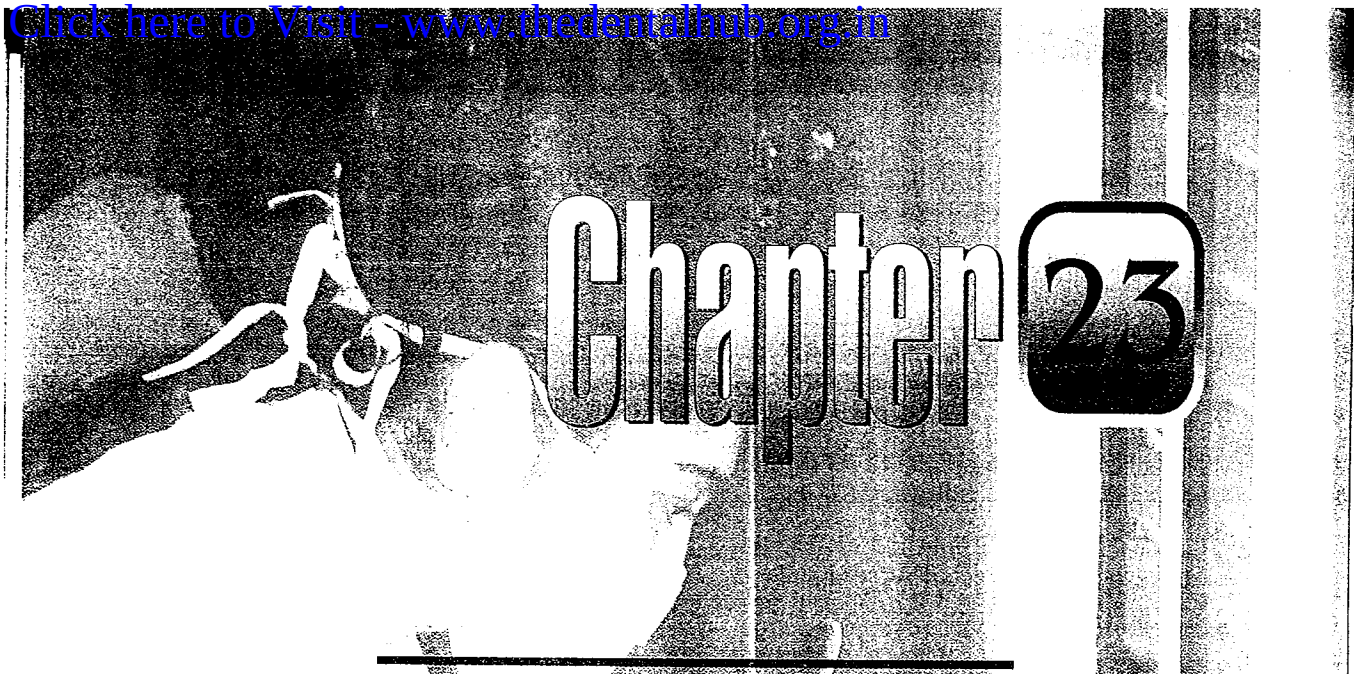
Action at international level:

- FAO, UNICEF, WHO, World Bank, UNDP and CARE are some agencies helping national governments in different parts of the world in their battle against malnutrition

CONCLUSION

Nutrition is vital to human development, growth, and health maintenance. Nutritional issues, at the forefront of popular culture are part of the current wellness and health promotion climate. Compared with other health care workers, dentists reach a larger number of the general public per year and are in a position to provide clinical and behavioral assessment, information, education, motivation, and follow-up. The dental visit, which is usually longer in duration than the medical visit, affords better opportunities for motivational interventions to enhance self care and health care decisions. Within the community, dentists are strategically positioned to be advocates for a better understanding of how oral health and systemic health are related and to be effectively involved in health promotion efforts and to advocate wellness for patients while improving or maintaining their oral health status.

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Chapter 23

OCCUPATIONAL HAZARDS & INFECTION CONTROL IN DENTISTRY

INTRODUCTION

IMMUNITY

COMMON TRANSMISSIBLE INFECTIONS IN DENTISTRY

- HERPES VIRUS INFECTIONS
- HIV INFECTION / ACQUIRED IMMUNO DEFICIENCY SYNDROME (AIDS)
- TUBERCULOSIS

ROUTES OF TRANSMISSION

CATEGORIES OF TASK IN RELATION TO RISK

VACCINES FOR DENTAL HEALTH-CARE WORKERS

PERSONAL BARRIER TECHNIQUES FOR INFECTION CONTROL

USE AND CARE OF SHARP INSTRUMENTS AND NEEDLES

STERILIZATION OR DISINFECTION OF INSTRUMENTS

CLEANING AND DISINFECTION OF DENTAL UNIT AND ENVIRONMENTAL SURFACES

DISINFECTION AND THE DENTAL LABORATORY

USE AND CARE OF HANDPIECES

HANDLING OF BIOPSY SPECIMENS

USE OF EXTRACTED TEETH IN DENTAL EDUCATIONAL SETTINGS

CONCLUSION

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INTRODUCTION

Infectious diseases have scourged the world throughout history. Some of these diseases are contained locally but others have spread over large areas and have sometimes resulted in worldwide epidemics.

A set of infection-control strategies common to all health-care delivery settings should reduce the risk of transmission of infectious diseases caused by bloodborne pathogens such as HBV and HIV. Because all infected patients cannot be identified by medical history, physical examination, or laboratory tests, Centers for Disease Control and prevention (CDC) recommends that blood and body fluid precautions be used consistently for all patients. These precautions, referred to as "universal precautions," must be observed routinely in the care of all dental patients.

Reports published from 1970 through 1987 indicate nine clusters in which patients were infected with HBV associated with treatment by an infected dental health care worker (DHCW). In addition, transmission of HIV to six patients of a Florida dentist with acquired immunodeficiency syndrome has also been reported. Transmission of HBV from dentists to patients has not been reported since 1987, possibly due to increased adherence to universal precautions - including routine glove use by dentists - and increased levels of immunity due to the use of hepatitis B vaccine. However, isolated sporadic cases of infection are more difficult to link with a health care worker than are outbreaks involving multiple patients. For both HBV and HIV, the precise event or events resulting in transmission of infection in the dental setting have not been determined. Epidemiologic and laboratory data indicate that these infections probably were transmitted from the dental health care workers (DHCWs) to patients, rather than from one patient to another.

Infection is the process of invasion of the tissue by organisms characterized by their multiplication in the body of the host to produce disease.

IMMUNITY

The word immunity is derived from a Latin word 'immunis' meaning 'free from' or 'exempt'. We live in an atmosphere surrounded by microbes and the body naturally possesses the power to resist their attacks.

Immunity, therefore is the condition which renders the host non susceptible or resistant to infective processes caused by bacteria or their products.

The body has natural resistance to a certain degree and this natural resistance to infection can be increased specifically by some practical methods known as immunization. The power of resistance to infection may be either inherited or acquired. Immunity is therefore classified into 2 main divisions.

1. Natural immunity
2. Acquired immunity

Natural Immunity:

This is an inherited resistance to infection and not acquired during the lifetime of an individual. They include.

- Phagocytosis of bacteria by WBC's and cells of the tissue macrophage system.
- Destruction by the acid secretions of the stomach.
- Presence of certain chemical compounds in the blood likes lysozyme that destroys microorganisms.

Acquired Immunity:

The immunity acquired during the lifetime of an individual is known as acquired immunity. It may be,

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1. Active immunity
2. Passive immunity

Active immunity is acquired by an individual in response to the introduction of microorganisms or their toxins into the body and the cells of the body take part in the formation of antibodies.

It can be further divided into:

- Natural
- Artificial

Natural active immunity is acquired after an infection and recovery from the disease or subclinical infection after repeated exposure to small doses of the infective organism. Artificial active immunity may be acquired artificially by inoculation of bacteria, viruses or their products.

In the case of passive immunity, the subject is immunized by prepared antibodies and the body cells do not take any active part in the production of immunity.

COMMON TRANSMISSIBLE INFECTIONS IN DENTISTRY

The dental environment is associated with a significant risk of exposure to various microorganisms. Many infectious agents may be present in blood or saliva, as a consequence of bacteremia or viremia associated with systemic infections. Dental patients and dental health care workers (DHCW) may be exposed to a variety of microorganisms via blood or oral or respiratory secretions. These microorganisms may include cytomegalovirus, hepatitis B virus (HBV), hepatitis C virus (HCV), herpes simplex virus types 1 and 2, human immunodeficiency virus (HIV), mycobacterium tuberculosis, staphylococci, streptococci, and other viruses and bacteria - specifically, those that infect the upper respiratory tract.

Herpes virus infections :

The herpes viruses are ubiquitous and are commonly present in the mouth. 50-90% of patients may be infected and may shed one or more of the viruses at different times. This shedding is particularly common for Epstein-Barr Virus (EBV) and Human Herpes Virus type 6 (HHV-6).

THE KNOWN HERPES VIRUS WHICH INFECTS HUMANS

Herpes Simplex Virus (HSV)- 1	Herpes labialis and keratitis, cold sores, encephalitis
Herpes Simplex Virus (HSV) - 2	Genital herpes, neonatal infections
Varicella Zoster Virus	Chicken pox
Ebstein Barr Virus	Infectious mononucleosis
Cyto Megalo Virus	Mononucleosis - type syndrome
Human Herpes Virus (HHV)- 6	Fever with rash, encephalitis, lymphadenopathy, myocarditis and myelosuppression
Human Herpes Virus (HHV) - 7	It has yet to be conclusively associated with any disease.
Human Herpes Virus (HHV) - 8	It has been identified in all AIDS and non-AIDS related Kaposi's sarcoma lesions.

Herpes viruses are characterized by their ability to establish latent infections following a primary infection, with asymptomatic shedding of herpes virus in saliva. Herpetic whitlow, infection of the finger with HSV, was a well-recognized occupational hazard among dentists in the days before latex gloves were worn routinely for clinical dentistry. Routine

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use of universal precautions, usage of gloves and avoidance of direct contact with oral mucosal HSV ulcers provide adequate protection against HSV in dental care workers.

Acute viral hepatitis:

Viral hepatitis is currently divided into five primary types, A, B, C, D. E

Hepatitis A :

Blood and secretions probably transmit hepatitis A but fecal shedding of the virus also occurs during the incubation period and ceases after symptoms begin. Most infections are subclinical. There is no known carrier state. The incubation period is 2-6 weeks.

Hepatitis C :

It is also called parenterally transmitted non-A, non-B hepatitis (PT- NANB). It is caused by the virus described in 1988. It can be transmitted by blood and a chronic carrier state exists in 20-50% of cases. From this chronic mild infection, cirrhosis sometimes develops. The incubation period is 2-25 weeks. Interferons have shown diminished disease activity in HCV carriers, but relapses occurred after 6 months.

Hepatitis D (Delta hepatitis):

It was recognized as an infection dependent on HBV by Rizetto in the early 1980's. It can appear clinically only if the individual is infected simultaneously with hepatitis B or is a carrier of hepatitis B. Hepatitis D virus is dependent on hepatitis B virus for repication. Therefore, immunization with hepatitis B vaccine will prevent infection. HDV is a defective virus that requires the HBs Ag for its replication and growth.

Hepatitis E :

It is the epidemic endemic form of non-A non-B hepatitis. It has a fecal-oral mode of transmission i.e. through ingestion of contaminated water or food containing hepatitis B virus.

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Hepatitis B :

The hepatitis B virus was first described in 1965. The infective particle consists of an inner core plus an outer surface coat. The core contains DNA and DNA polymerase and replicates in the infected liver cells. The surface coat can be detected in serum by immunological reactions.

3289

Globally, there are more than 300 million carriers of the virus. HBV infection is highly endemic in China and South East-Asia, Africa, most of the pacific Islands, parts of the Middle East and the Amazon basin. About 75% of the world's carriers are from the Asian continent. Hepatitis B surface antigen (HBs Ag) is found on the surface of the virus. The other antigens present are the hepatitis B early antigen (HBe Ag) and the hepatitis B core antigen (HBc Ag). The first humoral response to HBV infection is the development of IgM antibody to HBVAg (Anti HBc). It develops in all patients with HBV infection and persists indefinitely. Anti- HBs is responsible for long-term immunity. The hepatitis B early antigen correlates with HBV replication and high infectivity. Anti- HBe correlates with lower infectivity.

Clinical signs and symptoms of hepatitis B infection:

It varies from a mild flu like illness to fulminant, fatal liver failure depending on the individual's general health and immune response. The incubation period is 45 to 160 days, the average being 60-120 days. The onset of acute disease is generally insidious. The prodromal phase begins suddenly with anorexia, malaise, nausea, vomiting and fever. Urticaria and arthralgia may also occur. After 3 to 10 days, dark urine appears followed by Jaundice. After 1 to 2 weeks, Jaundice fades and recovery begins in 2 to 4

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weeks. Sequelae to this infection could be asymptomatic or symptomatic carrier state, cirrhosis, acute hepatitis infection, primary liver cancer or death.

Modes of transmission in dentistry:

HBV is transmitted both percutaneously and non percutaneously. Because dental treatment involves the use of small, sharp, contaminated instruments transferred between dental care providers during treatment, multiple opportunities exist for inadvertent percutaneous wounds to the operator and staff. Non percutaneous transmission in the dental environment includes transfer of infectious bodily secretions such as saliva, blood and crevicular fluid. HBV transmission during dental procedures occurs primarily in a horizontal mode among staff and patients, predominantly from patient to care provide and less likely from care provider to patien. Because of the potential chronicity and the overall morbidity and mortality associated with hepatitis B, this virus is a major blood borne pathogen of concern in the health care environment. Dental practitioners are considered as a group with one of the highest risk of exposures to HBV.

Frequency of infection:

An estimated 300,000 persons are infected with HBV every year. One quarter become ill with jaundice. more than 10,000 patients require hospitalization and an average of 250 patients die of fulminant disease each year. Between 6 and 10% of young adults with HBV infection become carriers. The role of the HBV carrier is central in the epidemiology of HBV transmission. A carrier is defined as a person who is HBsAg positive on at least two occasions 6 months apart. Carriers develop little anti-HBs and thus remain HBs Ag positive. The HBV carrier state develops more commonly by means of asymptomatic subclinical HBV infection versus acute infection. Carriers developing an asymptomatic subclinical infection are more likely to be HBe Ag positive, indicating that they are in a more infectious and contagious state.

Treatment:

Effective treatment is still not available. However. sub-cutaneous administration of interferon alfa-2b was effective in inducing a sustained loss of viral replication.

Prevention of transmission of HBV :

Hepatitis B vaccine

- Plasma - derived vaccine
- Recombinant DNA vaccine

Plasma derived vaccine :

The licensed vaccine, Heptavax-B was introduced in the U.S in 1982 although clinical tests began in 1975. The vaccine is given in 3 separate 20 mg intramuscular injections; the first two doses 1 month apart and the third dose at 6 months (0,1,6). Approximately 96% of young, healthy adults seroconvert following the completion of the vaccination series, achieve a protective level of antibodies to HBs Ag and are protected against the development of active hepatitis B, asymptomatic HBV infection and the carrier state.

Recombinant DNA vaccine

Recombivax HB became available for use in the U.S in January 1987. It provided an alternative to the plasma derived vaccine. Recombivax HB is produced in cultures of Saccharomyces cerevisiae (Common baker's yeast) into which a plasmid containing the gene for HBs Ag has been inserted. HBs Ag is subsequently harvested from the yeast cells. Administered vaccine is designed to contain 10 mg of HBs Ag protein. The regimen is same as that of the plasma derived vaccine. However, it has been shown to induce protective anti-HBs in more than 99% of healthy adults. Modifications have resulted in

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superior forms of the Recombivax HB vaccine. Another recombinant DNA hepatitis B vaccine, Engerix B was produced in Belgium and licensed for use in the U.S in 1989. The 2 recombinant vaccines differ in their production processes. Post vaccination testing should be scheduled within 6 months after the last innoculation. A vaccine recipient who is negative for ant-Hbs between 1 and 5 years after vaccination may be either a primary non responder who remains susceptible to hepatitis B or a vaccine responder whose antibody levels have decreased below detectability yet who is still protected against clinical disease. Those who do not respond to vaccination should consider revaccination with three additional doses of vaccine.

Passive Immunization:

It is usually required after accidental needlestick injuries during treatment of patients. A single injection of hyper immunoglobulin, given within 48 hours after injury, usually reduces the severity of infection. Simultaneously active immunization should also be provided.

HIV infection / Acquired Immuno deficiency syndrome (AIDS):

Human immuno deficiency virus (HIV) is a member of the retro virus family that can lead to Acquired Immuno Deficiency Syndrome (AIDS), a condition in which the immune system begins to fail leading to life threatening opportunistic infections. Infection with Human immunodeficiency virus (HIV) is a condition where transmission occurs through contact with blood and other body fluids. This disease was identified in June 1981 and has been the plague of the 20th century. Initially it was seen among homosexual persons and later found its way into all parts of the society including heterosexuals, females and children. The first HIV case in India was detected in 1986 in Chennai. This infection is on the rise in South Asia and Southeast Asia while the infection rates are on the decline or has been stable in the US.

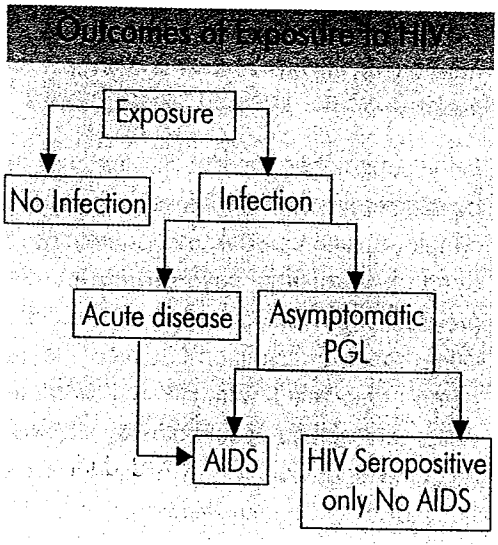
In the early stages, the HIV infection may not be noticeable and may be accompanied by symptoms such as weakness, arthralgias, or even be totally asymptomatic. On progression, HIV infection may be associated with a variety of conditions. Some of the oral lesions associated with HIV infection and AIDS are Hairy Leukoplakia, Kaposi's Sarcoma and Candidiasis. It is imperative that the dentist have knowledge of the clinical appearance of these oral lesions. Other than the oral conditions there may be systemic conditions such as protozoal infections, fungal infections, other viral infections and mycobacterial infections. Almost all organ systems may be involved in this infectious process. The initial HIV infection progresses into a more severe and debilitating condition where it is associated with a variety of other infections and is called Acquired Immunodeficiency Syndrome (AIDS).

Clinical manifestations of AIDS:

- Unexplained diarrhea lasting longer than 1 month.
- Fatigue
- Malaise
- Loss of more than 10% body weight.
- Fever
- Night sweats
- Oral thrush
- Generalized lymphadenopathy
- Enlarged spleen
- Opportunistic infections like,
  - Pneumocystis carinii pneumonia
  - Encephalitis
  - Meningitis
  - Cytomegalovirus rhinitis.
  - Herpes simplex infections
  - Tuberculosis

In initial exposure, there are two possibilities, infection or no infection. If there is no infection the person is lucky. If infected after

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exposure, the outcomes could be immediate or acute HIV infection leading to AIDS, or asymptomatic persistent generalized lymphadenopathy (PGL) that may be in a chronic state for many years and then go into the AIDS state. On the other hand asymptomatic PGL or asymptomatic patients can remain so for many years (over 20 years) without advancing into the AIDS stage.

Tuberculosis

Tuberculosis is one of the oldest infectious diseases known to humans. In the past most countries had this disease under control. But now this disease has re-emerged in both prevalence and with new types of multi-drug-resistant-strains. Mycobacterium tuberculosis is the organism which commonly affects the lungs but may involve any organ in the body. Each year about 8 million people develop TB and 3 million die. TB mimics many respiratory conditions, therefore when the practitioner observes a cough of more than 3 weeks of duration, sputum possibly tinged with blood, unexplained weight loss, and night sweats, the patient should be referred for a TB skin test and treatment. If diagnosed with active infection the patient must be treated till pronounced non-infectious and then may access dental care. It is pragmatic to defer dental care for patients with active TB till such time the disease is controlled especially in the clinics and all emergency dental treatments may be provided in institutions that are equipped to deal with the control of cross contamination or occupational exposure. Such facilities should include negative air pressure treatment rooms with the air vented to the outside of the building. The air conditioning and ventilation system must also be equipped with HEPA (high efficiency particulate air) filters and the personnel must use masks that have a HEPA filter during contact with infected patients. Dentists and staff must undergo testing for the disease on a periodic basis, especially if living in endemic areas where the prevalence is high.

ROUTES OF TRANSMISSION

Infections may be transmitted in the dental operatory through several routes, including direct contact with blood, oral fluids, or other secretions; indirect contact with contaminated instruments, operatory equipment, or environmental surfaces; or contact with airborne contaminants present in either droplet spatter or aerosols of oral and respiratory fluids.

Infection via any of these routes requires that all three of the following conditions be present (commonly referred to as "the chain of infection"): a susceptible host; a pathogen with sufficient infectivity and numbers to cause infection; and a portal through which the pathogen may enter the host. Effective infection-control strategies are intended to break one or more of these "links" in the chain, thereby preventing infection.

CATEGORIES OF TASK IN RELATION TO RISK

Categories of tasks, work areas and personnel are classified according to risk of infection. They are listed as follows,

Category I:

Tasks that involve exposure to blood, body fluid or tissues. Most tasks performed by the

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dentist, dental hygienist, dental assistant and laboratory technician falls in this category.

Category II:

Tasks that do not involve routine exposure to blood, body fluids or tissues. However, unplanned category I tasks may occasionally be required. Clerical or non-professional workers who may help clean up the office, handle instruments or impression materials or send dental materials to the laboratory fit into this category.

Category III:

Tasks that involve no exposure to blood, body fluids or tissues. A front-office receptionist, book keeper or insurance clerk who does not handle dental instruments or materials would be a category III worker.

The American Dental Association (ADA) and Occupational Safety and Health Act (OSHA) guidelines advise that all dental office staff in category I and II and dentists be trained in infection control to protect themselves and their patients.

VACCINES FOR DENTAL HEALTH-CARE WORKERS

The OSHA bloodborne pathogens final rule requires that employers make hepatitis B vaccinations available without cost to their employees who may be exposed to blood or other infectious materials. In addition, CDC recommends that all workers, including DHCWs, who might be exposed to blood or blood-contaminated substances in an occupational setting be vaccinated for HBV. DHCWs also are at risk for exposure to and possible transmission of other vaccine-preventable diseases. Accordingly, vaccination against influenza, measles, mumps, rubella, and tetanus may be appropriate for DHCWs.

PERSONAL BARRIER TECHNIQUES FOR INFECTION CONTROL

Washing and care of the hands

DHCWs should wash their hands before and after treating each patient (i.e., before glove placement and after glove removal) and after barehanded touching of inanimate objects likely to be contaminated by blood, saliva, or respiratory secretions. Hands should be washed after removal of gloves because gloves may become perforated during use and DHCWs' hands may become contaminated through contact with patient material. Soap and water will remove transient microorganisms acquired directly or indirectly from patient contact; therefore, for many routine dental procedures, such as examinations and nonsurgical techniques, hand washing with plain soap is adequate. For surgical procedures, an antimicrobial surgical handscrub should be used.

When gloves are torn, cut, or punctured, they should be removed as soon as patient safety permits. DHCWs then should wash their hands thoroughly and reglove to complete the dental procedure. DHCWs who have exudative lesions or weeping dermatitis, particularly on the hands, should refrain from all direct patient care and from handling dental patient-care equipment until the condition resolves.

Gloves

For protection of personnel and patients in dental-care settings, medical gloves (latex or vinyl) always must be worn by DHCWs when there is potential for contacting blood, blood-contaminated saliva, or mucous membranes. Nonsterile gloves are appropriate for examinations and other nonsurgical procedures; sterile gloves should be used for surgical procedures. Surgical or examination gloves should not be washed before use; nor should they be washed, disinfected, or

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sterilized for reuse. Washing of gloves may cause "wicking" (penetration of liquids through undetected holes in the gloves) and is not recommended. Disinfecting agents, oils, certain oil-based lotions, and heat treatments, such as autoclaving, may cause deterioration of gloves.

Gowns

Protective clothing such as reusable or disposable gowns, laboratory coats, or uniforms should be worn when clothing is likely to be soiled with blood or other body fluids. Reusable protective clothing should be washed using a normal laundry cycle, according to the instructions of detergent and machine manufacturers. Protective clothing should be changed at least daily or as soon as it becomes visibly soiled. Protective garments and devices (including gloves, masks, and eye and face protection) should be removed before personnel exit areas of the dental office used for laboratory or patient-care activities.

Masks / Protective eye wear

Chin-length plastic face shields or surgical masks and protective eyewear should be worn when splashing or spattering of blood or other body fluids is likely, as is common in dentistry. When a mask is used, it should be changed between patients or during patient treatment if it becomes wet or moist. Face shields or protective eyewear should be washed with an appropriate cleaning agent and when visibly soiled, disinfected between patients.

Rubber dam

Appropriate use of rubber dams, high-velocity air evacuation, and proper patient positioning should minimize the formation of droplets, spatter, and aerosols during patient treatment.

USE AND CARE OF SHARP INSTRUMENTS AND NEEDLES

Sharp items (e.g., needles, scalpel blades, wires) contaminated with patient blood and saliva should be considered as potentially infective and handled with care to prevent injuries. Used needles should never be recapped or otherwise manipulated utilizing both hands, or any other technique that involves directing the point of a needle toward any part of the body. Either a one-handed "scoop" technique or a mechanical device designed for holding the needle sheath should be employed. Used disposable syringes and needles, scalpel blades, and other sharp items should be placed in appropriate puncture-resistant containers located as close as is practical to the area in which the items were used. Bending or breaking of needles before disposal requires unnecessary manipulation and thus is not recommended.

Before attempting to remove needles from nondisposable aspirating syringes, DHCWs should recap them to prevent injuries. Either of the two acceptable techniques may be used. For procedures involving multiple injections with a single needle, the unsheathed needle should be placed in a location where it will not become contaminated or contribute to unintentional needlesticks between injections.

STERILIZATION OR DISINFECTION OF INSTRUMENTS

As with other medical and surgical instruments, dental instruments are classified into three categories - critical, semicritical, or noncritical - depending on their risk of transmitting infection and the need to sterilize them between use. Each dental practice should classify all instruments as follows:

A. **Critical:** Surgical and other instruments used to penetrate soft tissue or bone are classified as critical and should be

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sterilized after each use. These devices include forceps, scalpels, bone chisels, scalers and burs.

B. **Semi critical:** Instruments such as mirrors and amalgam condensers that do not penetrate soft tissues or bone but contact oral tissues are classified as semicritical. These devices should be sterilized after each use. If, however, sterilization is not feasible because the instrument will be damaged by heat, the instrument should receive, at a minimum, high-level disinfection.

C. **Noncritical:** Instruments or medical devices such as external components of x-ray heads that come into contact only with intact skin are classified as noncritical. Because these noncritical surfaces have a relatively low risk of transmitting infection, they may be reprocessed between patients with intermediate-level or low-level disinfection or detergent and water washing, depending on the nature of the surface and the degree and nature of the contamination.

Before sterilization or high-level disinfection, instruments should be cleaned thoroughly to remove debris. Persons involved in cleaning and reprocessing instruments should wear heavy-duty (reusable utility) gloves to lessen the risk of hand injuries. Placing instruments into a container of water or disinfectant/ detergent as soon as possible after use will prevent drying of patient material and make cleaning easier and more efficient. Cleaning may be accomplished by thorough scrubbing with soap and water or a detergent solution, or with a mechanical device (e.g., an ultrasonic cleaner). The use of covered ultrasonic cleaners, when possible, is recommended to increase efficiency of cleaning and to reduce handling of sharp instruments.

All critical and semi critical dental instruments that are heat stable should be sterilized routinely between uses by steam under pressure (autoclaving), dry heat, or chemical vapor, following the instructions of the manufacturers of the instruments and the sterilizers. Critical and semi critical instruments that will not be used immediately should be packaged before sterilization.

The three most commonly used methods of sterilization in dentistry are:

- The steam autoclave
- The unsaturated chemical vapor sterilizer (Chemiclave)
- Dry heat ovens

Other methods are:

- Exposure to ethylene oxide gas
- Boiling water
- Ionizing radiation

Autoclave (steam under pressure):

It is an efficient, reliable and rapid method of sterilization except for oils, greases and powders. All living organisms are rapidly destroyed at 121° C temperature and 15 lbs. pressure for 15 minutes. The major problems are excess moisture, air entrapment and severe wetting.

Materials to be sterilized should be wrapped in paper, muslin or steam permeable plastic. To prove sterilization, spore strips containing known numbers of Bacillus stearo-thermophilus should be placed in the deepest layer of the sterilizer load. After sterilization, the strips are incubated. Absence of growth proves sterilization. This check of efficacy should be done weekly.

Unsaturated chemical vapor sterilizer:

This sterilizer uses a special chemical solution containing formaldehyde and alcohol. The major advantage is the greatly reduced corrosion of metal items. Closed containers cannot be used, as the chemical vapors must

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reach the surface of the items being processed. Specified wrapping material should be used.

Dry heat sterilizer:

These sterilizers use hot air to kill microorganisms and do not cause corrosion. The standard dry heat sterilizing oven operates at an air temperature of about 320°F for exposure times of 60-120 minutes. Closed containers can be used.

A second type of dry heat sterilizer (rapid heat transfer) utilizes a controlled internal air flow system. The instruments warm faster as the 375° F air is rapidly circulated within the chamber. Sterilization time is 6 minutes for unwrapped instruments and 12 minutes for wrapped instruments.

Packages or instruments being sterilized must have access to the sterilizing agent. Approximately 0.5 inch space should be left around each package to maximize exposure and to achieve sterilization in the least amount of time. Trays should not be stacked one on top of another.

Sterilization monitoring is needed to achieve a high level of quality assurance. Proper functioning of sterilization cycles should be verified by the periodic use (at least weekly) of biologic indicators (i.e., spore tests). Heat-sensitive chemical indicators (e.g., those that change color after exposure to heat) alone do not ensure adequacy of a sterilization cycle but may be used on the outside of each pack to identify packs that have been processed through the heating cycle. A simple and inexpensive method to confirm heat penetration to all instruments during each cycle is the use of a chemical indicator inside and in the center of either a load of unwrapped instruments or in each multiple instrument pack; this procedure is recommended for use in all dental practices. Instructions provided by the manufacturers of medical/dental instruments and sterilization devices should be followed closely.

In all dental and other health-care settings, indications for the use of liquid chemical germicides to sterilize instruments (i.e., "cold sterilization") are limited. For heat-sensitive instruments, this procedure may require up to 10 hours of exposure to a liquid chemical agent classified as a "sterilant / disinfectant." This sterilization process should be followed by aseptic rinsing with sterile water, drying, and, if the instrument is not used immediately, placement in a sterile container. The product manufacturers' directions regarding appropriate concentration and exposure time should be followed closely. Liquid chemical agents that are less potent than the "sterilant / disinfectant" category are not appropriate for reprocessing critical or semi critical dental instruments.

Post sterilization procedures involve drying, cooling, storage and distribution. Careful handling, storage and distribution of the sterilized instrument packs or trays reduce the chances for recontamination until the instruments are re used.

If instruments are to be stored after sterilization, they should be wrapped or bagged before sterilizing, using a suitable wrap material such as muslin, clear pouches or paper as recommended by the manufacturer of the sterilizer. The wrap or bag should be sealed with appropriate tape. Pins, staples or paper clips should not be used, as these make holes in the wrap that permit entry of microorganisms.

Single-use disposable instruments

Single-use disposable instruments (e.g., prophylaxis angles; prophylaxis cups and brushes; tips for high-speed air evacuators, saliva ejectors, and air/water syringes) should be used for one patient only and discarded appropriately. These items are neither designed nor intended to be cleaned, disinfected, or sterilized for reuse.

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CLEANING AND DISINFECTION OF DENTAL UNIT AND ENVIRONMENTAL SURFACES

Impervious-backed paper, aluminum foil, or plastic covers should be used to protect items and surfaces (e.g., light handles or x-ray unit heads) that may become contaminated by blood or saliva during use and that are difficult or impossible to clean and disinfect. Between patients, the coverings should be removed (while DHCWs are gloved), discarded and replaced (after ungloving and washing of hands) with clean material.

After treatment of each patient and at the completion of daily work activities, countertops and dental unit surfaces that may have become contaminated with patient material should be cleaned with disposable toweling, using an appropriate cleaning agent and water as necessary. Surfaces then should be disinfected with a suitable chemical germicide.

A chemical germicide classified as a "hospital disinfectant" and labeled for "tuberculocidal" (i.e., mycobactericidal) activity is recommended for disinfecting surfaces that have been soiled with patient material. These intermediate-level disinfectants include phenolics, iodophors, and chlorine-containing compounds. Because mycobacteria are among the most resistant groups of microorganisms, germicides effective against mycobacteria should be effective against many other bacterial and viral pathogens. A fresh solution of sodium hypochlorite (household bleach) prepared daily is an inexpensive and effective intermediate-level germicide. Concentrations ranging from 500 to 800 ppm of chlorine (a 1:100 dilution of bleach and tap water or 1/4 cup of bleach to 1 gallon of water) are effective on environmental surfaces that have been cleaned of visible contamination. Caution should be exercised, since chlorine solutions are corrosive to metals, especially aluminum.

Low-level hospital disinfectants that are not labeled for "tuberculocidal" activity (e.g., quaternary ammonium compounds) - are appropriate for general housekeeping purposes such as cleaning floors, walls and other housekeeping surfaces. Intermediate- and low-level disinfectants are not recommended for reprocessing critical or semicritical dental instruments.

DISINFECTION AND THE DENTAL LABORATORY

Laboratory materials and other items that have been used in the mouth (e.g., impressions, bite registrations, fixed and removable prostheses, orthodontic appliances) should be cleaned and disinfected before being manipulated in the laboratory. These items also should be cleaned and disinfected after being manipulated in the dental laboratory and before placement in the patient's mouth. A chemical germicide having at least an intermediate level of activity (i.e., "tuberculocidal hospital disinfectant") is appropriate for such disinfection. Communication between dental office and dental laboratory personnel regarding the handling and decontamination of supplies and materials is important. In addition, splash shields should be used in the dental laboratory.

Receiving area:

A receiving area should be established separate from the production area. Countertops and work surfaces should be cleaned and then disinfected daily with an appropriate surface disinfectant used according to the manufacturer's directions.

Incoming cases:

Unless the laboratory employee knows that the case has been disinfected by the dental office, all cases should be disinfected as they

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are received. Containers should be sterilized or disinfected after each use. Packing materials should be discarded to avoid cross contamination.

Production area:

Persons working in the production area should wear a clean uniform or laboratory coat, a face mask, protective eyewear and disposable gloves. Work surfaces and equipment should be kept free of debris and disinfected daily. Any instruments, attachments and materials to be used with new prostheses or appliances should be maintained separately from those to be used with prostheses or appliances that have already been inserted in the mouth. Brushes and other equipment should be disinfected at least daily. A small amount of pumice should be dispensed in small disposable containers for individual use on each case. The excess should be discarded. A liquid disinfectant (1:20 sodium hypochlorite solution) can serve as a mixing medium for pumice. Adding three parts green soap to the disinfectant solution will keep the pumice suspended. Each outgoing case should be disinfected before it is returned to the dental office.

USE AND CARE OF HANDPIECES

- Routine between-patient use of a heating process capable of sterilization (autoclaving, dry heat, or heat/chemical vapor) is recommended for all high-speed dental hand pieces, low-speed hand piece components used intraorally and reusable prophylaxis angles. Manufacturers' instructions for cleaning, lubrication, and sterilization procedures should be followed closely to ensure both the effectiveness of the sterilization process and the longevity of these instruments. According to manufacturers, virtually all high-speed and low-speed hand pieces in production today are heat tolerant and most heat-sensitive models manufactured earlier can be retrofitted with heat-stable components.
- Internal surfaces of high-speed hand pieces, low-speed hand piece components and prophylaxis angles may become contaminated with patient material during use. This retained patient material then may be expelled intraorally during subsequent uses. Restricted physical access - particularly to internal surfaces of these instruments - limits cleaning and disinfection or sterilization with liquid chemical germicides. Surface disinfection by wiping or soaking in liquid chemical germicides is not an acceptable method for reprocessing high-speed hand pieces, low-speed hand piece components used intraorally, or reusable prophylaxis angles.
- Because retraction valves in dental unit water lines may cause aspiration of patient material back into the hand piece and water lines, antiretraction valves (one-way flow check valves) should be installed to prevent fluid aspiration and to reduce the risk of transfer of potentially infective material. Routine maintenance of antiretraction valves is necessary to ensure effectiveness; the dental unit manufacturer should be consulted to establish an appropriate maintenance routine.
- High-speed hand pieces should be run to discharge water and air for a minimum of 20-30 seconds after use on each patient. This procedure is intended to aid in physically flushing out patient material that may have entered the turbine and air or water lines. Use of an enclosed container or high-velocity evacuation should be considered to minimize the spread of spray, spatter and aerosols generated during discharge procedures. Additionally, there is evidence that overnight or weekend microbial accumulation in water lines can be reduced substantially by removing the hand piece and allowing water lines to run

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and to discharge water for several minutes at the beginning of each clinic day. Sterile saline or sterile water should be used as a coolant/irrigator when surgical procedures involving the cutting of bone are performed.

- Other reusable intraoral instruments attached to, but removable from, the dental unit air or water lines - such as ultrasonic scaler tips and component parts and air/water syringe tips - should be cleaned and sterilized after treatment of each patient in the same manner as hand pieces. Manufacturers' directions for reprocessing should be followed to ensure effectiveness of the process as well as longevity of the instruments.
- Some dental instruments have components that are heat sensitive or are permanently attached to dental unit water lines. Some items may not enter the patient's oral cavity, but are likely to become contaminated with oral fluids during treatment procedures, including, for example, handles or dental unit attachments of saliva ejectors, high-speed air evacuators, and air/water syringes. These components should be covered with impervious barriers that are changed after each use or, if the surface permits, carefully cleaned and then treated with a chemical germicide having at least an intermediate level of activity. As with high-speed dental hand pieces, water lines to all instruments should be flushed thoroughly after the treatment of each patient; flushing at the beginning of each clinic day also is recommended.

HANDLING OF BIOPSY SPECIMENS

In general, each biopsy specimen should be put in a sturdy container with a secure lid to prevent leaking during transport. Care should be taken when collecting specimens to avoid contamination of the outside of the container. If the outside of the container is visibly contaminated, it should be cleaned and disinfected or placed in an impervious bag.

USE OF EXTRACTED TEETH IN DENTAL EDUCATIONAL SETTINGS

Extracted teeth used for education should be considered infective and classified as clinical specimen because they contain blood. All persons who collect, transport, or manipulate extracted teeth should handle them with the same precautions as a specimen for biopsy. Universal precautions should be adhered to whenever extracted teeth are handled, because preclinical educational exercises simulate clinical experiences and the students enrolled in dental educational programs should adhere to universal precautions in both preclinical and clinical settings. In addition, all persons who handle extracted teeth in dental preclinical settings should receive hepatitis B vaccine.

Before the extracted teeth are manipulated in dental preclinical exercises, the teeth should first be cleaned of adherent patient material by scrubbing with detergent and water or by using an ultrasonic cleaner. Teeth should then be stored, immersed in a fresh solution of sodium hypochlorite (household bleach diluted 1:10 with tap water) or any liquid chemical germicide suitable for clinical specimen fixation.

3289

Persons handling extracted teeth should wear gloves. Gloves should be disposed of properly and hands washed after completion of activities. Additional personal protective equipment (e.g., face shield or surgical mask and protective eye wear) should be worn if mucous membrane contact with debris or spatter is anticipated when the specimen is handled, cleaned, or manipulated. Work surfaces and equipment should be cleaned and decontaminated with an appropriate liquid chemical germicide after completion of work activities.

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The handling of extracted teeth used in dental educational settings differs from giving patients their own extracted teeth. Several countries allow patients to keep such teeth, because these teeth are not considered to be regulated (pathologic) waste, because the removed body part (tooth) becomes the property of the patient and does not enter the waste system.

CONCLUSION

The aim of infection control is to control iatrogenic, nosocomial infections among patients, and potential occupational exposure of care providers to disease causing microbes during provision of care. Disease transfer to the dentist and dental staff during dental care is considered an "occupational exposure" to a given pathogen, while disease transfer from one patient to another in the dental clinics is considered "cross-infection". Therefore, the dental health care provider must be knowledgeable about the diseases commonly encountered in the dental operatory and must follow high standards of infection control for the safety of the patients and the dental health care workers.

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Chapter 24

ETHICS IN DENTISTRY

INTRODUCTION

HISTORY

ETHICAL PRINCIPLES

ETHICAL RULES FOR DENTISTS (PRESCRIBED BY THE DCI)

THE NUREMBERG CODE (1947)

DECLARATION OF GENEVA (1948)

WORLD MEDICAL ASSOCIATION INTERNATIONAL CODE OF MEDICAL ETHICS (1949)

DECLARATION OF HELSINKI (1964)

CONCLUSION

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INTRODUCTION

The dental profession is a vocation in which knowledge and skill is used for the service of others. One of the characteristics of a profession is adherence to a code of ethics. Being a health care provider it carries with it a responsibility to individual patients and society. The special status that society confers on the professionals requires them to behave in an ethical manner.

The word 'ethics' is derived from the Greek word 'ethos' meaning custom or character. Ethics is the philosophy of human conduct, a way of stating and evaluating principles by which problems of behavior can be solved. Ethics is concerned with standards judging whether actions are right or wrong.

Dental ethics would mean moral duties and obligations of the dentist towards his patients, professional colleagues and to the society. These help support autonomy and self-determination, protect the vulnerable and promote the welfare and equality of human beings. They focus primarily on individuals' rights and duties and do not see individuals as part of a wider social order. These principles may be called "micro-ethical" principles, whereas "macro-ethical" principles guide the conduct of population-based research and practice.. Macro-ethics can be defined as " a set of principles designed to protect the human dignity, integrity, self-determination, confidentiality, rights and health of populations and the people comprising them". (Ethics and Epidemiology - International Guidelines, 1991). They also establish positive moral responsibilities of persons and authorities who sponsor, conduct or oversee research on populations. They are not distinct from, but an expansion of, traditional ethics.

HISTORY

The "Hippocratic Oath" (in the 'Collection' widely attributed to Hippocrates of Cos) has been regarded as a summing up of a standard of professional ethics. It is widely believed that the oath was written by Hippocrates, the father of medicine, in the 4th century BC.

The Hippocratic Oath

I swear by Apollo, Asclepius, Hygieia, and Panacea, and I take to witness all the gods, all the goddesses, to keep according to my ability and my judgment, the following Oath.

- To consider dear to me, as my parents, him who taught me this art; to live in common with him and, if necessary, to share my goods with him; To look upon his children as my own brothers, to teach them this art.
- I will prescribe regimens for the good of my patients according to my ability and my judgment and never do harm to anyone.
- To please no one will I prescribe a deadly drug nor give advice which may cause his death.
- Nor will I give a woman a pessary to procure abortion.
- But I will preserve the purity of my life and my arts.
- I will not cut for stone, even for patients in whom the disease is manifest; I will leave this operation to be performed by practitioners, specialists in this art.
- In every house where I come I will enter only for the good of my patients, keeping myself far from all intentional ill-doing and all seduction and especially from the pleasures of love with women or with men, be they free or slaves..
- All that may come to my knowledge in the exercise of my profession or in daily-commerce with men, which ought not to be spread abroad, I will keep secret and will never reveal.
- If I keep this oath faithfully, may I enjoy my life and practice my art, respected by all men and in all times; but if I swerve from it or violate it, may the reverse be my lot.

In India the Dentist Act was amended via Section 17A empowering the Dental Council

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of India to prescribe standards of professional conduct and etiquette. The code of ethics was framed by the Dental Council in 1975 and later notified by the Government of India as " Dentists (code of ethics) Regulations 1976". It is in force from August 1976.

A systematic body of rules is needed "in order that dignity and honour of the dental profession may be upheld, its standards exalted, its sphere of usefulness extended and the advancement of dental science promoted and that the members of the dental association may understand clearly their duties and obligations to the dental profession, to their patients, and to the community at large" (Indian Dental Association - Constitution, bylaws and code of ethics, 1988).

ETHICAL PRINCIPLES :

1. To do no harm (non-maleficence)
2. To do good (beneficence)
3. Respect for persons
4. Justice
5. Veracity or truthfulness
6. Confidentiality.

To do no harm (Non-maleficence):

To do no harm or non - maleficence is considered to be the foundation of social morality. It is clear that although dental professionals support this principle in theory they are at times guilty of transgressions that go beyond a limitation (break a rule or law). Iatrogenic disease is the name we give to doctor - induced illness, and all of us in the dental field have seen overhanging restorations cause periodontal disease or failure to sterilize instruments cause an infection.

The dentist, in cases where pain cannot be avoided, can make attempts to minimize the pain. If feasible, the alternative of minimal or no treatment can be presented to the patient.

To do good (Beneficence):

To do good, or beneficence is required of all health care providers. It should be the role of dentists to benefit patients, as well as not to inflict harm. The expectation of the patient is that the care provider will initiate beneficial action and that there is an agreement between the doctor and the patient that some good will result.

In the process of treating a patient what has to be weighed are the consequences of treatment versus no treatment. For example, in treating questionable dental caries, it is not enough to say that it will not harm the patient. The point to be noted is whether it is of any good to the patient. Attempts should be to maximize the benefits and minimize harm.

Respect for persons:

It incorporates at least two fundamental ethical considerations, namely:

a) Autonomy, which dictates that health care professionals respect the patient's capacity for self-determination in making decisions concerning their treatment
b) Informed consent, which is an essential component of a patient's right to autonomy.

Autonomy :

The primary way to respect individuals is to abide by their choices whether or not others believe these choices to be wise or beneficial.

Autonomy is a principle that dictates that health care professionals respect the patient's right to make decisions concerning the treatment plan. Patients should not be bystanders in their treatment but active participants. An autonomous person is an individual capable of deliberation about personal goals and acting under the direction of such deliberation (think over, or discuss carefully).

Dentists sometimes attempt to direct a patient toward a particular mode of treatment by stressing certain advantages and not mentioning the disadvantages. It is a breach

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of ethics (unethical) to mislead or misinform patients. In addition, it may well become a legal problem. Dentists are often trained in a paternalistic setting and therefore practice in a paternalistic way after graduation from dental school.

Paternalism is the principle of government as by a father, i.e., a dictatorial "father knows best" attitude. Paternalism in health care can take the form of withholding information, restricting choices, or making the choice for the patient. Paternalism may also be expressed in laws that protect people from themselves as opposed to most laws, which protect people from other people. We may be able to justify paternalistic laws as being in the public's interest, but we should recognize that these laws limit the rights of a segment of the public because we judge that the laws are in their "best interest".

Informed consent:

Informed consent, both a legal and an ethical concept, is an essential component of a patient's right to autonomy.

Informed consent is the first stated and the largest principle of the Nuremberg code. The Nuremberg Code identifies four attributes of consent without which consent cannot be considered valid. Consent must be

- voluntary
- legally competent
- informed
- comprehending

The 'informed consent' is a two-step process. First, information is presented to the patient by the doctor. Secondly, the patient satisfies himself or herself that he or she understands, and based upon this understanding either agrees or refuses to undergo the treatment. Informed consent consists of,

1) A description of the procedures to be carried out.
2) A description of any reasonably foreseeable risks or discomforts to the subject.
3) A description of any benefits to the subject or to others which may reasonably be expected from the treatment.
4) A disclosure of appropriate alternative procedures or courses of treatment, if any, that might be advantageous to the subject.
5) A statement describing the extent, if any, to which confidentiality of records identifying the subject will be maintained.
6) A statement that the patient has understood the procedure and is willing to undergo the treatment.
7) The signature of the patient and of a witness. **(Refer chapter 25)**

Justice:

Justice is often described as fairness or equal treatment, giving to each her or his right or due. In providing dental care it is difficult to distribute services to all who are in need, but it should be the concern of health care professionals to see that as even a distribution as possible occurs. The primary duty of the health professional is service irrespective of class, creed etc. Justice demands that each person be treated equally. The principle of justice calls for an obligation to protect the weak and to ensure equity in rights and benefits, both for groups and for individuals.

Dentists can provide some free or discounted care in their offices to those who are truly needy, or they can provide financial support or donate some time to clinics for low-income patients. On a larger scale they can support local or statewide programs that seek to extend care to dentally needy clients.

Truthfulness:

The patient-doctor relationship is based on trust. Lying shows disrespect to the patient and threatens relationship.

Truthfulness or veracity is an ethical principle

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that one would expect to go unquestioned, yet many health care professionals practice in a less than truthful way. The dentist may feel that it would be better if the patient took a certain course of action and therefore manipulates the information that is given to the patient. Whatever the reason, the relationship will ultimately suffer and the dentist will be guilty of transgressing a major ethical principle.

Confidentiality:

Patients have the right to expect that all communications and records pertaining to their care will be treated as confidential. It is very natural to want to gossip about a patient, particularly if it is someone famous or possibly a neighbour, but to do so would break a bond of trust between the dental professional and the patient.

Earlier it was widely accepted that confidentiality could be breached if it was thought it would benefit the patient. However, knowledge of a patient gained in the course of examination and treatment is privileged and should not be disclosed without the consent of the patient or an order from the presiding judge in a Court of Law.

ETHICAL RULES FOR DENTISTS (PRESCRIBED BY THE DCI):

I. The duties and obligations of dentist towards the patients :

1. Every dentist should be courteous, sympathetic, friendly and helpful.
2. He should observe punctuality in fulfilling his appointments.
3. He should establish a well merited reputation for professional ability and fidelity.
4. The welfare of the patient should be conserved to the utmost of the practitioner's ability.
5. A dentist should not permit considerations of religion, nationality, race, party politics or social standing to intervene between his duties and his patients.
6. Information of a personal nature which may be learned about or directly from a patient in the course of dental practice should be kept in the utmost confidence. It is also the obligation of the dentist to see that his auxiliary staff observe this rule.

II. Duties of dentists towards one another:

1. Every dentist should cherish a proper pride in his / her colleagues and should not disparage them either by act or word.
2. When the dentist is entrusted with the care of the patient of another, during sickness or absence, mutual arrangements should be made regarding remuneration.
3. A dentist called upon in any emergency to treat the patient of another dentist, should, when the emergency is provided for, retire in favor of the regular dentist but shall be entitled to charge the patient for his services.
4. If a dentist is consulted by the patient of another dentist and the former finds that the patient is suffering from previous faulty treatment it is his duty to institute correct treatment at once with as little comments as possible and in such manner as to avoid reflection on his predecessor.

III. Duties of dentists to the public :

Dentist has to assume a leadership role in the community on matters related to dental health.

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Some unethical practices :

1. Practice by unregistered persons employed by the dentist.
2. Dentist signed under his name and authority issuing any certificate which is untrue, misleading or improper.
3. Dentist advertising whether directly, or indirectly, for the purpose of obtaining patients or promoting his own professional advantage.
4. Use of bogus diplomas etc.
5. Allowing commission
6. Paying or accepting commissions.
7. Undercutting of charges in order to solicit patients.
8. If the planned treatment is beyond the dentist's skill, the patient is not referred to a consultant.
9. In case of an emergency consultation during the temporary absence of the patient's dentist, temporary service is provided and the patient is not sent back.
10. If consulted, the dentist accepts charge of the case without request of the referring dentist.

THE NUREMBERG CODE (1947)

The Nuremberg Code is a set of research ethical principles for human experimentation set as a result of the Nuremberg Trials at the end of the Second World War. It was the first international instrument on the ethics of medical research, promulgated in 1947.

Specifically, they were in response to the inhumane Nazi human experimentation on unconsenting prisoners and detainees during the second world war. The trials were held in the city of Nuremberg, Germany, from 1945 to 1949.

The Code, designed to protect the integrity of the research subject, set out conditions for the ethical conduct of research involving human subjects, emphasizing their voluntary consent to research.

1. The voluntary informed consent of the human subject is absolutely essential. The duty and responsibility for ascertaining the quality of the consent rests upon each individual who initiates, directs, or engages in the experiment. It is a personal duty and responsibility which may not be delegated to another with impunity.
2. The experiment should be such as to yield fruitful results for the good of society, unprocurable by other methods or means of study, and not random and unnecessary in nature.
3. The experiment should be so designed and based on the results of animal experimentation and a knowledge of the natural history of the disease or other problem under study that the anticipated results justify the performance of the experiment.
4. The experiment should be so conducted as to avoid all unnecessary physical and mental suffering and injury.
5. No experiment should be conducted where there is a prior reason to believe that death or disabling injury will occur.
6. The degree of risk to be taken should never exceed that determined by the humanitarian importance of the problem to be solved by the experiment.
7. Proper preparations should be made and adequate facilities provided to protect the experimental subject against even remote possibilities of injury, disability or death.
8. The experiment should be conducted only by scientifically qualified persons. The highest degree of skill and care should be required through all stages of the experiment of those who conduct or engage in the experiment.
9. During the course of the experiment the human subject should be at liberty to bring the experiment to an end if he has reached the physical or mental state where continuation of the experiment seems to him to be impossible.
10. During the course of the experiment the

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scientist in charge must be prepared to terminate the experiment at any stage, if he has probable cause to believe, in the exercise of the good faith, superior skill and careful judgment required of him, that a continuation of the experiment is likely to result in injury, disability, or death to the experimental subject.

DECLARATION OF GENEVA

(Adopted by the 2nd General Assembly of the World Medical Association, Geneva, Switzerland, September 1948 and amended by the 22nd World Medical Assembly, Sydney, Australia, August 1968 and the 35th World Medical Assembly, Venice, Italy, October 1983 and the 46th WMA General Assembly, Stockholm, Sweden, September 1994 and editorially revised at the 170th Council Session, Divonne-les-Bains, France, May 2005 and the 173rd Council Session, Divonne-les-Bains, France, May 2006)

The World Medical Association is an association of national medical associations. This oath seems to be a response to the atrocities committed by doctors in Nazi Germany. Notably, this oath requires the physician to "not use [his] medical knowledge contrary to the laws of humanity." This document was adopted by the World Medical Association only three months before the United Nations General Assembly adopted the Universal Declaration of Human Rights (1948) which provides for the security of the person.

At the time of being admitted as a member of the medical profession:

I SOLEMNLY PLEDGE to consecrate my life to the service of humanity;

I WILL GIVE to my teachers the respect and gratitude that is their due;

I WILL PRACTISE my profession with conscience and dignity;

THE HEALTH OF MY PATIENT will be my first consideration;

I WILL RESPECT the secrets that are confided in me, even after the patient has died;

I WILL MAINTAIN by all the means in my power, the honour and the noble traditions of the medical profession;

MY COLLEAGUES will be my sisters and brothers;

I WILL NOT PERMIT considerations of age, disease or disability, creed, ethnic origin, gender, nationality, political affiliation, race, sexual orientation, social standing or any other factor to intervene between my duty and my patient;

I WILL MAINTAIN the utmost respect for human life;

I WILL NOT USE my medical knowledge to violate human rights and civil liberties, even under threat;

I MAKE THESE PROMISES solemnly, freely and upon my honour.

WORLD MEDICAL ASSOCIATION INTERNATIONAL CODE OF MEDICAL ETHICS

(Adopted by the 3rd General Assembly of the World Medical Association, London, England, October 1949 and amended by the 22nd World Medical Assembly Sydney, Australia, August 1968 and the 35th World Medical Assembly Venice, Italy, October 1983 and the WMA General Assembly, Pilanesberg, South Africa, October 2006)

DUTIES OF PHYSICIANS IN GENERAL

A physician shall

- always exercise his/her independent professional judgment and maintain the highest standards of professional conduct.
- respect a competent patient's right to accept or refuse treatment.
- not allow his/her judgment to be influenced by personal profit or unfair discrimination.

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- be dedicated to providing competent medical service in full professional and moral independence, with compassion and respect for human dignity.
- deal honestly with patients and colleagues, and report to the appropriate authorities those physicians who practice unethically or incompetently or who engage in fraud or deception.
- not receive any financial benefits or other incentives solely for referring patients or prescribing specific products.
- respect the rights and preferences of patients, colleagues, and other health professionals.
- recognize his/her important role in educating the public but should use due caution in divulging discoveries or new techniques or treatment through non-professional channels.
- certify only that which he/she has personally verified.
- strive to use health care resources in the best way to benefit patients and their community.
- seek appropriate care and attention if he/she suffers from mental or physical illness.
- respect the local and national codes of ethics.

DUTIES OF PHYSICIANS TO PATIENTS

A physician shall

- always bear in mind the obligation to respect human life.
- act in the patient's best interest when providing medical care.
- owe his/her patients complete loyalty and all the scientific resources available to him/her. Whenever an examination or treatment is beyond the physician's capacity, he/she should consult with or refer to another physician who has the necessary ability.
- respect a patient's right to confidentiality. It is ethical to disclose confidential information when the patient consents to it or when there is a real and imminent threat of harm to the patient or to others and this threat can be only removed by a breach of confidentiality.
- give emergency care as a humanitarian duty unless he/she is assured that others are willing and able to give such care.
- in situations when he/she is acting for a third party, ensure that the patient has full knowledge of that situation.
- not enter into a sexual relationship with his/her current patient or into any other abusive or exploitative relationship.

DUTIES OF PHYSICIANS TO COLLEAGUES

A physician shall

- behave towards colleagues as he/she would have them behave towards him/her.
- NOT undermine the patient-physician relationship of colleagues in order to attract patients.
- when medically necessary, communicate with colleagues who are involved in the care of the same patient. This communication should respect patient confidentiality and be confined to necessary information.

DECLARATION OF HELSINKI (1964)

These recommendations guiding physicians in biomedical research involving human subjects was issued by the World Medical Association (WMA) in 1964, adopted by the 18th World Medical Assembly, Helsinki, Finland, June 1964, amended 6 times, latest at the 59th WMA general assembly at Seoul in October 2008.

A). INTRODUCTION

1. The World Medical Association (WMA) has developed the Declaration of Helsinki as a statement of ethical principles for medical

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research involving human subjects, including research on identifiable human material and data.

The Declaration is intended to be read as a whole and each of its constituent paragraphs should not be applied without consideration of all other relevant paragraphs.

2. Although the Declaration is addressed primarily to physicians, the WMA encourages other participants in medical research involving human subjects to adopt these principles.

3. It is the duty of the physician to promote and safeguard the health of patients, including those who are involved in medical research. The physician's knowledge and conscience are dedicated to the fulfilment of this duty.

4. The Declaration of Geneva of the WMA binds the physician with the words, "The health of my patient will be my first consideration," and the International Code of Medical Ethics declares that, "A physician shall act in the patient's best interest when providing medical care."

5. Medical progress is based on research that ultimately must include studies involving human subjects. Populations that are underrepresented in medical research should be provided appropriate access to participation in research.

6. In medical research involving human subjects, the well-being of the individual research subject must take precedence over all other interests.

7. The primary purpose of medical research involving human subjects is to understand the causes, development and effects of diseases and improve preventive, diagnostic and therapeutic interventions (methods, procedures and treatments). Even the best current interventions must be evaluated continually through research for their safety, effectiveness, efficiency, accessibility and quality.

8. In medical practice and in medical research, most interventions involve risks and burdens.

9. Medical research is subject to ethical standards that promote respect for all human subjects and protect their health and rights. Some research populations are particularly vulnerable and need special protection. These include those who cannot give or refuse consent for themselves and those who may be vulnerable to coercion or undue influence.

10. Physicians should consider the ethical, legal and regulatory norms and standards for research involving human subjects in their own countries as well as applicable international norms and standards. No national or international ethical, legal or regulatory requirement should reduce or eliminate any of the protections for research subjects set forth in this Declaration.

B). PRINCIPLES FOR ALL MEDICAL RESEARCH

11. It is the duty of physicians who participate in medical research to protect the life, health, dignity, integrity, right to self-determination, privacy, and confidentiality of personal information of research subjects.

12. Medical research involving human subjects must conform to generally accepted scientific principles, be based on a thorough knowledge of the scientific literature, other relevant sources of information, and adequate laboratory and, as appropriate, animal experimentation. The welfare of animals used for research must be respected.

13. Appropriate caution must be exercised in the conduct of medical research that may harm the environment.

14. The design and performance of each research study involving human subjects must be clearly described in a research protocol.

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The protocol should contain a statement of the ethical considerations involved and should indicate how the principles in this Declaration have been addressed. The protocol should include information regarding funding, sponsors, institutional affiliations, other potential conflicts of interest, incentives for subjects and provisions for treating and/or compensating subjects who are harmed as a consequence of participation in the research study. The protocol should describe arrangements for post-study access by study subjects to interventions identified as beneficial in the study or access to other appropriate care or benefits.

15. The research protocol must be submitted for consideration, comment, guidance and approval to a research ethics committee before the study begins. This committee must be independent of the researcher, the sponsor and any other undue influence. It must take into consideration the laws and regulations of the country or countries in which the research is to be performed as well as applicable international norms and standards but these must not be allowed to reduce or eliminate any of the protections for research subjects set forth in this Declaration. The committee must have the right to monitor ongoing studies. The researcher must provide monitoring information to the committee, especially information about any serious adverse events. No change to the protocol may be made without consideration and approval by the committee.

16. Medical research involving human subjects must be conducted only by individuals with the appropriate scientific training and qualifications. Research on patients or healthy volunteers requires the supervision of a competent and appropriately qualified physician or other health care professional. The responsibility for the protection of research subjects must always rest with the physician or other health care professional and never the research subjects, even though they have given consent.

17. Medical research involving a disadvantaged or vulnerable population or community is only justified if the research is responsive to the health needs and priorities of this population or community and if there is a reasonable likelihood that this population or community stands to benefit from the results of the research.

18. Every medical research study involving human subjects must be preceded by careful assessment of predictable risks and burdens to the individuals and communities involved in the research in comparison with foreseeable benefits to them and to other individuals or communities affected by the condition under investigation.

19. Every clinical trial must be registered in a publicly accessible database before recruitment of the first subject.

20. Physicians may not participate in a research study involving human subjects unless they are confident that the risks involved have been adequately assessed and can be satisfactorily managed. Physicians must immediately stop a study when the risks are found to outweigh the potential benefits or when there is conclusive proof of positive and beneficial results.

21. Medical research involving human subjects may only be conducted if the importance of the objective outweighs the inherent risks and burdens to the research subjects.

22. Participation by competent individuals as subjects in medical research must be voluntary. Although it may be appropriate to consult family members or community leaders, no competent individual may be enrolled in a research study unless he or she freely agrees.

23. Every precaution must be taken to protect the privacy of research subjects and the

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confidentiality of their personal information and to minimize the impact of the study on their physical, mental and social integrity.

24. In medical research involving competent human subjects, each potential subject must be adequately informed of the aims, methods, sources of funding, any possible conflicts of interest, institutional affiliations of the researcher, the anticipated benefits and potential risks of the study and the discomfort it may entail, and any other relevant aspects of the study. The potential subject must be informed of the right to refuse to participate in the study or to withdraw consent to participate at any time without reprisal. Special attention should be given to the specific information needs of individual potential subjects as well as to the methods used to deliver the information. After ensuring that the potential subject has understood the information, the physician or another appropriately qualified individual must then seek the potential subject's freely-given informed consent, preferably in writing. If the consent cannot be expressed in writing, the non-written consent must be formally documented and witnessed.

25. For medical research using identifiable human material or data, physicians must normally seek consent for the collection, analysis, storage and/or reuse. There may be situations where consent would be impossible or impractical to obtain for such research or would pose a threat to the validity of the research. In such situations the research may be done only after consideration and approval of a research ethics committee.

26. When seeking informed consent for participation in a research study the physician should be particularly cautious if the potential subject is in a dependent relationship with the physician or may consent under duress. In such situations the informed consent should be sought by an appropriately qualified individual who is completely independent of this relationship.

27. For a potential research subject who is incompetent, the physician must seek informed consent from the legally authorized representative. These individuals must not be included in a research study that has no likelihood of benefit for them unless it is intended to promote the health of the population represented by the potential subject, the research cannot instead be performed with competent persons, and the research entails only minimal risk and minimal burden.

28. When a potential research subject who is deemed incompetent is able to give assent to decisions about participation in research, the physician must seek that assent in addition to the consent of the legally authorized representative. The potential subject's dissent should be respected.

29. Research involving subjects who are physically or mentally incapable of giving consent, for example, unconscious patients, may be done only if the physical or mental condition that prevents giving informed consent is a necessary characteristic of the research population. In such circumstances the physician should seek informed consent from the legally authorized representative. If no such representative is available and if the research cannot be delayed, the study may proceed without informed consent provided that the specific reasons for involving subjects with a condition that renders them unable to give informed consent have been stated in the research protocol and the study has been approved by a research ethics committee. Consent to remain in the research should be obtained as soon as possible from the subject or a legally authorized representative.

30. Authors, editors and publishers all have ethical obligations with regard to the publication of the results of research. Authors have a duty to make publicly available the results of their research on human subjects and are accountable for the completeness and accuracy of their reports. They should adhere to accepted guidelines for ethical

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reporting. Negative and inconclusive as well as positive results should be published or otherwise made publicly available. Sources of funding, institutional affiliations and conflicts of interest should be declared in the publication. Reports of research not in accordance with the principles of this Declaration should not be accepted for publication.

C). ADDITIONAL PRINCIPLES FOR MEDICAL RESEARCH COMBINED WITH MEDICAL CARE

31. The physician may combine medical research with medical care only to the extent that the research is justified by its potential preventive, diagnostic or therapeutic value and if the physician has good reason to believe that participation in the research study will not adversely affect the health of the patients who serve as research subjects.

32. The benefits, risks, burdens and effectiveness of a new intervention must be tested against those of the best current proven intervention, except in the following circumstances:

- The use of placebo, or no treatment, is acceptable in studies where no current proven intervention exists; or
- Where for compelling and scientifically sound methodological reasons the use of placebo is necessary to determine the efficacy or safety of an intervention and the patients who receive placebo or no treatment will not be subject to any risk of serious or irreversible harm. Extreme care must be taken to avoid abuse of this option.

33. At the conclusion of the study, patients entered into the study are entitled to be informed about the outcome of the study and to share any benefits that result from it, for example, access to interventions identified as beneficial in the study or to other appropriate care or benefits.

34. The physician must fully inform the patient which aspects of the care are related to the research. The refusal of a patient to participate in a study or the patient's decision to withdraw from the study must never interfere with the patient-physician relationship.

35. In the treatment of a patient, where proven interventions do not exist or have been ineffective, the physician, after seeking expert advice, with informed consent from the patient or a legally authorized representative, may use an unproven intervention if in the physician's judgement it offers hope of saving life, re-establishing health or alleviating suffering. Where possible, this intervention should be made the object of research, designed to evaluate its safety and efficacy. In all cases, new information should be recorded and, where appropriate, made publicly available.

CONCLUSION

A profession consists of a limited group of persons who have acquired some special skill and are therefore able to perform that function in society better than the average person. A professional person is expected to have respect for human beings, competence in his chosen field, integrity and a primary concern with service rather than with prestige or profit. Ethical codes are the result of an attempt to direct the moral consciousness of the members of the profession to its peculiar problems. Ethical codes are important in developing higher standards of conduct, for they are based upon what is considered to be the correct attitude and the correct procedure.

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Chapter 25

LAW AND DENTISTRY

INTRODUCTION

DOCTOR - PATIENT CONTRACT

CONSENT

PROFESSIONAL NEGLIGENCE

CONSUMER PROTECTION ACT (CPA/COPRA)

OTHER LEGAL AVENUES AVAILABLE TO AGGRIEVED PATIENTS

- MEDICAL COUNCIL OF INDIA / DENTAL COUNCIL OF INDIA.
  CIVIL COURTS.
- MRTP (MONOPOLIES AND RESTRICTIVE TRADE PRACTICES COMMISSION)
- PUBLIC INTEREST LITIGATION.
- SECTIONS OF INDIAN PENAL CODE, 1860

DO'S AND DON'T'S FOR MEDICAL PROFESSIONALS

PREVENTIVE MEASURES

CONCLUSION

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INTRODUCTION

"Thou shalt be free from envy, not cause another's death, and pray for the welfare of all creatures. Day and night thou shalt not desert a patient, nor commit adultery, be modest in thy attire and appearance, not to be drunkard or sinful, while entering a patient's house, be accompanied by a person known to the patient. The peculiar customs of the patient's household shall not be made public.". (Charaka's Oath - 1000 B.C)

DOCTOR - PATIENT CONTRACT

Contract is defined as an agreement between two or more persons which creates an obligation to do or not to do a particular thing.

A dentist may refuse to treat a patient for any reason except race, creed, color, national origin or based upon a person's disability.

Patients suffering from acquired immunodeficiency syndrome, or who test positive for HIV, fall into the category of disabled persons and may not be refused care, if the refusal is based solely on the presence of AIDS or their HIV status. The law declares that all health providers' offices are "places of public accommodation" and therefore subject to antidiscrimination laws.

As long as the person is not a patient of record, dentist may even refuse to provide emergency care. It may be unethical, but it is not illegal and cannot form the basis of a civil suit. However just as soon as the dentist expresses a professional judgement, or performs a professional act, the doctor-patient relationship begins, and duties begin to attach.

Contract may be implied or express.

An implied contract

is one inferred from conduct of parties and arises where one person renders services under circumstances indicating that he expects to be paid there for, and the other person knowing such circumstances, avails himself of the benefit of those services.

Implied contract is not established when,

1. the doctor renders first-aid in an emergency
2. he makes a pre-employment medical examination for a prospective employer
3. he performs an examination for life insurance purpose
4. he is appointed by the trial court to examine the accused for any reason

Implied warranties (duties) owed by the doctor :

In accepting a patient for care the dentist warrants that he or she will do the following:

1. Use reasonable care and methods in the provision of services as measured against acceptable standards set by other practitioners with similar training in a similar community.
2. Be properly licensed and registered and meet all other legal requirements to engage in the practice of dentistry.
3. Employ competent personnel and provide for their proper supervision.
4. Maintain a level of knowledge in keeping with current advances in the profession.
5. Not use experimental procedures.
6. Obtain informed consent from the patient before instituting an examination or treatment.
7. Not abandon the patient.
8. Ensure that care is available in emergency situations.
9. Charge a reasonable fee for services based on community standards.
10. Not exceed the scope of practice authorized by the license or permit any person acting under his or her direction to engage in unlawful acts.
11. Keep the patient informed of her or his progress.
12. Not undertake any procedure for which the practitioner is not qualified.

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13. Complete the care in a timely manner.
14. Keep accurate records of the treatment rendered to the patient.
15. Maintain confidentiality of information.
16. Inform the patient of any untoward occurrences in the course of treatment.
17. Make appropriate referrals and request necessary consultations.
18. Comply with all laws regulating the practice of dentistry.
19. Practice in a manner consistent with the code of ethics of the profession.

Implied duties owed by the patient :

When a patient hires or avails of services of a doctor for treatment, he has the following duties :-

1. He must disclose all information that may be necessary for proper diagnosis and treatment.
2. He must co-operate with the doctor for any relevant investigations required to diagnose and treat him.
3. He must carry out all the instructions as regards drugs, food, rest, exercise or any other relevant /necessary aspect.
4. He should notify the dentist of a change in health status.
5. In the case of a private medical practitioner he must compensate the doctor in terms of money.

If the patient breaches any of these duties, notes to that effect should be made in the patients record. Moral considerations apart, failure on the part of the patient / attendant to do his duty

- will enable the doctor to terminate patient -physician contract and that would free him from his legal responsibilities,
- will be construed as contributory negligence, and weaken the case of the patient for compensation.

An express contract

is an actual agreement of the parties, the terms of which are openly uttered or declared at the time of making it, being stated in distinct and explicit language, either orally (oral agreement) or in writing (written agreement). The doctor-patient contract is almost always of the implied type, except where a written informed consent is obtained.

A doctor-patient contract requires that the doctor must continue to treat such a person with reasonable care, reasonable skill, not undertake any procedure/ treatment beyond his skill and must not divulge professional secrets.

1. Continue to treat such a person

Responsibility towards a patient begins the moment a doctor agrees to examine the case. He must not, therefore, abandon his patient except under the following circumstances -

- The patient has recovered from the illness, for which treatment was initiated.
- The patient / attendant does not pay the doctor's fees (in case of a private practitioner).
- The patient / attendant consults another doctor (of any branch of medicine) without the knowledge of the first attending doctor.
- The patient / attendants do not co-operate and follow the doctor's instructions.
- The patient is under some other responsible care, e.g., the patient, after admission in a hospital, comes under care of senior doctors / unit head.
- The doctor has given due notice (orally or written) for discontinuing treatment.
- The doctor is convinced that the illness is a fictitious one.

2. With reasonable care

A doctor must use clean and proper instruments, and provide his patients with proper and suitable medicines if he

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dispenses them himself. If not, he should write the prescriptions legibly, using standard abbreviations and mention instructions for the pharmacist in full. He should give full directions to his patients as regards administration of drugs and other measures, preferably in local written language. He must suggest / insist on consultation with a specialist in the following circumstances,

- When the case is complicated.
- When the question arises about performing an operation which may be dangerous to life or requiring amputation.
- Operating on a case in which there has been a criminal assault.
- Performing an operation, which may affect the intellectual or reproductive functions of a patient.
- In cases where there is suspicion of poisoning or other criminal act.
- When desired by the patient / attendants.
- When it appears that the quality of medical service is required to be enhanced.
- When there is no one from whom informed consent can be obtained.

3. Reasonable skill

The degree of skill a doctor undertakes is the average degree of skill possessed by his professional brethren of the same standing as himself. The best form of treatment may differ when different choices are available. There is an implied contract between the doctor and the patient when the patient is told in effect : "Medicine is not an exact science. I shall use my experience and best judgement and you take the risk that I may be wrong. I guarantee nothing."

4. Not undertake any procedure/ treatment beyond his skill

This depends upon his qualifications, special training and experience. The doctor must always ensure that he is reasonably skilled before undertaking any special procedure / treating a complicated case. To quote an example, a doctor who is not sufficiently trained or qualified should not administer anaesthesia.

5. Must not divulge professional secrets

A professional secret is one which a doctor comes to learn in confidence from his patients, on examination, investigations or which is noticed in the ordinary privacies of domestic life. A doctor is under a moral and legal obligation not to divulge any such secret except under certain circumstances. This is known as privileged communication which is defined as a communication made by a doctor to a proper authority who has corresponding legal, social and moral duties to protect the public. It must be bonafide and without malice, e.g., as a witness in a court of law; warning partners or spouses of AIDS patients and those found infected with HIV; informing public health authorities of food poisoning from a hotel etc; assisting apprehension of a person who has committed a serious crime; informing law enforcers about medico-legal cases, etc.

The doctor- patient relationship ends when,

- Both parties agree to end it
- Either the patient or dentist dies
- The patient ends it by act or statement
- The patient is cured
- The dentist unilaterally decides to terminate the care.

The major causes that contribute to a decision to terminate treatment before it is complete are,

- The patient has not fulfilled the payment agreement.

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- The patient has not co-operated in keeping appointments
- The patient has not complied with home care instructions.
- There has been a breakdown in interpersonal relationships.

Any of these is ample justification for the dentist to terminate treatment. The dentist should not discontinue treatment at a time when the patients health may be compromised.

CONSENT

The term 'consent ' is defined as "when two or more persons agree upon the same thing in the same sense they are said to consent" as per the definition of 'consent ' given in section 13 of the Indian Contract Act, 1872.

Who can give consent:

For the purpose of clinical examination, diagnosis and treatment, consent can be given by any person who is conscious, mentally sound and is of and above twelve years of age as provided under sections 88 and 90 of the Indian Penal Code(IPC), 1860.

Doctors are reminded that consent is taken under section 13 of the Indian Contract Act, 1872. This Act, however also provides under Section 11 that only those persons who are of and above 18 years of age are competent to enter into a contract. Since doctor-patient relationship amounts to entering into a contract, it is advisable that consent should be obtained, specially written consent, from parents / guardian of a patient who is below 18 years so that validity of the contract is not challengeable.

When consent is not valid:

Consent given under fear, fraud or misrepresentation of facts, or by a person who is ignorant of the implications of the consent, or who is under 12 years of age is invalid (Sec. 90 IPC).

Types of consent

Depending upon the circumstances in each case, consent may be implied, express or informed.

Implied consent (Tacit consent)

This is the most common variety of consent. The fact that a patient comes to a doctor for an ailment implies that he is agreeable to medical examination in the general sense. This, however, does not imply consent to procedures more complex that inspection, palpation, percussion, auscultation and routine sonography. For other examinations, notably withdrawal of blood for diagnostic purpose, express consent (oral or written) should be obtained. For more complicated diagnostic procedures, e.g., radiology, C.T. Scan, etc. express written consent should be obtained.

Express consent

Anything other than the implied consent is express consent. This may be either oral or written. Express oral consent is obtained for relatively minor examinations or therapeutic procedures, preferably in the presence of a disinterested third party. Express written consent is to be obtained for all major diagnostic procedures, general anesthesia and for surgical operations.

Informed consent

The concept of informed consent has come to the fore in recent years. All information must be explained in comprehensible non-medical terms preferably in local language about the

(a) diagnosis
(b) nature of treatment
(c) risks involved
(d) prospects of success
(e) prognosis if the procedure is not performed, and
(f) alternative methods of treatment.

(see chapter 24)

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Proxy consent (Substitute consent)

All the above types of consent can take the shape of proxy consent. Parent for child, close relative for mentally unsound /unconscious patient, etc.

Situations where consent may not be obtained

1. Medical emergencies. The well being of the patient is paramount and medical rather than legal considerations come first.
2. In case of person suffering from a notifiable disease. In case of AIDS/HIV positive patients, the position in India regarding it's being a notifiable disease or not is not yet clear. However, in England the Public Health (Infectious Diseases) Regulations 1988 extend the provisions of notifiable diseases to AIDS but not to persons who are HIV positive.
3. Immigrants.
4. Members of armed forces.
5. Handlers of food and dairymen.
6. New admission to prisons.
7. In case of a person where a court may order for psychiatric examination or treatment.
8. Under Section 53 (1) of the Code of Criminal Procedure, a person can be examined at the request of the police, by use of force.

To be valid the consent must be real. The purpose of obtaining the patient's consent is to inform the patient about what the intended treatment is going to be like. However, consent will be invalid if it is obtained without proper explanation or by fraud or misrepresentation. Thus, the consent obtained when the patient is under sedation cannot be considered valid, as the same is not obtained voluntarily.

Situations requiring extra caution:

Doctors should keep in mind certain high-risk situations, which are common cause for medical negligence actions.

1. Retention of objects in operations sites: Swabs, packs, instruments or towels may be left behind in the field of operation. The responsibility remains with the surgeon.
2. Accident & emergency departments: This is the most hazardous part of the hospital and senior staff must be readily available to supervise the work.
3. Amputation of the wrong limb, digit or operation of wrong eye/tooth: This is a common mishap. Carelessness in hospital notes, errors in pre-operative skin marking and failure to check notes against the patient in the operating theater are the common reasons for the misadventure.
4. Anesthesia
   Anesthetists along with surgeons, present a common target for litigation. The actual administration of the anesthetic is not usually the cause of complaint, but the many ancillary responsibilities such as transfusions, injections, airways, I. V. Catheters, diathermy, and hot water bottle burns may form grounds for allegations of negligence.

PROFESSIONAL NEGLIGENCE

(Malpractice, Malpraxis)

Professional negligence is defined as the breach of duty caused by the omission to do something which a reasonable man guided by those considerations which ordinarily regulate the conduct of human affairs would do or doing something which a prudent and reasonable man would not do.

Medical negligence or malpractice is defined as lack of reasonable care and skill or willful negligence on the part of a doctor in the treatment of a patient whereby the health or life of a patient is endangered.

The term 'damage' means physical, mental or

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functional injury to the patient, while 'damages' are assessed in terms of money by the court on the basis of loss of concurrent and future earnings, treatment costs, reduction in quality of life, etc.

In order to achieve success in an action for negligence, the consumer must be able to establish to the satisfaction of the court that,

a. the doctor owed him a duty to conform to a particular standard of professional conduct
b. the doctor was derelict and breached that duty
c. the patient suffered actual damage
d. the doctor's conduct was the direct or proximate cause of the damage.

The burden of establishing all four elements is upon the patient / consumer. Failure to provide substantiative evidence on any one element may result in no compensation.

Criminal negligence

Here the negligence is so great as to go beyond the matter of mere compensation. Not only has the doctor made a wrong diagnosis and treatment, but also that he has shown such gross ignorance, gross carelessness or gross neglect for the life and safety of the patient that a criminal charge is brought against him. For this he may be prosecuted in a criminal court for having caused injury to or the death of his patient by a rash and negligent act amounting to culpable homicide under Section 304-A of the Indian Penal Code. Some examples are as follows :

1. Injecting anesthetic in fatal dosage or in wrong tissues.
2. Amputation of wrong finger, operation on wrong limb, removal of wrong organ / tooth, or errors in ligation of ducts.
3. Operation on wrong patient.
4. Leaving instruments or sponges inside the part of body operated upon.
5. Leaving tourniquets too long, resulting in gangrene.
6. Transfusing wrong blood.
7. Applying too tight plaster or splints, which may cause gangrene or paralysis.
8. Performing a criminal abortion.

CONSUMER PROTECTION ACT (CPA/COPRA)

The Consumer Protection Act, 1986 that came into force on 15th April 1987 is a milestone in the history of socio-economic legislation in the country. It is one of the most progressive and comprehensive piece of legislations enacted for the protection of consumers.

The main objective of the act is to provide for the better protection of consumers. Unlike other laws which are punitive or preventive in nature, the provisions of this Act are compensatory in nature. The act is intended to provide simple, speedy and inexpensive redressal to the consumers' grievances, and relief of a specific nature and award of compensation wherever appropriate to the consumer. The act has been amended in 1993 and in 2002 both to extend its coverage and scope and to enhance the powers of the redressal machinery.

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Who is liable?

1. All medical / dental practitioners doing independent medical / dental practice unless rendering only free service.
2. Private hospitals charging all patients.
3. All hospitals having free as well as paying patients and all the paying and free category patients receiving treatment in such hospitals.
4. Medical / dental practitioners and hospitals paid by an insurance firm for the treatment of a client or an employment for that of an employee.

Who is not liable?

It exempts only those hospitals and the medical / dental practitioners of such

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SUPREME COURT
(Final Appeal)
|
NATIONAL COMMISSION
Appellate Authority over State Commission
Original Jurisdiction
Over Rs.20,00,000
|
STATE COMMISSION
Appellate Authority for District Forum
Suo moto Revision
Original Jurisdiction over Rs. 5,00,000 up to Rs. 20,00,000
|
DISTRICT FORUM
Original Jurisdiction up to Rs. 5,00,000

hospitals which offer free service to all patients.

The Act envisages a three- tier quasi-judicial machinery at the National (National Commission), State (State Commission) and District levels (District Forum).

Structure of consumer forums / commissions and their jurisdictions

As per the Consumer Protection Rules, 1987, a complaint filed in the Consumer Forum / Commission shall be adjudicated, within a period of 90 days from the date of notice by opposite party and within 150 days if it requires analysis or testing of commodities.

The Consumer Protection (Amendment) Act, 1993 has introduced a new section, stating that the forums shall not admit a complaint unless if it is filed within 2 years from the date of cause of action.

Further, a complainant/opposite party can present his case on his own without the help of a lawyer.

The Consumer Protection (Amendment) Act, 2002 has increased the claim amount at different levels as,

National commission - over Rs. 1 crore

State commission - over Rs. 20 lakhs up to Rs. 1 crore

District forum - up to Rs. 20 lakhs

DISTRICT FORUM

This shall consists of:

1. A person who is, or has been or is qualified to be a District Judge, who shall be its president
2. Two other members who shall be persons of ability, integrity and standing and have adequate knowledge or experience of or shown capacity in dealing with problems relating to economics, law, commerce, accountancy, industry, public affairs or administration, one of whom shall be a woman.

Jurisdiction of District Forum

The District Forum shall be jurisdiction to entertain complaints where the value of goods or services and the compensation, if any, claimed does not exceed rupees twenty lakhs.

A complaint may be filled with a District Forum by:

- The consumer to whom such service is provided or is agreed to be provided
- Any recognized consumer association, whether the consumer to whom the service is provided or is agreed to be provided is a member of such association or not
- One or more consumer, where there are numerous consumers having the same interest, with the permission of the district forum, on behalf of, or for the benefit of, all consumers so interested

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STATE COMMISSION

It shall consists of:

1. A person who is or has been judge of a High Court, appointed by the State Government, who shall be its President
2. Two other members with qualifications and experience (as for District Forum) within the State

Jurisdiction of State Commission

- The State Commission shall be jurisdiction to entertain complaints where the value of goods or services and the compensation, if any, claimed is between rupees twenty lakhs and rupees one crore.
- Revision petitions against the District Forum

Procedure of hearing appeal by State Commission:

Procedure of the State Commission for entertaining original complaints is the same as for District Forum. Appeal may be decided ex parte in case the opposite party fails to file a reply to the appeal and /or fails to appear himself or through his agent/advocate on the date fixed. It may be decided on merit, in case the appellant fails to appear on the date fixed for hearing.

Appeals against orders of State Commission

Any person aggrieved by an order made by the State Commission may appeal against such order to the National Commission within a period of 30 days. The National Commission may entertain an appeal after 30 days if it is satisfied that there was sufficient cause for not filing it within that period.

NATIONAL COMMISSION

This shall consists of :

1. A person who is or has been a judge of the Supreme Court to be appointed by the Central Government who shall be its President. (Appointment under this clause shall be made after consultation with the Chief Justice of India).
2. Four other members (qualification: As for District Forum/State Commission), one of whom shall be a woman.

The National Commission shall have jurisdiction:

1. To entertain
   (a) complaints where the value of goods services & compensation if any, claimed exceeds rupees one crore; and
   (b) appeals against the orders of any State Commission.
2. To entertain revision petitions against the State Commission.

Procedure to be followed by the National Commission:

A complaint containing the following particulars shall be presented by the complainant in person or by his agent to the National Commission or be sent by registered post, addressed to the National Commission:

1. The name, description and the address of the complainant
2. The name, description and address of the opposite party or parties
3. The facts relating to the complaint and when and where it arose
4. Documents in support of allegations contained in the complaint
5. The relief which the complainant claims

The remaining procedure is similar to that for State Commission.

Appeal against orders of the National Commission:

Any person aggrieved by an order made by the National Commission, may appeal against such order to the Supreme Court

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within 30 days from the date of the order.

The Supreme Court may entertain an appeal after 30 days if it is satisfied that there was sufficient cause for not filing it within that period.

OTHER LEGAL AVENUES AVAILABLE TO AGGRIEVED PATIENTS

a) Medical Council of India and Dental Council of India
b) Civil Courts
c) MRTP (Monopolies and Restrictive Trade Practices Commission)
d) Public Interest Litigation
e) Sections of Indian Penal Code, 1860

Medical Council of India / Dental Council of India

The affected person can complain to the Medical Council of India / Dental Council of India or the state council.

Civil Courts

The aggrieved patients can file a case against the doctor for monetary compensation for which the patient has to pay court fees that depends upon the compensation sought.

The legal remedies are based on the law of Torts, Section 1-A of the Fatal Accidents Act, 185536 and the Section 357 of Cr. P.C., 197337. But to avail it, an aggrieved patient have to wait for years and spend considerable amount of money on litigations.

The civil court cases take the route of Sub-Court, District Court, High Court and Supreme Court.

Monopolies and Restrictive Trade Practices Act (MRTP), 1969

This Act is the precursor of CPA, 1986. Before the advent of CPA, this act was the only resource to consumers against the unfair trade practices. The commission that looks into the disputes brought under MRTP Act is based in New Delhi.

Public Interest Litigation (PIL)

An aggrieved patient can directly approach the High Court or the Supreme Court when his/her grievances are not properly redressed. PIL's are usually resorted when public health programs are not implemented properly.

Indian Penal Code and Medical Negligence

Indian Penal Code, 1860 sections 52, 80, 81, 83, 88, 90, 91, 92 304-A, 337 and 338 contain the law of medical malpraxis in India.

A physician can be charged with criminal negligence when a patient dies from the effects of a drug or other kind of treatment, if it can be proved that the death was the result of malicious intention, or gross negligence. Before the administration of any drug or performance of an operation, the medical man is expected to follow the accepted precautions. In such cases, the physician should be able to prove that he used reasonable and ordinary care in the treatment of his patient to the best of his judgment. He is, however, not liable for an error judgment. The law expects a duly qualified physician to use that degree of skill and care which an average man of his qualifications ought to have, and does not expect him to bring the highest possible degree of skill in the treatment of his patients, or to be able to guarantee cures.

The Indian courts have been very careful not to hold qualified physicians criminally (instances of quacks for criminal negligence are there) liable for patients' deaths that are the result of a mere mistake of judgment in the selection and application of remedies and when the death resulted merely from an error of judgment or an inadvertent death.

Do's for doctors

- Mention your qualifications/ training/ experience/ designation on the prescription. Qualifications mean

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recognized degrees/ diplomas. Mention of scholarships/ membership/ awards which are not qualifications should be avoided.

- Always mention date and timing of the consultation.
- Mention age and sex of the patient. In a pediatric prescription, weight of the patient must also be mentioned.
- Listen attentively. Look carefully. Ask questions intelligently.
- If, after completing the examination, the patient/ attendant feels that something has been left out or wants something to be examined, oblige him.
- Always face the patient. Do not stare. Some patients tolerate very little eye contact. Learn to observe out of the corner of your eyes.
- In case you have been distracted/ inattentive during the history taking, ask the patient/ attendant to start all over again. He will never mind it. As far as possible, consultations should not be interrupted for non-urgent calls.
- Ask the patient to come back for review the next day, in case you have examined him hurriedly or if you are not sure about the diagnosis/ treatment.
- Mention "diagnosis under review" until the diagnosis is finally settled.
- In complicated cases, record precisely the history of illness and substantial physical findings about the patient on your prescription.
- If the patient/ attendants are erring on any count (history not reliable, refusing investigations, refusing admission) make a note of it or seek written refusal preferably in local language with proper witness.
- Mention the condition of patient in specific/objective terms. Avoid vague/ non-specific terminology.
- Record history of drug allergy.
- Write names of drugs clearly. Use correct dosages and mention clearly method and interval of administration.
- Mention additional precautions, e.g., food, rest, avoidance of certain drugs, allergens, alcohol, smoking, etc., if indicated.
- Give instruction to the patient in comprehensible terms, making sure that the patient understands both the instruction and the importance of strictly adhering to them,
- Mention likely side-effects, and action to be taken if they occur.
- Always advice the patient not to stop taking a drug suddenly, which is required to be tapered before it is stopped.
- Mention if patient/ attendant is under effect of alcohol/ drugs.
- In case a particular drug/equipment is not available, make a note.
- Mention whether prognosis is explained. If necessary take a signature of patient/ attendant, after explaining the prognosis in written local language.
- Mention where the patient should contact in case of your non-availability/ emergency.
- Whenever referring a patient, provide him with a referring note.
- In case of emergency/ serious illness, ring up the concerned doctor in the patient's presence. Show your concern.
- Update your knowledge and skill from time to time. Update the facilities and equipment according to prevailing current standards in your area.
- Preferably employ qualified assistants.
- Always obtain a legally valid consent before undertaking surgical/ diagnostic procedure. Learn the difference between "informed persuasion" and "informed consent". The first is legally wrong, through at times it may be medically correct
- Routinely advise X-rays in injury/ diseases of bones and joints

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- Always rule out pregnancy before subjecting the uterus to X-ray.
- Always read reports carefully and interpret the results of tests/ X-rays properly and make a note of it.
- Always seek proper legal and medical advice before filing reply to the complaint referred to you from a consumer court.

While administering an injection/drug always check:

1. Name of the drug
2. Expiry date
3. Reconfirm the route of administration
4. If it is to be diluted, check the dilution factor
5. Rate of administration (fast, slow, in drip, etc.)
6. That a disposable syringe and needle are used.
7. In case the patient is agitated/ not co-operating, restrain him properly with 1 or 2 assistants or wait until he calms down. It is not unusual for a broken needle leaking to a claim for compensation
8. Confirm that it has been kept at the required temperature

Don'ts for Doctors

1. Don't prescribe without examining the patient, even if he is a close friend or relative
2. Never examine a female patient without presence of female nurse/ attendant.
3. Don't insist on the patient to tell the history of illness or be examined in presence of others. He has right to privacy and confidentiality.
4. Do not permit considerations of religion, nationality, race, party, politics or social standing to intervene between you and your patient.
5. Don't smoke while examining a patient.
6. Don't examine a patient when you are sick, exhausted, or under influence of alcohol or any intoxicated substance.
7. Don't be overconfident. Don't look overconfident.
8. Don't' prescribe a drug or indulge in a procedure of you cannot justify its indication, or a drug which is banned
9. Don't write instructions on a separate slip. Don't allow substitutions.
10. Don't adopt experimental method in treatment. If there is some rationale do it only after informed consent.
11. Don't do anything beyond your level of competence. Competence is defined by your qualification, training and experience.
12. When you are not sure what and why to do, consult your senior/ specialist/ colleague.
13. Don't refuse if the patient/ attendants want to leave against medical advice. It is their right. Document this properly.
14. Don't withhold information, however harsh and difficult. The doctors and especially their assistants must train in the art of sensitive communication. It would be wise to take into confidence the family members, close relatives and friends; this would often make the acceptance easier and quicker.
15. Don't leave at the moment of death. There is a tendency especially on the part of senior doctors to go away at this time when his presence and experience are most needed.
16. Don't hesitate to extend your condolences and sympathies to the bereaved persons.
17. Don't deny medical care to a patient with HIV infection/ AIDS. Observe all necessary precautions.
18. Don't inform that the person is infected with HIV unless confirmatory test results are received. Don't give untrue, misleading or improper reports, documents, etc.
19. Don't refuse the patient's right to examine and receive an explanation about your bill

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regardless of the source of payment; whether or not it is reimbursed by the government or by his employer/ insurance company.

PREVENTIVE MEASURES - How To Avoid Litigation

1. True and MCI / DCI approved qualification

Training & experience of recognized centers are the primary safeguards against any litigation. The prescription heads, signboards and advertisements should mention the actual facilities available. Refrain from claims of guarantee of results.

2. Communication / Interpersonal behavior

This is the key to doctor-patient relationship. Increasing crowds of patients and improper communication to patient about diagnostics and treatment procedures, complications and claims of guaranteed success are main reasons for patient dissatisfaction. So it is desirable for us to give our behavior a human face with a sympathetic attitude. We must answer all queries of the patients/relative without getting irritated and patiently. We should not be averse of any demand/suggestion for second opinion by patient/relatives. The right of patient/relatives to seek explanation about the bill should not be denied.

The whole system of medical establishment should be made courteous, and polite. Special training should be imported to the staff about dealing with patients/relatives under grievous mental stress due to some loss/injury.

3. Academic & technical upgradation

To keep pace with fast changing scenario of technical advancement, one should regularly attend continuing education programs, workshops and other academic sessions and should also organize workshops to upgrade the auxiliaries.

4. Medical / dental ethics and laws

A through knowledge of ethics and laws is essential for all medical professionals. This helps in improving/correcting the practice standards. Feedback from patients about the setup, staff, charges etc, will give an idea about further improvement/improvisation. Proper documentation is also an important factor.

5. Prevention by professional indemnity (Insurance cover)

Professional indemnity insurance is a tool, which not only meets the claim of compensation awarded against doctor/hospital but also gives a sense of mental security that even if same negligence is proved the insurance company will take care of it. The insurance companies not only pay the compensation to the other party but also arranges for legal help from advocates.

CONCLUSION

After the Consumer Protection Act, 1986, came into effect, a number of patients have filed cases against doctors. Although, no human being is perfect and even the most renowned specialist could make a mistake in detecting or diagnosing the true nature of a disease, the doctor/ dental surgeon can be held liable for negligence only if one can prove that she/ he is guilty of a failure that no doctor with ordinary skills would be guilty of if acting with reasonable care.

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Chapter 26

THE DENTISTS ACT OF INDIA

CHAPTER

I - INTRODUCTORY
II - DENTAL COUNCIL OF INDIA
III - STATE DENTAL COUNCILS
IV- REGISTRATION
V- MISCELLANEOUS

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The Dentists Act, 1948 (Act 16 of 1948) is an act to regulate the profession of dentistry.

It was introduced on the 29th of March, 1948.

The Act contains five chapters and their sub-sections.

CHAPTER - I - INTRODUCTION

Short title and extent:

1. This act may be called the Dentists Act, 1948.
2. It extends to the whole of India.

Interpretation of the Act:

In this Act,

a. "The Council" means the Dental Council of India.

b. "Dental Hygienist" means a person not being a dentist or a medical practitioner, who scales, cleans or polishes teeth or gives instruction in dental hygiene.

c. "Dental Mechanic" means a person who makes or repairs denture and dental appliances.

d. "Dentistry" includes,

(i) The performance of any operation on, and the treatment of any disease, deficiency or lesion of human teeth or jaws and the performance of radiographic work in connection with human teeth or jaws or the oral cavity.

(ii) The giving of any anesthetic in connection with and such operation or treatment.

(iii) The mechanical construction or the renewal of artificial dentures or restorative dental appliances.

(iv) The performance of any operation on, or the giving of any treatment, advice or attendance to any person for the purpose of or in connection with the fitting, inserting, fixing, constructing, repairing or renewing of artificial dentures or restorative dental appliance and the performance of any such operation and the giving of any such treatment, advice or attendance as is usually performed or give by dentists.

e. "Dentist" means a person who practices dentistry.

f. "Medical practitioner" means a person who holds a qualification granted by an authority specified or notified under section 3 of the Indian Medical Degrees Act 1916.

g. "Prescribed" means prescribed by rules or regulations made under this act.

h. "State Council" means a state Dental Council constituted under Section 21 and includes a Joint (state) Council constituted in accordance with an agreement under section 22.

i. "Register" means a register maintained under this act.

j. "Recognized Dental Qualification" means any of the qualifications included in the schedule.

k. "Recognized Dental Hygiene Qualification" means qualification recognized by the council under section 11

l. "Registered Dentist", "Registered Dental Hygienist" and "Registered Dental Mechanic" shall mean respectively, a person whose name is for the time being registered in a register of dentists, a register of dental hygienists and a register of dental mechanics.

CHAPTER - II - DENTAL COUNCIL OF INDIA

Constitution and composition of the council:

The central government shall constitute a council consisting of the following members, namely,

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a) One registered dentist possessing a recognized dental qualification elected by the dentists registered in part A of each state register.

b) One member elected from amongst themselves by the members of the Medical Council of India.

c) Not more than 4 members elected from among themselves by;

i) Principals, Deans, Directors and Vice-Principals of Dental colleges in the states training students for recognized dental qualifications, provided that not more than one member shall be elected from the same dental college.

ii) Heads of dental wings of medical colleges in the states training students for recognized dental qualifications.

iii) One member from each university established by law in the states which grants a recognized dental qualification, to be elected by the members of the Senate of the University.

d) One member to represent each state nominated by the government of each such state from among persons registered either in a medical or dental register of the state.

e) Six members nominated by the Central Government of whom atleast one shall be a registered dentist possessing a recognized dental qualification and practicing or holding an appointment in an institution for the training of dentists, and at least two shall be dentists registered in part B of a state register.

f) The Director General of Health Services (ex-officio).

Incorporation of council

The council shall be a body corporate by the name of the Dental Council of India having perpetual succession and a common seal.

Mode of elections

Elections shall be conducted in the prescribed manner and where any dispute arises regarding any such election, it shall be referred to the central government whose decision shall be final.

Term of office and casual vacancies

i) An elected or nominated member shall hold office for a term of five years from the date of his election or nomination or until his successor has been duly elected or nominated, whichever is longer.

ii) An elected or nominated member may at any time resign his membership by writing (under his hand addressed) to the president and the seat of such member shall thereupon become vacant.

iii) An elected or nominated member shall be deemed to have vacated his seat if he is absent, without excuse, from three consecutive ordinary meetings of the council or in the case of a member who was elected among principals and deans of dental colleges, if he ceases to hold his appointment as the dean or principal, or as the case may be.

iv) A casual vacancy in the council shall be filled by fresh "election or nomination, as the case may be, and the person "elected or nominated to fill the vacancy shall hold office only for the remainder of the term for which the member whose place he takes was elected or nominated.

v) Members of the council shall be eligible for re-election or re-nomination.

vi) No act done by the council shall be called in question on the ground merely of the existence of any, vacancy in or, defect in the constitution of the council.

President and vice-president of the council

i) The President and Vice-President of the council shall be elected by the members,

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(thereof) from among themselves.

ii) An elected president or vice-president shall hold office for a term not exceeding five years and not extending beyond the expiry of his term as member of the council, but subject to his being a member of the council, he shall be eligible for re-election.

The Executive Committee

1. The council shall constitute from among its members, an Executive Committee or other committees necessary for carrying out its functions under this Act.
2. The Executive Committee shall consist of the president and vice-president ex-officio and the Director General of Health Services ex-officio and five other members elected by the council.
3. The President and Vice-president of the council shall be Chairman and Vice-chairman, respectively, of the Executive Committee.
4. A member of the Executive Committee shall hold office until the expiry of his term of office as member of the council and subject to his being a member of the council, he shall be eligible for re-election.
5. In addition to the powers and duties conferred and imposed on it by this Act, the Executive Committee shall exercise and discharge such powers and duties as may be prescribed.

Recognition of dental qualifications

1. The dental qualifications granted by any authority or institution in India, which are included in Part I of the schedule shall be recognized dental qualifications for the purpose of this act.
2. Any authority or institution in India which grants a dental qualification not included in Part I of the schedule may apply to the central government to have such qualification recognized and included in that part and the Central Government, after consulting the council, may, by notification in the official gazette amend Part I of the schedule so as to include such qualification therein and also direct that an entry shall be made in Part I of the schedule declaring that the dental qualification shall be recognized only when granted after a specified date.
3. a. The dental qualifications granted by any authority or institution outside India, which are included in Part II of the schedule shall be recognized dental qualifications only for the purpose of the registration of citizens of India when the register is first prepared under this Act.

   b. Where any dental qualification granted by any authority or institution outside India and held by a citizen of India, is recognized for the purposes of the register when it is first prepared, after the commencement of the Dentists (Amendment) Act, 1972, the Central Government may, after consultation with the council, amend Part II of the schedule so as to include therein the dental qualification so recognized.

   a. The dental qualifications granted by any authority or institution outside India, which are included in Part III of the schedule, shall be recognized dental qualifications for the purposes of this Act, but no person possessing any such qualification shall be entitled for registration unless he is a citizen of India.

   b. Where any dental qualification granted by any authority or institution outside India and held by citizen of India, is recognized, after the commencement of the Dentists Amendment Act, 1972, the Central Government may, after consultation with the council, amend Part III of the schedule so as to include therein the dental qualification so recognized.
5. The council may enter into negotiations with any authority or institution in any state or country outside India which is entrusted

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with the maintenance of a register of dentists, for the settling of a scheme of reciprocity for the recognition of dental qualifications and in pursuance of any such scheme, the Central Government may declare that such qualification when granted after a specified date, shall be a recognized dental qualification for the purposes of this Act.

6. The central government may, after consultation with the council, amend the schedule by directing that an entry be made therein in respect of any dental qualification only when granted before a specified date.

Qualifications of dental hygienists

Any authority in a state which grants a qualification for dental hygienists may apply to the council to have such qualification recognized and the council may, after consulting the government and the state council of the state in which the authority making the application is situated, declare that such qualification when granted after a specified date, shall be a recognized dental hygiene qualification for the purposes of this act.

Qualifications of dental mechanics

The council may prescribe the period and nature of an apprenticeship or training which shall be undergone and other conditions which shall be satisfied by a person before he is entitled to be registered under this act as a dental mechanic.

Effect of recognition

1. Any recognized dental hygiene qualification shall be a sufficient qualification for enrolment in the approximate register of any state.
2. No person shall be entitled to be enrolled in any register as a dentist or dental hygienist unless he holds a recognized dental or dental hygiene qualification or as a dental mechanic unless he has undergone training which satisfies the prescribed requirements.

Withdrawal of recognition

1. When upon report by the Executive committee it appears to the council:
   a) that the courses of study and training or the examinations to be undergone or the conditions for admission to such courses are not in confirmation with regulations made under this act or fall short of the standards required thereby or,
   b) that an institution does not satisfy the requirements of the council, a statement to that effect may be sent by the council to the Government of the State in which the authority or institution is situated and the state government shall forward it to the authority or institution concerned with an intimation of the period within which the authority or institution may submit its explanation to the government.
2. On receipt of the explanation or on the expiry of the fixed period, the state government shall, after consulting the state council, forward, its recommendations to the council.
3. The council, after considering the recommendations of the state government may declare that the qualification granted by the authority or institution shall be a recognized dental hygiene qualification only when granted before a specified date.
4. The council may declare that any recognized dental hygiene qualification granted outside the states shall be recognized as such only if granted before a specified date.

Withdrawal of recognition of recognized dental qualification

1. When it appears to the council:
   a) that the courses of study and training or the examination to be undergone or the

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conditions for admission to such courses or the standards of proficiency required from the candidates at such examinations are not in conformity with the regulations made under this act or fall short of the standards required thereby or;
b) that an institution does not, in the matter of staff, equipment, accommodation, training and other facilities, satisfy the requirements of the council, the council shall send a statement to that effect to the central government.

2. After considering such a statement, the central government may send it to the state government in which the authority or institution is situated and the state government shall forward it to the authority or institution concerned, with an intimation of the period within which the authority or institution may submit its application to the state government.
3. After considering the application, or on the expiry of the fixed period, the state government shall make its recommendations to the central government.
4. The Central Government, after considering the recommendations of the state government, may direct that an entry be made in part I of the schedule against the qualification granted by the authority or institution declaring that it shall be a recognized dental qualification only when granted before a specified date.

Mode of declarations

All declarations shall be made by a resolution passed at the meeting of the council and shall be published in the official gazette.

Professional conduct

1. The council may prescribe standards of professional conduct and etiquette or the code of ethics for dentists.
2. Regulations made by the council may specify which violation shall constitute professional misconduct.

The Indian register

1. The council shall maintain a register of dentists to be known as the Indian Dentists Register and consisting of the entries in all the state registers of India.
2. Each state council shall supply to the council, twenty printed copies of the state register after the first day of April each year and each registrar shall inform the council of all the additions or amendments in the state register.

CHAPTER-III - STATE DENTAL COUNCILS

Constitution and composition of state councils

1. The State Government shall constitute a state council consisting of the following members;
   a) Four members elected from among themselves by dentists registered in Part A of the state register.
   b) Four members elected from among themselves by dentists registered in Part B of the state register.
   c) The heads of dental colleges in the state which train students for any recognized dental qualification included in Part I of the schedule.
   d) One member elected from amongst themselves by the members of the Medical Council.
   e) Three members nominated by the state government and,
   f) The chief medical officer of the state.

Inter state agreements

1. Two or more state governments may enter into an agreement;
   a) for the constitution of a joint state council for all the participating states or,
   b) for the state council of one state to serve

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the needs of the other participating states.

2. The agreement may,

   a) provide for the appointment between the participating states of the expenditure in connection with the state council or joint state council.

   b) determine which of the participating state governments shall exercise the functions under this act.

   c) provide for consultation between the participating state governments.

   d) make such incidental and ancillary provisions, not inconsistent with this Act, as may be deemed necessary for giving effect to the agreement.

3. The agreement shall be published in the official gazettes of the participating states.

Composition of joint state councils

The members are,

a) Two members elected from among themselves by dentists registered in Part A of the register of each of the participating states.

b) Two members elected from among themselves by dentists registered in Part B of the register of each participating states.

c) The heads of dental colleges in the participating states which train students for any of the recognized dental qualifications included in Part I of the schedule.

d) One member elected by the medical council of each participating state.

e) Two members nominated by each participating state government.

f) The chief medical officer of each participating state.

President and vice-president of state council

1. They shall be elected by the members from among themselves, provided that for five years from the first constitution of the state council, the President shall, if the state government so decides, be a person nominated by the state government.
2. The president or vice-president shall hold office for a term not exceeding five years and not extending beyond the expiry of his term as a member of the state council.

Mode of elections

Elections shall be conducted in the prescribed manner and where any dispute arises regarding any such election, it shall be referred to the state government whose decision shall be final.

Term of office and casual vacancies

1. An elected or nominated member shall hold office for a term of five years or until his successor has been duly elected or nominated, whichever is longer.
2. An elected or nominated member may at any time resign his membership by writing to the president and the seat of such member shall thereupon become vacant.
3. An elected or nominated member shall be deemed to have vacated his seat,

   a) If he is absent without excuse from three consecutive ordinary meetings of the state council or

   b) In the case of a member whose name is required to be included in any state register, if his name is removed from the register.

   c) Where he has been elected from among the members of the medical council, if he ceases to be a member.

4. A casual vacancy in the state council shall be filled by fresh election or nomination and that person shall hold office only for the remainder of the term for which the member whose place he takes was selected or nominated.
5. Members of the state council shall be eligible for re-election or re-nomination.
6. No act done by the state council shall be called in question on the ground merely of the existence of any vacancy in or defect in

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the constitution of the state council.

Executive committee

1. The state council shall constitute among its members an Executive Committee consisting of the president and vice-president ex-officio and the chief medical officer of the state or the states concerned.
2. The president and vice-president of the state council shall be chairman and vice chairman respectively of the executive committee.
3. A member of the Executive Committee shall hold office until the expiry of his term of office as a member of the state council, but subject to his being a member of the state council, he shall be eligible for re-election.
4. The Executive Committee shall exercise and discharge such powers and duties as may be prescribed.

CHAPTER - IV- REGISTRATION

Preparation and maintenance of register

1. The state government shall prepare a register of dentists for the state.
2. The state council shall assume the duty of maintaining the register in accordance with the provisions of this act.
3. The register of dentists shall be maintained in two parts, A and B. Persons possessing recognized dental qualification being registered in part A and persons not possessing such qualifications being registered in part B.
4. The register shall include the following particulars namely,
   a) The full name, nationality and residential address of the registered person.
   b) The date of his first admission to the register.
   c) His qualification for registration and the date on which he obtained his degree or diploma in dentistry and the authority which conferred it.
   d) His professional address.

First preparation of register

The State government shall constitute a Registration tribunal consisting of 3 persons and shall also appoint a registrar who shall act as secretary of the tribunal. The state government shall appoint a date on or before which, application for registration which shall be accompanied by the prescribed fee shall be made to the Registration Tribunal.

Qualifications for entry on first preparation of register

A person shall be entitled on payment of the prescribed fee to have his name entered on the register when it is first prepared if he resides or carries on the profession of dentistry in the state and if he,

a) holds a recognized dental qualification
b) does not hold such a qualification, but being a citizen of India has been engaged in practice as a dentist as his principal means of livelihood for a period of not less than five years, prior to the date appointed under sub-section (2) of section 32.

Scrutiny of applications for registration

1. All applications should be addressed to the registrar of the state council and shall be accompanied by the prescribed fee.
2. If the registrar is of the opinion that the applicant is entitled to have his name entered on the register, he shall enter it.
3. Any person whose application for registration is rejected by the registrar may, within three months appeal to the state council and the decision of the state council shall be final.
4. Upon entry of a name in the register, the registrar shall issue a certificate of registration in the prescribed form.

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Registers of dental hygienists and dental mechanics

The state government may, by notification in the official gazette, direct that the state council shall maintain a register of dental hygienists or a register of dental mechanics.

A person shall be entitled on payment of the prescribed fees to have his name registered if he has satisfied the prescribed requirements.

Renewal fees

The state government may direct that for the retention of a name in a register after the 31st day of December, following the year in which the name is first entered in the register, there shall be paid annually to the state council such renewal fees as prescribed. Where a renewal fee is not paid before the due date, the registrar shall remove the name of the defaulter from the register. On payment of the renewal fee, the registrar shall issue a certificate of renewal.

Effect of registration

1. Any reference to a person recognized by law as a dentist shall be deemed to be a reference to a dentist registered under this act.
2. No certificate required by law from a dentist shall be valid unless the person signing it is registered as a dentist under this act.
3. Any person who is a registered dentist in a state may practice as such in any other state.

Transfer of registration

Where a dentist recognized in one state is practicing dentistry in another state, he may, on payment of the prescribed fee, make an application to the council for the transfer of his name from the register of the state in which he is registered to that of the state in which he is practicing dentistry.

CHAPTER - V- MISCELLANEOUS

1. If any person, whose name is not for the time being entered in a register falsely represents that it is so entered, he shall be punishable on first conviction with fine, which may extend to five hundred rupees and on any subsequent conviction with imprisonment which may extend to six months or with fine not exceeding one thousand rupees or with both.
2. If any person,

   a) Not being a person registered in a register of dentists, takes or uses the description of dental practitioner or

   b) Not possessing a recognized dental qualification uses a degree or a diploma or an abbreviation indicating or implying a dental qualification, he shall be punishable on first conviction with fine which may extend to five hundred rupees and on any subsequent conviction with imprisonment which may extend to six months or with fine not exceeding one thousand rupees or with both.
3. If any person whose name has been removed from a register, fails to surrender his certificate of registration or certificate of renewal, he shall be punishable with fine which may extend to fifty rupees per month and in the case of a continuing offence, with an additional fine which may extend to two rupees per day after the first day during which the offence continues.
4. The profession of dentistry shall not be carried on by a company or other corporate body except in case of

   a) a company or other corporate body which carries on no business other than the profession of dentistry or some business ancillary to the profession of dentistry and of which the majority of the directions and operating staff are registered dentists.

   b) the carrying on of the profession of dentistry by employers who provide dental treatment for their employees by

5.

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registered dentists otherwise than for profit,

c) the carrying on of the profession of dentistry by any hospital or dispensary or institution for the training of dentists or by any authorized body to provide dental treatment.

5. Whenever it appears to the central government that the council is not complying with any of the provision of this Act, the central government may appoint a commission of enquiry consisting of three persons, two of whom shall be appointed by the central government, one being the judge of a high court and one by the council. The commission, after enquiry will report to the central government. The central government may accept the report or remit the same to the commission for modification or reconsideration. After the report is finally accepted, the central government may order the council to adopt the remedies so recommended within a specified time and if the council fails to comply, the central government may take action as may be necessary to give effect to the recommendations of the commission.

The dentists (amendment) act, 1993

The act came into force on the 27th day of August, 1992. The following sections were inserted after section 10 of the Dentists Act, 1948.

1. a) No person shall establish an authority or institution for a course of study or training (including a post-graduate course of study) which would enable a student to qualify himself for a recognized dental qualification.

   b) No authority or institution conducting a course of study or training for granting a recognized dental qualification shall -

   (i) open a new or higher course of study or training which would enable a student to qualify himself for any recognized dental qualification, or

   (ii) increase its admission capacity in any course of study or training except with the previous permission of the central government.

2. Every person, authority or institution granting recognized dental qualification shall, for the purpose of obtaining permission, submit to the central government a scheme in accordance with the provisions and the central government shall refer the said scheme to the council for its recommendations.
3. On receipt of a scheme by the council, it may -

   a) if the scheme is defective and does not contain any necessary particulars, give a reasonable opportunity to the authority concerned for making a written representation and it shall be open to such authority to rectify the defects, if any, specified by the council.

   b) Submit the scheme together with its recommendations to the central government.
4. The central government after considering the scheme and the recommendations of the council, may either approve or disapprove the scheme.
5. Where within a period of one year from the date of submission of the scheme to the central government, no order passed by the central government has been communicated to the authority submitting the scheme, such scheme shall be deemed to have been approved by the central government and accordingly, the permission of the central government shall also be deemed to have been granted.
6. The council while making its recommendations and the central government while passing an order either approving or disapproving the scheme, shall have due regard to the following factors:

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a. Whether the proposed authority for grant of recognized dental qualification would be in a position to offer the minimum standards of dental education in conformity with the requirements.

b. Whether the person seeking to establish an authority has adequate resources.

c. Whether necessary facilities in respect of staff, equipment, accommodation, training and other facilities to ensure proper functioning have been provided or would be provided within the time limit specified in the scheme.

d. Whether adequate hospital facilities, with regard to the number of students, have been provided or would be provided within the specified time.

e. Whether any arrangement has been made to impart proper training, to students likely to attend such a course, by persons having the recognized dental qualifications.

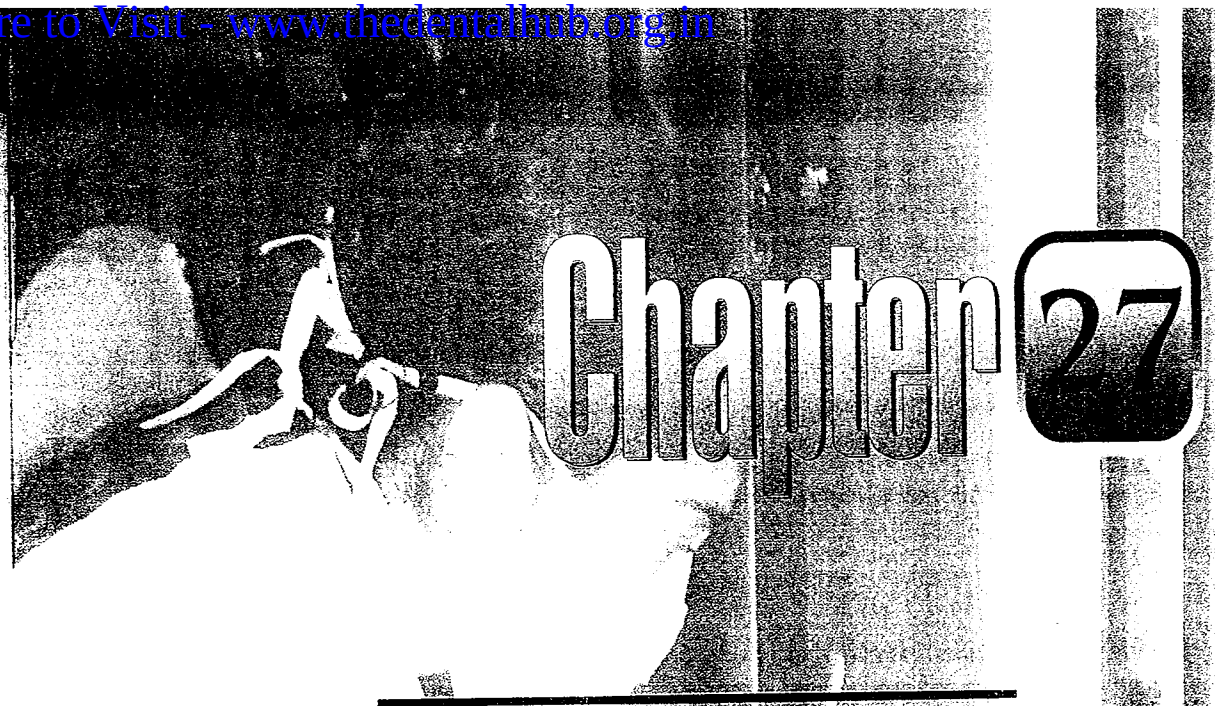
f. The requirement of manpower in the field of dental practice.

7. a. Where any authority or institution is established without the previous permission of the central government, no dental qualification granted to any student on the basis of such study shall be a recognized dental qualification.

   b. Where any authority increases its admission capacity in any course of study without the previous permission of the central government, no dental qualification granted to any student of such authority on the basis of the increase in its admission capacity shall be a recognized dental qualification.

8. If, after the 1st day of June, 1992 and on and before the commencement of the Dentists (Amendment) Act 1993, any person has established an authority or institution for grant of recognized dental qualification, such person shall seek within a period of one year from the commencement of the Dentists (Amendment) Act 1993, the permission of the Central Government.

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Chapter 27

INDIAN DENTAL ASSOCIATION AND DENTAL COUNCIL OF INDIA

INTRODUCTION
OBJECTIVES OF IDA
FUNCTIONS OF IDA
STRUCTURE OF THE ASSOCIATION
MEMBERSHIP OF IDA
PRIVILEGES OF IDA MEMBERSHIP
OFFICE BEARERS OF IDA
CENTRAL COUNCIL OF IDA
RECEIPTS AND EXPENDITURE OF THE ASSOCIATION
ANNUAL GENERAL BODY MEETING AND ANNUAL CONFERENCE
CONCLUSION

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INTRODUCTION

The All India Dental Association became the Indian Dental Association (IDA) was formed in the year 1946.

OBJECTIVES OF IDA

The main objectives of the association are,

1. Promotion, encouragement and advancement of dental and allied sciences.
2. To encourage the members to undertake measures for the improvement of public health and education in India, and
3. The maintenance of the honour and dignity and the upholding of interests of the dental profession and co-operation between the members there of.

FUNCTIONS OF IDA

For the attainment of the above objective and to strengthen the association, various programs are undertaken and different measures adopted for its implementation. These include,

1. Holding periodical meetings and conferences of the members of the association and of the dental profession in general.
2. Publishing and circulating a journal which is the official organ of the association, of a character specially adopted to the needs of the dental profession in India and which shall undertake publicity and propaganda of the work of the association through its columns.
3. Encouraging the opening of libraries in the branches and buying books out of the funds of the association.
4. Publishing from time to time papers related to dental researches conducted by members independently or under the auspices of the association.
5. Encouraging research in dental and allied sciences, with grants out of the funds of the association, by the establishment of scholarships and maintaining international contacts with foreign dental association.
6. Conducting educational campaigns among the masses of India in the matter of oral hygiene by co-operating with different public bodies working with the same objectives.
7. Also to express its views on all questions pertaining to the Indian legislation affecting public health, the dental profession and dental education and take such steps from time to time regarding the same as shall be deemed expedient or necessary. And finally to do all such other things as are cognate to the objectives of the association or are incidental or conducive to the attainment of the above objectives.
8. Protects public from unethical treatment by unqualified practitioners.
9. Trying to set exemption from custom duty for essential dental materials & instruments.

STRUCTURE OF THE ASSOCIATION

The association has got a registered office in India where the Honorary General Secretary resides. Branches of this association spreads all over India. There are mainly 2 types of branches.

1. Local branches
   Branches which are situated either at district head quarters or in other places in the district.
2. State branches
   Branches which have their headquarters within their respective state and are made up of various local branches within the state as their units.

   Local and state branches are formed for the better attainment of the objectives of the association. Local branches should have a minimum of 30 annual /life members and there shall not be more

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than one branch in the same town.

MEMBERSHIP OF IDA

Dental practitioners registered under the Indian Dentist Act 1948 are eligible to become members of the association.

The members of the association itself are of different categories,

1. Honorary members
   Persons of high scientific or literary attainment or person who have rendered conspicuous services to the association or persons whose connections with the association may be deemed desirable and if willing to be made Honorary members are so elected according to the rules of the association.
2. Life members
   Dental practitioners and other members of the dental profession eligible to become a member of the association on payment of life subscription.
3. Annual members
   Persons with required qualifications mentioned in rule 10 who pay by annual subscription.
4. Direct members
   Persons eligible for membership but who are not residing or practicing in the area of a local branch. These members shall be attached to a state branch or to the central head-quarters.
5. Student members
   Only undergraduate students of recognized dental institution may be admitted as student members.
6. Affiliate members
   Non residential foreign dental practitioners having dental qualification according to section 10 are eligible to become affiliated members, subject to the approval of the central council of the Indian dental association. All affiliated members will be attached only to the head office.

If a person has to be elected as honorary member at least 25 members of the association or 10 members of the central council should propose his/her name along with claims of the candidate for such honour before the central council. Director member and other members shall fill up and sign the prescribed form of application of membership which can be sent directly to the Honorary general secretary or through the state branch or local branch.

PRIVILEGES OF IDA MEMBERSHIP

1. All member shall be supplied with a copy of the journal and such other publication of the association free of cost.
2. All members can use the library and association rooms if any.
3. All members have the right to attend / take part in discussions in all general meetings, lectures and demonstrations or conferences organized by the association.
4. All members shall enjoy any other privilege that may be conferred by the central council.

OFFICE BEARERS OF IDA

For the proper management of the association, the following office bearers are elected.

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1. One President.
2. One President - elect.
3. Three Vice Presidents.
4. One Honorary General Secretary.
5. One Honorary Joint Secretary.
6. One Honorary Assistant Secretary.
7. One Honorary Treasurer.
8. One Editor of the Journal of the IDA.
9. One Chairman of the Council on Dental Health (CDH)
10. One Honorary secretary of the council on Dental health (CDH).

The Honorary secretary, Joint secretary, Assistant secretary and Treasurer must reside in the city where the head office is

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located. Local branches also have office bearers of the same grade. In case of branches having its own constitution, the office bearership shall be decided by the general body of the branch concerned. Each of the office bearers have their own duties, powers and tenure.

Election of the office - bearers:

a) For President & the Vice presidents, nominations are invited from local branches to nominate one member of the association for the office of the president elect and three members of the association for the office of the three Vice-Presidents. The Executive committee of the branch selects the members and before forwarding these nominations, the secretary of the branch ascertains from the person concerned whether he/she accepts the nominations or not. After screening or self withdrawal of the candidature by any, the list of nominations is sent to all the branches requesting them to elect one name for President elect and three names for the Vice-President, from among the names in the list of nominees. Ballot papers are prepared by the branch secretary using this list. Voting is done at the general body meeting. The voted ballot papers are sent back to the head office where the scrutinizing committee headed by the Honorary General Secretary counts the votes and tabulates the results.

b) The Honorary General Secretary, Joint Secretary, Assistant Secretary, Treasurer, Editor of the Journal and Chairman and Honorary Secretary of the council of dental health are elected at the annual general body meeting.

CENTRAL COUNCIL OF IDA

The central council has the right to enquire into the charges leveled against any of the office bearers, and has the power to remove the office-bearer by the no confidence motion. The general management of the association shall be vested in a "Central Council" while that of the branches are done by the executive committee of the branch.

The central council is composed of the following members of the association.

a) Office bearers

1. The President
2. The President - elect
3. The three Vice-Presidents
4. The Honorary General Secretary
5. The Honorary Joint Secretary
6. The Honorary Assistant Secretary
7. The Honorary Treasurer
8. The Editor of the journal
9. Chairman of the Council of Dental Health (CDH).
10. Honorary Secretary of the Council of Dental Health (CDH)

b) Members without portfolios

1. Immediate past president.
2. Representatives from the state branches.

The executive committee of the state branches and local branches also have a same pattern of office bearers except the chairman, the Honorary General Secretary of the council of dental health, member without portfolios such as immediate past president, members of the executive committee and representatives from the local branches. In the place of Honorary General Secretary, Honorary Secretary is in charge.

The general body of a state or district or local branch having its own constitution is free to create any post of office bearership for the branch or state.

Functions of the Central Council of IDA

The Functions of central council is to direct and regulate the general affairs of the

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association. The council has been given the following powers also.

a) To frame, alter or repeal rules and bye laws of the association, subject to the approval of the annual general meetings of the association.
b) To appoint committees or sub committees and standing committees as deemed necessary by the council.
c) To consider and decide application for direct membership, the resignation of members and the question of taking disciplinary action against any member or branch.
d) To write off the whole or part of the arrears of dues against any individual members or a branch or other outstanding.
e) To appoint or remove salaried officers and servants of the association.
f) One of the important functions of the council is to represent to government, public bodies or any constituted authority, for any matter in which the interests of the association or the dental profession are affected.
g) All properties of the association is under the control of the central council, i.e., all transactions and management of these properties are to be carried out by the central council only.
h) Fund raising/Investment of association money are looked after by the central council.
i) In case of any dispute between any two members or branches, it shall be referred to a tribunal appointed by the central council. The tribunal consists of three members of the parties, a third member is either the one accepted by both contesting parties or the one appointed by the central council.

The decision of the central council in all matters shall be final. The functions and powers of the executive committee is same as that of the central council but is confined to that branch only. It is also under the control of central council.

RECEIPTS AND EXPENDITURE OF THE ASSOCIATION

The sources of income of the association is derived from the subscription of the members, central fund contribution from the branches, special contribution or donations raised directly or through the branches, income derived from the journal and other publication of the associations, contributions received on account of organizing Indian dental conference, Bequests received by legacies from persons who desire to benefit the association and other sources as authorized by the central council.

The funds are utilized to carry out the work of the association, the issue of the journal and other publications of the association as authorized by the association.

Association also spends money on scientific investigations, conferences, prizes, scholarships and on such other purposes as it may consider advisable for furtherance of the objective of the association.

ANNUAL GENERAL BODY MEETING OF THE ASSOCIATION AND ANNUAL CONFERENCE

It is held once in every year usually in the month of December. The business to be translated at the annual general meeting is in the following order.

a) The election of a chairman (if necessary)
b) Adoption of the annual report for the previous year.
c) Adoption of the audited accounts of the previous year.
d) Any other motion for changes in the order of business
e) Election of an auditor.
f) Election of the office bearers and other election resolution brought forwards by the Central Council, State branches,

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local branches, and individual member.

Annual conferences are organized by the association as decided by the central council. All members can attend the conference and can actively take part in the business of the conference. In this conference prizes and gifts are given out for members elected for their outstanding performance. During this conference latest advancement in the field of dentistry and current problems concerning dentistry or dental professionals are discussed.

CONCLUSION

In brief, the Indian dental association is for the well being of dental professionals and dentistry as a whole and at the same time they are well concerned with the dental health needs of the Indian citizen and their upliftment in that aspect by conducting and organizing dental health camps in rural areas and taking a leading hand in community dental services and such other service to the people of India. The Indian dental association fulfills the duties and obligation for the dental profession, and to the community at large. The IDA believes that it is their duty to uphold the dignity and honour of the dental profession.

THE DENTAL COUNCIL OF INDIA (DCI)

The Dental Council of India was formed on 12th April 1949. As per the Dentist act 1948, the representatives of the following groups contribute to the composition of Dental Council of India.

a) One registered dentist possessing a recognized dental qualification elected by the dentists registered in part A of each state register.

b) One member elected from amongst themselves by the members of the Medical Council of India.

c) Not more than 4 members elected from among themselves by,

   i) Principals, Deans, Directors and Vice-Principals of Dental colleges in the States training students for recognized dental qualifications, provided that not more than one member shall be elected from the same dental college.

   ii) Heads of dental wings of medical colleges in the states training students for recognized dental qualifications.

   iii) One member from each university established by law in the states which grants a recognized dental qualification, to be elected by the members of the Senate of the University.

d) One member to represent each state nominated by the government of each such state from among persons registered either in a medical or dental register of the state.

e) Six members nominated by the Central Government of whom atleast one shall be a registered dentist possessing a recognized dental qualification and practicing or holding an appointment in an institution for the training of dentists, and at least two shall be dentists registered in part B of a state register.

f) The Director General of Health Services (ex-officio).

Functions and responsibilities

The Dental Council of India is a statutory body which is mainly concerned with maintenance of standard of dental education and further it is the duty of the council to register qualified dentist and eliminate quacks from the field.

To serve the above functions the Dental Council of India has formed some rules and regulations in which the following are specified.

a) Basic principles for the maintenance of minimum education standard for the BDS

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degree.

b) Minimum physical requirements of a dental college.

c) Minimum staff pattern for under graduate dental studies in colleges with 40, 60 & 100 admissions.

d) Basic qualifications and teaching experience required to teach BDS & MDS students.

e) General establishment of dental facilities, its duration of course, selection of students.

f) Migration and transfer rules for students.

g) Regulations of scheme of examination for BDS & MDS.

h) Dental curriculum: Time and subject specifications to clinical program and field program, syllabus etc.

Note : The Dental Council of India is explained in detail in chapter 26 - "The Dentists Act of India"

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Chapter 28

HEALTH AGENCIES AROUND THE WORLD

INTRODUCTION

THE INTERNATIONAL RED CROSS AND RED CRESCENT MOVEMENT

THE PAN AMERICAN SANITARY BUREAU (PASB)

THE OFFICE INTERNATIONAL D'HYGIÈNE PUBLIQUE (OIHP)

THE ROCKEFELLER FOUNDATION

THE HEALTH ORGANIZATION OF THE LEAGUE OF NATIONS

INTERNATIONAL LABOUR ORGANIZATION (ILO)

THE FORD FOUNDATION

THE UNITED NATIONS RELIEF AND REHABILITATION ADMINISTRATION (UNRRA)

THE WORLD BANK GROUP

COOPERATIVE FOR ASSISTANCE AND RELIEF EVERYWHERE (CARE)

THE FOOD AND AGRICULTURE ORGANIZATION (FAO)

UNITED NATIONS CHILDREN'S FUND (UNICEF)

THE WORLD HEALTH ORGANIZATION (WHO)

THE COLOMBO PLAN

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID)

UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP)

CONCLUSION

INTRO

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INTRODUCTION

There is no longer any question in this and many other countries that the health of the citizens is a proper concern of the government. The concept of public health today has changed in a striking manner and a vast network of public health units have evolved. The smallest of these cater to the health needs of small rural areas; the largest, the World Health Organization, concerns itself with the entire world.

Two kinds of agencies carry on public health work: official and voluntary. Official agencies are those supported by public taxation and operated by national or state governments. Voluntary agencies are those which obtain their money from fund-raising appeals and other voluntary private sources, and are operated by groups of interested citizens.

THE INTERNATIONAL RED CROSS AND RED CRESCENT MOVEMENT

The International Red Cross and Red Crescent Movement is the world's largest humanitarian network. The movement is neutral and impartial, and provides protection and assistance to people affected by disasters and conflicts.

The movement is made up of almost 97 million volunteers, supporters, and staff in 186 countries. It has three main components:

- The International Committee of the Red Cross (ICRC)
- The International Federation of Red Cross and Red Crescent Societies
- 186 member Red Cross and Red Crescent Societies

The Red Cross idea was born in 1859, when Henry Dunant, a young Swiss man, came upon the scene of a bloody battle in Solferino, Italy, between the armies of imperial Austria and the Franco-Sardinian alliance. Some 40,000 men lay dead or dying on the battlefield and the wounded were lacking medical attention.

Dunant organized local people to bind the soldiers' wounds and to feed and comfort them. On his return, he called for the creation of national relief societies to assist those wounded in war, and pointed the way to the future Geneva Conventions.

The Red Cross was born in 1863 when five Geneva men, including Dunant, set up the International Committee for Relief to the Wounded, later to become the International Committee of the Red Cross. Its emblem was a red cross on a white background: the inverse of the Swiss flag. The following year, 12 governments adopted the first Geneva Convention; a milestone in the history of humanity, offering care for the wounded, and defining medical services as "neutral" on the battlefield.

The International Federation was founded in 1919 in Paris in the aftermath of World War I. The war had shown a need for close cooperation between Red Cross Societies, which, through their humanitarian activities on behalf of prisoners of war and combatants, had attracted millions of volunteers and built a large body of expertise. A devastated Europe could not afford to lose such a resource.

It was Henry Davison, president of the American Red Cross War Committee, who proposed forming a federation of these National Societies. An international medical conference initiated by Davison resulted in the birth of the League of Red Cross Societies, which was renamed in October 1983 to the League of Red Cross and Red Crescent Societies, and then in November 1991 to become the International Federation of Red Cross and Red Crescent Societies.

The first objective of the Federation was to improve the health of people in countries that

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had suffered greatly during the four years of war. Its goals were "to strengthen and unite, for health activities, already-existing Red Cross Societies and to promote the creation of new Societies"

There were five founding member Societies: Britain, France, Italy, Japan and the United States. This number has grown over the years and there are now 186 recognized National Societies - one in almost every country in the world.

The International Red Cross and Red Crescent Movement is the world's largest humanitarian network, with a presence and activities in almost every country. The seven fundamental principles of the Red Cross and Red Crescent

1. Humanity
   The International Red Cross and Red Crescent Movement, born of a desire to bring assistance without discrimination to the wounded on the battlefield, endeavors, in its international and national capacity, to prevent and alleviate human suffering wherever it may be found. Its purpose is to protect human life and health and to ensure respect for the human being. It promotes mutual understanding, friendship, cooperation and lasting peace amongst all people.
2. Impartiality
   It makes no discrimination as to nationality, race, religious beliefs, class or political opinions. It endeavors to relieve the suffering of individuals, being guided solely by their needs, and to give priority to the most urgent cases of distress.
3. Neutrality
   In order to continue to enjoy the confidence of all, the movement may not take sides in hostilities or engage at any time in controversies of a political, racial, religious or ideological nature.
4. Independence
   The Movement is independent. The National Societies must always maintain their autonomy so that they may be able at all times to act in accordance with the principles of the Movement.
5. Voluntary service
   It is a voluntary relief movement not prompted in any manner by desire for gain.
6. Unity
   There can be only one Red Cross or one Red Crescent Society in any one country. It must be open to all. It must carry its humanitarian work throughout its territory.
7. Universality
   The International Red Cross and Red Crescent Movement is worldwide, in which all Societies have equal status and share equal responsibilities and duties in helping each other

The Indian Red Cross Society

The Indian Red Cross is a voluntary humanitarian organization which came into existence in the year 1920 through an Indian Parliamentary Act. It has a network of over 700 branches throughout the country, providing relief in times of disasters/ emergencies and promotes health & care of the vulnerable people and communities. The Mission of the Indian Red Cross is to inspire, encourage and initiate at all times all forms of humanitarian activities so that human suffering can be minimized and even prevented and thus contribute to creating a more congenial climate for peace.

The various activities of Red Cross Society of India can be outlined as follows:

a) Social and relief work
   During the times of disasters like floods, drought, earthquakes, epidemics and other calamities, the Red Cross Society of India provide medical relief as well as rescue operations for the affected people.
b) Supplies of essential items

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The Red Cross Society gives assistance to hospitals, maternity health centres, child care centres, schools, orphanages and rehabilitation centres through the supply of drugs, milk, milk powder, vitamins, nutritional supplements and artificial appliances.

c) Maintenance of blood banks

The Red Cross Society has established large number of blood banks in different parts of the country, for helping the people in need of blood at emergencies.

d) Services for maternal and child welfare

The Red Cross Society has established a wide number of maternity and child welfare centres in different states within the country. The agency also provides assistance to other health organizations providing maternal and childcare.

e) Medical care for defence forces

The Red Cross Society provides help to the sick and wounded members of the defence forces and runs special centres for their care. The best example for such a service in India is the "Red Cross Home" in Bangalore, which looks after permanently disabled ex-servicemen.

f) Family planning services

The Red Cross Society supports many family planning programs in different parts of the country.

g) First aid services

The Red Cross Society conducts training programs in first aid and allied topics in most parts of the country through its branches. The "St. Johns Ambulance Association" -functioning in India is a subsidiary of the Red Cross Society that has provided training for large number of people in first aid activities.

THE PAN AMERICAN SANITARY BUREAU (PASB)

The Pan American Sanitary Bureau (PASB), the oldest international health agency in the world, is the Secretariat of the Pan American Health Organization (PAHO). It was set up in 1902 in Washington to serve the objectives for the American continent. In 1958, its name was changed to Pan American Health Organization.

The Bureau is committed to providing technical support and leadership to PAHO Member States as they pursue their goal of Health for All and the values therein.

THE OFFICE INTERNATIONAL D'HYGIENE PUBLIQUE (OIHP)

The Office International D'Hygiene Publique (OIHP) was created under the arrangements signed in Rome on 9 December 1907 and was governed by the authority of the Permanent Committee composed of delegates technically qualified in the field of health, designated by the member states. Responsibilities of the office were the administration of the international sanitary conventions, the service of epidemiological intelligence and collection and dissemination to member states of information of general public health importance.

The office was dissolved under the protocol provided for OIHP in the arrangements signed on 22 July 1946. Its epidemiological service was officially transferred to the Interim Commission of WHO on 1 January 1947.

THE ROCKEFELLER FOUNDATION

John Davison Rockefeller (July 8, 1839 May 23, 1937) was a billionaire American industrialist and philanthropist. His bent for philanthropy began early in life. In his teens, from sums earned in his first job, he allotted money for his Sunday school and other activities of his Baptist church. Rockefeller's interest in philanthropy on a large scale began in 1889, influenced by Andrew Carnegie's published essay, The Gospel of Wealth, which prompted him to write a letter to Carnegie praising him as an example to other rich men. It was in that year that he made the first of what would become $35

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million in gifts, over a period of two decades, to fund the University of Chicago. In 1901 he established the Rockefeller Institute for Medical Research, now Rockefeller University. In 1903 he created the General Education Board at an ultimate cost of $129 million to promote education in the United States "without distinction of sex, race, or creed." In 1909 he established the Rockefeller Sanitary Commission for Eradication of Hook-worm Disease to cure and prevent the disease, particularly in the southern United States.

In 1913, the Rockefeller Foundation was officially founded with the purpose of promoting the well being of human populations around the world. Although the initial activities were mainly in the field of medical and public health education, later it was extended to the fields of life sciences, agricultural sciences, social sciences and the humanities.

The Rockefeller Foundation has been active with its work in India since 1920. The first of its work in this country was a project for the control of hookworm infections. The foundation is mainly responsible for the establishment of the All India Institute of Hygiene and Public Health in Calcutta. The programs sponsored by this foundation in India includes:

1. Training of competent research workers.
2. Scholarships to candidates from India for trainings or research work in foreign countries.
3. Financial assistance to teaching institutions and research projects.
4. Setting up of libraries in medical colleges.
5. Assistance for improvements in the field of agriculture, family planning, rural health etc.

THE HEALTH ORGANIZATION OF THE LEAGUE OF NATIONS

The League of Nations was an international organization founded as a result of the Treaty of Versailles in 1919-1920. The League held its first council meeting in Paris on 16 January 1920. In November, the headquarters of the League moved to Geneva, where the first General Assembly was held on 15 November 1920 with representatives from 41 nations in attendance. The League's goals included disarmament, preventing war through collective security, settling disputes between countries through negotiation, diplomacy and improving global quality of life.

The organization did outstanding works in the fields of nutrition, malaria, biological standardization, and rural hygiene. It gave international help to governments in fighting epidemics; it started the series of periodical epidemiological reports, now issued by the WHO. It greatly extended the epidemic intelligence service begun by the International Office of Public Health in Paris, and established a Far Eastern Bureau at Singapore for that purpose.

The League of Nations was dissolved in 1939, but its health organization in Geneva continued the publication of the weekly epidemiological record.

INTERNATIONAL LABOUR ORGANIZATION (ILO)

The ILO is a relatively old organization dating from the end of the First World War. It was formed in 1919 with its headquarters in Geneva, Switzerland, as an affiliate of the League of Nations. The main purpose of establishment of ILO was for improving the living and working conditions of the working population in different parts of the world.

The primary function of ILO is the establishment of conventions safeguarding the conditions of labour. The functions of ILO include:

1. Establishment of peace by promoting social justice.
2. To improve the living standards and labour conditions of working people

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around the world.

3. To promote economic and social stability. The ILO co-operates with WHO in industrial health, in the hygiene of ships and the health of seamen, and in the study of social and health insurance schemes.

THE FORD FOUNDATION

The Ford Foundation was established on January 15, 1936, with an initial gift of $25,000 from Edsel Ford, whose father Henry, founded the Ford Motor Company. During its early years, the foundation operated in Michigan under the leadership of Ford family members. Since the founding charter stated that resources should be used "for scientific, educational and charitable purposes, all for the public welfare," the foundation made grants to many kinds of organizations. After the deaths of Edsel Ford in 1943 and Henry Ford in 1947, the nonvoting stock of the Ford Motor Company was bequeathed to the Ford Foundation and this made the Ford foundation the largest philanthropic organization in the world.

A seven-member Gaither Study Committee was then formed, headed by the future Ford Foundation president H. Rowan Gaither, a respected San Francisco lawyer. It recommended that the foundation become a national and international philanthropy dedicated to the advancement of human welfare. The panel urged the foundation to focus on solving humankind's most pressing problems, whatever they might be, rather than work in any particular field, which, at the time, was the traditional and accepted approach taken by foundations.

In India,

The Ford Foundation established an office in India in 1952 at the invitation of the then Prime Minister Jawaharlal Nehru. It was the foundation's first office outside the United States and is one of the largest international field operations. The New Delhi office also serves Nepal and Sri Lanka.

Initially, it operated both as a grant-making organization and an implementing agency and focused primarily on agricultural and rural development. Since 1972, it is functioning mainly as a grant maker, providing funds to academic institutions, research organizations, government agencies and civil society groups.

Over the past five decades, major commitments have been made in these areas:

- Agriculture and rural development
- Forest and natural resource management
- Reproductive health
- Microfinance and livelihoods
- Human rights
- Local-global governance
- Civil society
- Higher education and scholarship
- Arts and culture
- Regional cooperation and international security
- Promotion of local philanthropy

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Grants in these fields have been designed to strengthen individual and institutional capabilities, to support innovative concepts and approaches and to promote the sharing of knowledge.

THE UNITED NATIONS RELIEF AND REHABILITATION ADMINISTRATION (UNRRA)

The United Nations Relief and Rehabilitation Administration (UNRRA) was created at a 44-nation conference at the White House on November 9, 1943. Its mission was to provide economic assistance to European nations after World War II and to repatriate and assist the refugees who would come under Allied control. The U.S. government funded close to half of UNRRA's budget.

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UNRRA was wound up in 1946-47, and some of its residual funds were given to the International Refugee Organization and the Interim Commission of the World Health Organization, with the largest share going to the United Nations Children's Fund (UNICEF).

THE WORLD BANK GROUP

The World Bank Group comprises of five organizations:

1. The International Bank for Reconstruction and Development (IBRD)

The IBRD, frequently called the "World Bank," is the main lending organization of the World Bank Group and was conceived in July 1944 at the United Nations Monetary and Financial Conference in Bretton Woods, New Hampshire, US.

2. The International Finance Corporation (IFC)

The IFC formally came into existence on 14 July 1956 as a separate legal entity affiliated with the IBRD. The International Finance Corporation is the member of the World Bank Group that promotes the growth of the private sector in less developed member countries. The IFC's principal activity is helping finance individual private enterprise projects that contribute to the economic development of the country or region where the project is located. The IFC is the World Bank Group's investment bank for developing countries.

3. The International Development Association (IDA)

The International Development Association (IDA), an affiliate of the World Bank, was established in 1960 to promote economic development in the world's poorest countries-those that cannot afford to borrow from the IBRD.

4. The International Centre for the Settlement of Investment Disputes (ICSID)

The International Centre for Settlement of Investment Disputes is an autonomous institution founded in 1966 to promote increased flows of international investment by providing facilities for the conciliation and arbitration of disputes between governments and foreign investors.

5. The Multilateral Investment Guarantee Agency (MIGA)

MIGA was established in 1988. Its main purpose is to promote the flow of foreign direct investment among member countries by insuring investments against non-commercial (political) risk, and by providing promotional and advisory services to help member countries create an attractive investment climate.

COOPERATIVE FOR ASSISTANCE AND RELIEF EVERYWHERE, INC. (CARE)

CARE is one of the world's largest private humanitarian organizations. It was founded in 1945, when 22 American organizations came together to rush lifesaving CARE Packages to survivors of World War II. Headquartered in Atlanta, Georgia, it is part of an international confederation of 11 member organizations committed to helping communities in the developing world achieve lasting victories over poverty. In 1945, CARE stood for "Cooperative for American Remittances to Europe." Today, with projects in more than 60 countries around the world, CARE stands for "Cooperative for Assistance and Relief Everywhere, Inc."

Over the years, their work has expanded to

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address the world's most threatening problems such as hunger, famine and primary health care.

With a staff of more than 12,000, CARE helps strengthen communities through an array of programs that work to create lasting solutions to root causes of poverty.

In India, CARE has been involved with many feeding programs like the mid-day meal scheme for school children, health care programs, educational and vocational training etc. The CARE also provides mobile medical units, medical equipments, medicines etc for the health care of the rural people.

THE FOOD AND AGRICULTURE ORGANIZATION (FAO)

The FAO was formed in the year 1945 and its headquarters is situated in Rome. This is an organization concerned with human diseases of animal origin, with nutrition and with rural hygiene.

The main functions of FAO include:

1. Providing help to all nations to fight poverty and to raise the living standards of their people.
2. Ensuring adequate availability of food to people of all nations through increased production of food.
3. Helping nations to increase the efficiency in the fields of farming, forestry and fishing.
4. Campaigning for the freedom from hunger in all nations.
5. Helping the nations to better the conditions of their people in rural areas.

UNITED NATIONS CHILDREN'S FUND (UNICEF)

Origin

The UNICEF was created by the General Assembly during its first session in 1946. It was then called United Nations International Children's Emergency Fund. The main purpose was to meet the emergency needs of children around the world. In the year 1950, the general assembly changed the main emphasis of UNICEF's mandate to programs of long-range benefit to children of developing countries. In 1953, its name was changed to the United Nations Children's Fund, but the well-known acronym "UNICEF" was retained.

Organization

The headquarters of UNICEF is situated in New York. It has eight regional offices in different parts of the World. The UNICEF Regional Office for South Asia (ROSA) is at New Delhi, which includes India, Srilanka, Afghanistan, Maldives, Nepal, Bangladesh, Bhutan and Pakistan.

Functions

Combining humanitarian and development objectives, UNICEF cooperates with countries in their efforts to protect their children and to enable them to develop their full potential. UNICEF has its goal as the realization of every child of the opportunity to enjoy the basic rights and privileges, and to contribute to their country's progress and well being.

UNICEF cooperates with over 137 developing countries in several ways:

1. It assists in the planning and extension of services benefiting children, in consultation with the countries concerned.
2. It provides support to strengthen the training and orientation of national personnel including health and hygiene functionaries, teachers, nutritionists and child-welfare specialists.
3. It supports activities related to women's empowerment as well as community

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participation in implementation and monitoring of services benefiting children and women.

4. It helps in the development of appropriate communication material for advocacy and information dissemination and education.
5. It delivers technical supplies, equipment and other aids.

UNICEF promotes a movement for basic needs and advocates with the states to promote primary education, to protect children against diseases, to provide household food security, to promote family planning, to encourage breastfeeding, to combat specific problems such as iodine deficiency or Vitamin-A disorders, to support immunization and polio eradication, to promote today's health knowledge, and to protect children who are abused at home, at work or in difficult situations.

THE WORLD HEALTH ORGANIZATION (WHO)

Introduction :

The World Health Organization is a specialized agency within the Charter of the United Nations, which is non-political in its functions. WHO was established in the year 1948 by 61 Governments "for the purpose of co-operation among themselves and with others to promote the health of all people". WHO serves as the directing and coordinating authority for international health matters and public health. One of WHO's constitutional functions is to provide objective and reliable information and advice in the field of human health, a responsibility that it fulfils in part through its extensive program of publications.

The origins of WHO:

In 1851, the first International Sanitary Conference was initiated to discuss measures against the importation of plague into Europe. By the end of the Second World War there were four international health organizations in existence. The oldest among them - the Pan-American Sanitary Organization - was a regional organization limited only to the Americas. The International Office of Public Health was restricted to quarantine and was later replaced by the Health Division of United Nations Relief and Rehabilitation Administration. The Health Organization of the League of Nations was a mere relic, most of the staff having been transferred to UNRRA, and the League itself was due to be transmuted into the new United Nations.

The Charter of the United Nations was adopted and signed at the San Francisco Conference in May 1945. At this conference, Brazil and China suggested the establishment of an international health organization. The Economic and Social Council convened an international health conference for the summer of 1946, and a preparatory committee met previously in Paris to draft a constitution. The eighteen members of the Technical Preparatory Committee, whose chairman was Dr. Rene Sand of Brussels, a pioneer of social medicine, with Dr. Brock Chisholm, a Canadian psychiatrist and administrator who became the first Director-General of WHO, produced so admirable a draft that the full conference accepted it without serious amendment.

The World Health Conference met in New York for a month in June/July 1946, and adopted the Constitution of the future World Health Organization. Thus, the World Health Organization was officially born on the 7th April 1948, when the 26th government (out of the 61 who signed it) formally ratified it in its national parliament. Since then, 7th April is celebrated every year as "World Health Day", when attention all around the globe is focused on a chosen theme of international public health interest.

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The First World Health Assembly opened in Geneva on 24 June 1948 with delegations from 50 of the 55 governments attending it. Geneva was chosen as the headquarters of the Organization and English and French as the working languages, with the addition of Chinese, Russian, and Spanish as official languages. It was also decided, at the instance of India, to push ahead with regionalization, and the world was divided into six regions.

The constitution of WHO :

The Constitution of WHO reads as follows,

"The state parties to this constitution declare, in conformity with the Charter of the United Nations, that the following principles are basic to the happiness, harmonious relations and security of all peoples:

- 'Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.
- 'The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition.
- 'The health of all peoples is fundamental to the attainment of peace and security and is dependent upon the fullest co-operation of individuals and states.
- 'The achievement of any state in the promotion and protection of health is of value to all. Unequal development in different countries, in the promotion of health and control of disease, especially communicable disease, is a common danger.
- 'Healthy development of the child is of basic importance; the ability to live harmoniously in a changing total environment is essential to such development.
- 'The extension to all peoples of the benefits of medical, psychological and related knowledge is essential to the fullest attainment of health.
- 'Informed opinion and active co-operation on the part of the public are of the utmost importance in the improvement of the health of the people.
- Governments have a responsibility for the health of their peoples, which can be fulfilled only by the provision of adequate health and social measures.

Then follows the often-quoted Article 1: 'The objective of the World Health Organization shall be the attainment by all peoples of the highest possible level of health.'

Membership in WHO :

The membership in WHO is open to all countries, with non-self-governing territories as associate members. In 1948, WHO had only 56 member countries. India became a member on 12 January 1948. As on January 1998, WHO had 191 members and 2 associate members (Puerto Rico and Tokelau).

Structural organization of WHO:

The structural organization of WHO consists of:

1. The World Health Assembly (or Parliament):

The World Health Assembly is the supreme decision-making body for WHO. It generally meets in Geneva in May each year, and is attended by delegations from all 193 Member States. Its main function is to determine the policies of the Organization. The Health Assembly appoints the Director-General, supervises the financial policies of the Organization, and reviews and approves the Proposed program budget. It similarly considers reports of the Executive Board, which it instructs in regard to matters upon which further action, study, investigation or report may be required.

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2. The Executive Board (or Cabinet):

The Executive Board is composed of 34 members technically qualified in the field of health. Members are elected for three-year terms. The main board meeting, at which the agenda for the forthcoming Health Assembly is agreed upon and resolutions for forwarding to the Health Assembly are adopted, is held in January, with a second shorter meeting in May, immediately after the Health Assembly, for more administrative matters. The main functions of the board are to give effect to the decisions and policies of the Health Assembly, to advise it and generally to facilitate its work.

3. The Secretariat:

The Secretariat of WHO is staffed by some 8000 health and other experts and support staff on fixed-term appointments, working at headquarters, in the six regional offices, and in countries. The Organization is headed by the Director-General, who is appointed for a five year-term by the Health Assembly on the nomination of the Executive Board.

Regional directors are appointed by the board with the agreement of the relevant regional committee. The personnel at WHO Headquarters are appointed by the Director-General in accordance with staff regulations established by the assembly and by agreement between the Director-General and the Regional Director.

WHO has its own governing bodies, its own membership and its own budget. While the member making the largest contribution is assessed at one-quarter of the WHO budget, the smallest contributors each pay only one-hundredth of it. Nevertheless, each member has one vote, irrespective of the size of its contribution. WHO receives voluntary contributions from both governmental and non-governmental sources.

The headquarters and regional offices

WHO Headquarters, situated in Geneva, Switzerland, is responsible for establishing technical and administrative policies and procedures that are applicable throughout the Organization. In general, all technical activities that are of universal applicability - such as biological standardization, the overall assessment of the efficacy of methods and materials, promoting the control of diseases - are the responsibility of headquarters.

A characteristic feature of WHO is its decentralization. Control of general policy and of finance is retained in Geneva, with certain of the statutory functions, such as quarantine, but other functions are as far as possible decentralized to the regional organizations. It has six "regional organizations", each consisting of a Regional Committee and a Regional Office. The Regional Offices were set up between 1948 and 1952. The six regional offices are,

REGIONAL OFFICE OF WHO	HEADQUARTERS
African Region	Brazzaville, Congo
Region of the Americas	Washington D.C, USA
South East Asia Region	New Delhi, India
European Region	Copenhagen, Denmark
Eastern Mediterranean Region	Cairo, Egypt
Western Pacific Region	Manila, Philippines

The regional offices are responsible for formulating policies of a regional character and for monitoring regional activities. Regional Directors are normally appointed from one of the countries of the corresponding region. The Regional Director is the technical and administrative head of a regional office.

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In many countries there is a resident WHO representative. He /she acts as the senior officer responsible for WHO's activities in the country and supports the government in the planning and management of national health programs. He /she assists in the strengthening of national capacities to prepare and implement national health for all strategies, and keeps the organization informed of any special health problems in the country.

The staff of WHO

Among the technical staff, many are medical and public health specialists, but nursing, pharmacy, dentistry, veterinary medicine, sanitary engineering, biology, chemistry, economics, statistics and library science are also represented. The supporting services include specialists in informatics, budgeting and accountancy, management techniques, procurement of supplies and personnel. Because of the exceptional language requirements of an international organization, linguistic staff provide important supporting services, and at the WHO headquarters there are many translators and editors.

The only staff specified by the constitution of the organization are the Director-General and the six Regional Directors. It is the responsibility of the Director-General to establish a staff structure adapted to the organization's needs and within the budgetary limits determined by the assembly. The Director-General is assisted by a Deputy Director-General and five Assistant Directors-General. Each of these is responsible for several divisions or programs, the directors and managers of which in their turn, supervise the work of chiefs of specialized units.

The WHO agenda

The six points address two health objectives, two strategic needs, and two operational approaches.

1. Promoting development

WHO activities aimed at health development give priority to health outcomes in poor, disadvantaged or vulnerable groups. Attainment of the health-related Millennium Development Goals, preventing and treating chronic diseases and addressing the neglected tropical diseases are the cornerstones of the health and development agenda.

2. Fostering health security

Shared vulnerability to health security threats demands collective action. One of the greatest threats to international health security arises from outbreaks of emerging and epidemic-prone diseases. Such outbreaks are occurring in increasing numbers, fuelled by factors like rapid urbanization, environmental mismanagement, the way food is produced and traded, and the way antibiotics are used and misused.

3. Strengthening health systems

For health improvement to operate as a poverty-reduction strategy, health services must reach poor and underserved populations. Health systems in many parts of the world are unable to do so, making the strengthening of health systems a high priority for WHO.

4. Harnessing research, information and evidence

Evidence provides the foundation for setting priorities, defining strategies, and measuring results. WHO generates authoritative health information, in consultation with leading experts, to set norms and standards, articulate evidence-based policy options and monitor the evolving global heath situation.

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5. Enhancing partnerships

WHO carries out its work with the support and collaboration of many partners, including UN agencies and other international organizations, donors, civil society and the private sector.

6. Improving performance

WHO participates in ongoing reforms aimed at improving its efficiency and effectiveness, both at the international level and within countries.

The role of WHO in public health

- providing leadership on matters critical to health and engaging in partnerships where joint action is needed;
- shaping the research agenda and stimulating the generation, translation and dissemination of valuable knowledge;
- setting norms and standards and promoting and monitoring their implementation;
- articulating ethical and evidence-based policy options;
- providing technical support, catalyzing change, and building sustainable institutional capacity; and
- monitoring the health situation and assessing health trends.

Key WHO publications

1. The World Health Report: Annual report with an expert assessment of global health including statistics. Focuses on a particular theme every year.
2. International Travel and Health: Publication on health risks for international travellers, vaccination requirements and precautions to take.
3. International Health Regulations: Latest edition of the public health regulations that are legally binding on WHO Member States.
4. The International Classification of Diseases: The international standard diagnostic classification for epidemiological and health management purposes.
5. International Pharmacopoeia: Collection of quality specifications for pharmaceutical substances and dosage forms, for reference or adaptation by WHO Member States.

WHO journals

1. Bulletin of the World Health Organization: Monthly journal with peer-reviewed papers. Focus on developing countries.
2. Weekly Epidemiological Record: Epidemiological information on cases and outbreaks of communicable diseases.
3. WHO Drug Information: Quarterly journal on topics relating to medicines development and regulation.

In addition to the publications issued from WHO's headquarters, others, dealing with subjects of more regional interest, are issued from the regional offices. The South-East Asia Regional Headquarters in New Delhi has a well equipped library which has connection to PubMed and to the NLM's (National Library of Medicine) Databases & Electronic Information Sources, which is helpful for students and researchers in the field of medicine in retrieving references and information in medical literature.

Global Oral Health Database

The Oral Health Unit of WHO was established in 1956. The WHO Global Oral Health Data Bank was established in 1969. The bank emerged from the gathering of information from surveys on the growing burden of dental caries among children, particularly notable in industrialized countries. Over the past decades, WHO has encouraged member states to report

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information on disease level for making international comparisons, by use of a standardized methodology. To ensure data of high validity and reliability, WHO has designed basic instruments and record forms for use in the collection of clinical data. (WHO basic Oral Health Surveys)

An important public health rationale of the WHO Global Oral Health Data Bank has been to provide for epidemiological analysis of changing oral health status, to highlight how such changes might be related to new risk profiles in countries or regions, and to assess the impact of development or adjustment of oral health systems. In parallel to the continuous update of the Global Data Bank, similar databanks have been developed for the WHO Regional Offices based on common procedures for data collection.

In 1996, WHO established an Internet online oral health database, supported by the WHO Collaborating Centre in oral health at Malmö University, Sweden and the Niigata University, Japan. The WHO Oral Health Country/Area Profile Program (CAPP) aims at presenting information on oral diseases in individual countries, including data on oral health services, programs, dental education and human resources. Data are obtained from the scientific literature, WHO, and ministry of health reports. The database is designed for easy use and information is targeted to oral health professionals, policy-makers, health planners, universities and the general public. The user can select a country and in addition to country data on oral health, the CAPP provides a databank of ideas and experiences in relation to oral health programs as well as facilitating access to other important databases (e.g. PubMed and WHO technical programs).

The world health day

The Constitution of WHO came into force on 7th April 1948 and since then 7th April every year is celebrated as "World Health Day". Every year a theme is selected and global attention is focused on that particular theme. The World Health Day theme of 1994 focused on oral health "Oral Health for a Healthy Life"

THE COLOMBO PLAN

The organization was born out of a Commonwealth Conference of Foreign Ministers, held in Colombo, Ceylon (now Sri Lanka), in January 1950. The main objective of Colombo Plan is for co-operative economic and social development in Asia and the Pacific countries. The main function of Colombo Plan is providing assistance to its member countries in the field of agricultural and industrial development. It also provides support for health promotion. The Colombo plan has grown from a group of 7 common wealth nations (Australia, Britain, Canada, Srilanka, India, Newzealand and Pakistan) into an international organization of 26 countries.

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID)

The USAID was established in 1961 with the aim of helping countries in their economic and social development. The USAID assists India in a wide variety of projects for the improvement of health of the people. These projects include:

1. Support to National Health Programs like malaria eradication.
2. Supports in the field of medical, nursing and health education.
3. Supports to projects related to water supply and sanitation.
4. Supports for projects related to the control of communicable diseases.
5. Supports for projects in nutrition and family planning.

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WORLD HEALTH DAY THEMES

Year	World Health Day Theme
1950	Know your own health services.
1951	Health for your child and the World's children.
1952	Healthy surroundings make healthy people.
1953	Health is Wealth.
1954	The Nurse : Pioneer of health.
1955	Clean water means better health.
1956	Destroy disease-carrying insects.
1957	Food and Health.
1958	Ten years of health progress.
1959	Mental illness and mental health in the world today.
1960	Malaria eradication - A world challenge.
1961	Accidents need not happen.
1962	Preserve sight - Prevent blindness.
1963	Hunger : Disease of Millions.
1964	No trace of Tuberculosis.
1965	Small Pox - Constant Alert.
1966	Man and his cities.
1967	Partners in health.
1968	Health in the world of tomorrow.
1969	Health, labour and productivity.
1970	Early detection of cancer saves lives.
1971	A full life despite diabetes.
1972	Your heart is your health.
1973	Health begins at home.
1974	Better food for a healthier world.
1975	Small Pox - point of no return.
1976	Foresight prevents blindness.
1977	Immunize and protect your child.
1978	Down with high blood pressure.
1979	A healthy child - A sure future.
1980	Smoking or health : The choice is yours.
1981	Health for all by the year 2000.
1982	Add life to years.
1983	Health for all by 2000 : The count down has begun.
1984	Childrens Health : Tomorrow's wealth.
1985	Healthy Youth : Our best resource.
1986	Healthy living - Everyone a winner.
1987	Immunization - A chance for every child.

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1988	Health For All - All for health.
1989	Let's talk health.
1990	Our Planet - Our health : Think Globally, Act Locally.
1991	Should disaster strike - Be prepared.
1992	Heart beat the rhythm of life.
1993	Handle life with care - Prevent violence and negligence.
1994	Oral health for a healthy life.
1995	Target 2000, a world without polio.
1996	Healthy cities for better life - A challenge.
1997	Emerging infectious diseases - Global alert and Global response
1998	Safe Motherhood : Pregnancy is precious - Let's make it special.
1999	Healthy Aging, Healthy Living, Start Now
2000	Safe blood starts with me - Blood saves lives.
2001	Mental Health : Stop exclusion - Dare to Care
2002	Move for Health
2003	Healthy Environment for Children
2004	Road safety is no accident
2005	Make every mother and child count
2006	Working together for health
2007	Invest in health, build a safer future
2008	Protecting health from climate change
2009	Save lives - Make hospitals safe in emergencies

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WORLD HEALTH - DAYS OF IMPORTANCE

The following days are observed every year focusing on the topic of importance:

Day	Importance
30th January	Antileprosy day.
7th April	World health day.
22nd April	World habitat day.
31st May	World no-tobacco day
1st July	Doctors' day
11th July	World population day
24th September	International girl child day
2nd October	Anti-drug addiction day.
13th October	Anti-natural disaster day.
1st December	Anti-AIDS day.
11th December	UNICEF day.

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UNITED NATIONS DEVELOPMENT PROGRAM (UNDP)

This organization was established in 1966. The UNDP serves as the main source of funds for technical assistance to both developed and developing countries. The main objective of this organization is to help nations in strengthening their natural and human resources.

The UNDP takes up several projects in different parts of the world, covering economic and social sectors like agriculture industry, education and science, health, social welfare etc.

CONCLUSION

International health has come to comprise those problems in the field of health, which require consideration and action by more than one country. Such problems may be dealt with officially by governments or unofficially by national or international voluntary associations.

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Chapter 29

ESTABLISHING AND MANAGING A DENTAL OFFICE

INTRODUCTION

GOAL OF PRACTICE MANAGEMENT

THE DENTAL OFFICE SETTING

- SELECTION OF THE LOCATION
- SELECTION OF THE BUILDING
- DESIGNING OF THE DENTAL OFFICE

MANAGEMENT OF THE DENTAL OFFICE

FINANCIAL ASPECTS OF A DENTAL PRACTICE

MOBILE DENTAL CLINICS

- EQUIPMENTS TO BE FITTED INSIDE THE CLINIC
- DESIGN OF A MOBILE DENTAL VAN
- ADVANTAGES AND DISADVANTAGES OF MOBILE CLINICS
- SOME MOBILE DENTAL CLINICS

CONCLUSION

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INTRODUCTION

It is every individual's dream of obtaining basic sustenance, shelter and clothing through a socially acceptable profession. And if this livelihood is earned through a profession, which is service oriented, then there is an added sense of satisfaction along with fulfillment. One such noble profession is dentistry, which deals with providing oral health care for people.

Practice management, in addition to being a method to increase income, also includes creating an efficient practice that has a low stress level and where there is open communication between the dental staff and the patients.

GOAL OF PRACTICE MANAGEMENT

The goal of practice management is to develop business management skills that enable the dentist to enjoy good dentistry with a harmonious staff resulting in satisfied patients and a good income.

THE DENTAL OFFICE SETTING

Selection of the location

Selection of the place is a very crucial step in ones decision of private practice.

- The place for private practice is selected depending upon the number of dentists practicing in that place. It is preferable to move to a place where there are fewer dentists.
- In a town, which is surrounded by many villages, the location near the bus stop has great advantages as people from near by villages can come easily for the treatment.
- In a city where railways are the biggest mode of commuting, naturally a location close by has an advantage.
- In cities the shopping complex areas have advantages of good public transport facilities.
- The heart of the city has the advantage of attracting people from all walks of life, for dental treatment.
- The location close to the government, commercial offices, corporate and business houses also has an advantage in that the employees can avail dental treatment facility by taking permissible short breaks from their offices.
- On the other hand the residential area also has potentiality if proper timing is fixed. The office goers can visit the dentist in the morning before going to office or in the evening after returning back from office. The house wife as well as the retired and the elderly can visit the dentist at their convenience. Mothers can bring their children for dental treatment after school hours.
- The location should also be selected keeping safety in mind. The dental office should be located in a place from where ladies can commute easily without fear.

Selection of the building

- It is better to select the dental office in a new building. When an old building is selected one may face certain situations like,
  - Old building has danger of leakage, improper electrical insulations, grounding etc wherein one may have to face the dangers
  - The owner of the building may decide to demolish the building and construct a new one or sell the building where the dentist has established, say about 20-25 years of practice.
- If a rented place is taken there is every chance that the landlord might hike the rent at regular intervals.
- The building for practice should be well ventilated. It should have proper electrical, water and drainage system. It is also necessary to make sure that

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standard electrical wire connection and grounding is done for electrical connections.

- The building for dental practice should have parking facility for the patient as well as for the dentist.
- It is not always required to take on rent or to own a separate building for practice. It is also possible to practice at home if some alterations are made. These are some of the ways through which one can establish their dental office at home.

1. Renovate the existing building to suit the requirements.
2. Planning the dental office during the construction of the house itself
3. If the house which has got 2 garages, one garage can be esthetically modified into a dental clinic. The courtyard with garden may be converted as waiting area with little modification.

Designing of the dental office

Since there is no ideal dental office design, it has to be done according to individual requirements. Primarily, the dental office projects how the dentist feels about his office. It is important that patients should not be intimidated by the office and the dentist also needs to be comfortable in his working environment.

- A spacious waiting area, work area with dental chair and unit, x-ray room, laboratory, resting place, toilet etc. should be incorporated in the design.
- The furniture in the reception area must be durable, esthetic and comfortable. Otherwise patients may wonder if the quality of dental work is as cheap as the furnishing or, if the reception area is excessively lavish, patients may wonder if the dental work is going to be more expensive than usual.
- Sound proofing is an important consideration in the pediatric dental office. Buffering the noise from the reception area is advised by having a second waiting area between the operating and reception / waiting areas. Having a "quiet room" where difficult patients can be treated is also useful. The waiting room should be carefully decorated, so that safety comes first and the area should require little or no supervision.
- Placement of each electrical equipment and gadget which will be used by the dentist and some to be acquired in the future should be considered while designing the electrical connections. It is better to have concealed electrical connection, keeping in mind the lighting, fan, exhaust, compressor, x-ray unit, computer, dental chair and music system.
- It also important to know the exact position of the dental chair and unit, washbasins in the clinic and laboratory to design the inlets and outlets for water and drainage connections. This helps in the proper designing and conduction of plumbing work with proper slopes for drainage etc avoiding water stagnation in the pipe lines and further inconvenience.
- The floors and walls should be designed considering the esthetics and whether they can be cleaned easily. Avoid designs where there is possibility of dust accumulation. Instead of having the joints and grooves in the tiled flooring, one can choose the rubberized vinyl flooring which is easy to keep clean.
- Designing of the work area where the dental chair and the unit will be placed requires enough space for dental chair in the supine position. Also consider availability of space for the movement of the assistant around the dental chair and the operating stool.
- A separate X-ray room with the wall enclosed within a lead barrier will help to minimize the X-ray hazards.

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- Autoclaving & sterilization can be done in a separate chamber near the work area so that it is easy to carry the instruments from there. The instruments should be neatly arranged in the cabinets avoiding unnecessary exposure.
- The compressor and the generators should be kept as far away as possible from the dental office. It is better to keep them in the basement area, if available, to reduce noise level.

Before designing your own dental office it is very helpful to visit different establishments, discuss with the dentist the short comings and positive features of their clinic. One must have forethought of the type of clinic, the future growth of ones practice and expansion required. Thus one can avoid restructuring, which necessitates major inconvenience, expense and disruption of an established busy practice.

Before starting a dental clinic, all the required statutory licenses should be attained. It is always better to have insurance coverage against fire, natural catastrophes like earth quakes and flood, burglary and riots.

Management of the dental office

It is not sufficient just to begin the dental office, it is also important to effectively manage this office to get the maximum benefits. Private practice can be carried out in the following 3 ways:

1. Solo practice- in this a dentist manages all types of cases according to his capacity.
2. Group Practice- Here dentists trained in different specialities form a group and practice in the same office
3. Solo practice with visiting specialties- In this type of practice a single dentist manages the practice in his office but calls the specialists whenever required, to carry out the speciality work.

Whatever may be the type of practice a dentist should manage his office keeping certain points in mind.

Personnel system:

- A dentist may appoint a full time receptionist, a dental (chair side) assistant or a person who can do both the work and also a part time house keeping personnel who will clean the dental office floor, equipments etc.
- The front office staff play a very vital role in the success of the practice. After all they are the first point of contact that patients establish with the practice. The receptionist should be able to handle all kinds of patients. She should be the liaison between the dentist and the patients. While giving the appointments she should know the approximate time required for each treatment. She should be able to rearrange the appointments if such a situation emerges, so that the patient flow is regularly maintained without wasting any time.
- A personable, professional staff is vitally important for practice success.
- The number of employees in an office varies depending upon the type of practice and patient load.
- Two of the most desirable traits in a dental team member are a warm, empathetic personality and cognitive ability, defined as aptitude for learning and capacity to draw from past experience in new situations.
- When a new employee joins the dental office, he must be made to feel welcome and as part of the team.
- Orientation on the first day of employment and a written training schedule to be followed the first 6 - 8 weeks should be a part of this process.
- Orientation may begin with a review of the office manual which outlines the duties, obligations and mutual expectations of the employee and employer and clarifies office policies.

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- A training period of 60 to 90 days is necessary to determine whether there is a match between office needs and a new employee's skills and personal style.
- A well-trained veteran staff member may become a training co-ordinator, available to instruct the new employee, answer questions and check progress.
- For a successful practice, the dentist and the team members should consider training as an on- going practice.
- Attendance at continuing education courses, review of current literature and journals and group study using audio and videotapes are appropriate for continuous training.
- Fair salaries and good benefits are necessary to avoid job dissatisfaction. However, these do not necessarily motivate an employee to perform better.
- Motivated staff members are often those to whom responsibility is delegated. Their personal and professional growth is encouraged and recognized by the dentist. They are appreciated and told how valuable they are to the office, the dentist and the patients.

Patient system:

- The dentist should have good communication with his patients. He should see that the patients are aware of the timings, weekly holidays etc. clearly. On unavoidable circumstances when the clinics have to be closed, information should be given to patients through notices on the notice board in his dental office or through classified advertisements in news papers.
- To be able to make the full use of the dentist's time throughout the day, an appointment book can be maintained. When the appointment book is under good control, production becomes high and the day flows with little stress. At the conclusion of the present appointment, the next appointment is scheduled for re-care and patient is recalled after 6 months. A reminder post card may then be mailed 3 to 4 weeks before the appointment. A confirmatory telephone call should be made 1 or 2 days before the appointment.
- If a patient fails to keep an appointment, he must be listed in the computer. Later, a broken appointment list can be printed so that those patients can be re-contacted. The patient can also be sent a letter explaining the dental consequences of not completing the treatment.
- It is a good practice to open the clinic at least 30 minutes before the first appointment. The assistant should keep the working area and all the necessary equipments ready for work. It is also important that the assistant keeps the autoclaved instruments ready after each case, which can save a lot of time by maintaining continuity in the treatment work.
- A good first appointment experience provides the foundation for an enjoyable long-term relationship with patients and parents. The impression given on that visit is lasting. Since the dental receptionist is the first person to greet the new patient, she must be skilled in understanding people so that she can appropriately adjust to the initial meeting to develop rapport. At the first visit, the new patient and parent should be ushered into a private office to complete the patient information form and health history. Offering a hot or cold beverage would be a nice gesture.
- In case of a child, it is better not to have a hard and fast rule that parents remain in the reception area. The dental surgeon can judge the emotional status of the child and whether or not it is advantageous to have the mother accompany the child to the operatory for the initial examination. It is important to remember to inform the parent before any procedure to avoid misunderstandings.

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- During consultation the dentist should explain about the diagnosis, investigation if required, different treatment plans available, approximate cost of the treatment and the mode of payment etc, to the patient. After the treatment, written instructions can be given to the patients, which saves the time for the dentists. Instructions regarding care after extractions, maintenance of artificial dentures, oral health education etc. may be given through printed instructions or explained through a trained receptionist.
- For the smooth functioning of the clinic, his assistant or receptionist should have good knowledge about the materials used in the clinic. The staff working in the clinic should know the amount of each material required for a particular period, amount of material in the stock, quantity to order, from where to purchase, the mode of payment etc. Care should be taken to have sufficient amount in the stock, so that the routine work doesn't get disturbed. The dental office staff should know, how to make economical use of the materials. The receptionist or the office manager should maintain the book of accounts keeping all the bills of purchase of equipments, instruments, materials, stationary items, receipt of water, electricity, telephone bills and records for the disbursement of salaries for the staff, any donation given etc. through computers.
- The dentist should have business association with a good dental laboratory, which promptly delivers the work on time. Clear instructions regarding the work required by the technician should be given in writing. One should be aware of the time required for receiving the completed work from the laboratory. While giving appointment in such cases the laboratory personnel should also be instructed properly about the date by which the work should be ready.
- In our country the payment plans are limited. Most of the transactions are made through cash. It's better to have a link with the credit card managers. If desired by the patient the dentist should entertain the payment through credit cards, where in, the dentist can get his bill paid through the credit card managers at the service cost of 2% within two days and the patient gets the advantages of having the credit for about 30 days. It is also suggested that the dentist should try to get an attachment with an insurance agency or to join the medical panel of a company. Through this the dentist can get the payment directly from the company or after making the payment the patient gets the bill reimbursed by the company.
- A short form completed daily showing the patients scheduled, patients seen as well as broken appointments and the collection for that particular day keeps the dentist informed of daily activities. Similarly, monthly statistics can also be collected in a single-sheet format which allows for quick evaluation and comparison. All the records should be systematically maintained. The receptionist can be trained to keep these records in files or it can be fed in to the computer.
- Every dental office should have its own arrangement for the proper disposal of waste.
- To keep in touch with the recent advances & also to sharpen the skills it is very important to keep in touch with the subject. One can achieve this through subscribing for the journals, attending workshops, continuing dental education program, conferences, seminars etc. This helps to acquire more knowledge in this field and gives confidence to the dentist.
- A dental practitioner must take one day off every week, should have at least two vacations every year to spend his time with his family. These holidays help the dentist to manage the profession linked stress.

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Financial aspects of a dental practice

- Maintain patient record along with fees charged on day to day basis preferably in a computer.
- Maintain records of all expenses on a day to day basis.
- Approach a chartered accountant at the initial stage of setting up the profession itself.
- Start filing tax return from the first year of practice itself since this would help in being law compliant

Production and collections

For the dental practice to operate profitably, high quality dental treatment must be provided in an efficient manner.

A production goal is important for any successful enterprise. It determines the amount of money that must be charged to reach the Break-Even Point [BEP] and enjoy a certain amount of profit. The BEP is the amount of money needed each year to pay all office expenses, both fixed as well as variable costs. Fixed cost includes staff salaries and benefits, occupancy costs, administrative costs, continuing education, taxes, insurance and repayment of money borrowed to finance the practice start up or purchase. Variable costs usually include laboratory fees and dental supplies, the cost of which varies depending upon patient load.

Office supplies and dental supplies account for a considerable bulk of the gross income. Proper inventory control methods help in saving quite an amount on supplies. An inventory control card should be maintained for each item purchased. The card should contain information such as name, address and phone number of each preferred vendor, an alternate vendor and a third vendor, if desired; the price of the item, the date of the pricing and the time needed for delivery. The preferred vendor is chosen not only because of the low price but also because of other factors like best availability or the fastest delivery. The alternate vendor may be more expensive but deliver at short notice. Whenever an item is ordered, the date and amount ordered must be noted. Ordering supplies on contract for 1 year at dental conventions where there are special prices from manufacturers, results in substantial savings. Therefore, inventory control and proper timing of purchases can considerably reduce the total cost of supplies, indirectly increasing the profits.

The following factors must be considered when setting fees:

1. The dentist's and assistant's time required to do the procedure.
2. The cost of operations per hour, including fixed as well as variable costs.
3. Prevailing professional fees in the area.

Fees must be reviewed annually and if necessary, raised more than the inflation rate to continue to generate adequate margin of profit. Most patients accept and may not even notice small adjustment in fees. Problems may arise, when a dentist who does not increase fees for several years, implements an increase of 20% or higher. Most patients notice and complain about such a large increase. Fee increase should not be announced to patients. However, staff members should be informed about the expenses such as laboratory fees and office supplies and utilities so as to allow them to understand the necessity of regular fee increases.

Success in dental practice is a subjective measure and it can be achieved when one's personal and professional needs are met. The key to a successful dental practice is a cohesive dental team. Such a team will create an atmosphere of co-operation, while providing the highest caliber of dentistry for patients in a highly efficient manner, resulting in high production and income with minimal stress.

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MOBILE DENTAL CLINICS

Over the ages, oral health care has been delivered to the community, in different ways. The horse back dentistry of olden days has evolved into the most modern painless dental procedures.

All over the world, different countries have different health care delivery systems. In our country, different state governments have established the dental offices at different levels from the state capitals to rural areas where salaried dentists give dental treatment

In India about 30% of the population live in urban areas and the rest 70% in the rural areas whereas 70% of the dentists practice in urban areas and we seldom find dental offices in rural areas except for a few government establishments, which lack the required infrastructure.

Fully equipped mobile dental clinics to provide effective dental care to the doorsteps of the underprivileged, rural population is the need of the hour.

The mobile dental clinic should be equipped with 2 dental chairs with all attachments and seating space for 15 to 20 people.

Equipments to be fitted inside the clinic:

1. Dental chair

- Hydraulically operated dental chair with water connection, spittoon and tumbler.
- Air ventury suction with flow control valve, auto drain & auto flush system.
- Aerotor, Micromotor and Scaler with 3 scaling tips.
- 3-Way-Syringe.
- Light Cure Unit with gun, eye protection shield.
- Multi functional foot control
- Transparent water booster.
- Basin
- Stainless steel instrument tray
- X-Ray viewer.
- Dental operator's stool

2. Operating light with two intensity, fixed with hinge on the top of the Van
3. Dental x-ray unit 70 KV, 8 mA with digital arm timer, scissor arm with day light manual developer.
4. Autoclave
   High speed automatic instrument autoclave with digital timer for wet and dry cycles which can achieve 135°C with minimum capacity of 20 litres. Screw type handle for the door locking, to prevent sudden opening of the door
5. Glass bead sterilizer
   Portable, easy to handle with a very low current consumption. Instruments may be kept only for 10 to 30 seconds and will be ready for use.
6. Metal cabinets with wash basin
7 Portable dental unit

   The dental chair should be portable and easy to handle. It should be of total aluminium construction, able to be folded for easy transportation. The chair should have provision for raising & lowering and back rest movement from upright to complete flat. The chair should have hand rest and head rest. All the parts should be of detachable type and well balanced and sturdy when placed on the ground.

Mobile suitcase unit: Fitted with

- Aerotor and micromotor hand piece.
- Scaler with 3 Scaling Tips
- Three way syringe for air & water spray.
- Control box with transparent, regulated water tank, foot control
- Compact compressor: Built in 0.25 HP oil-free, medical grade Monobloc compressor fitted with auto head air release valve, safety release valve and over heat thermo cut off.

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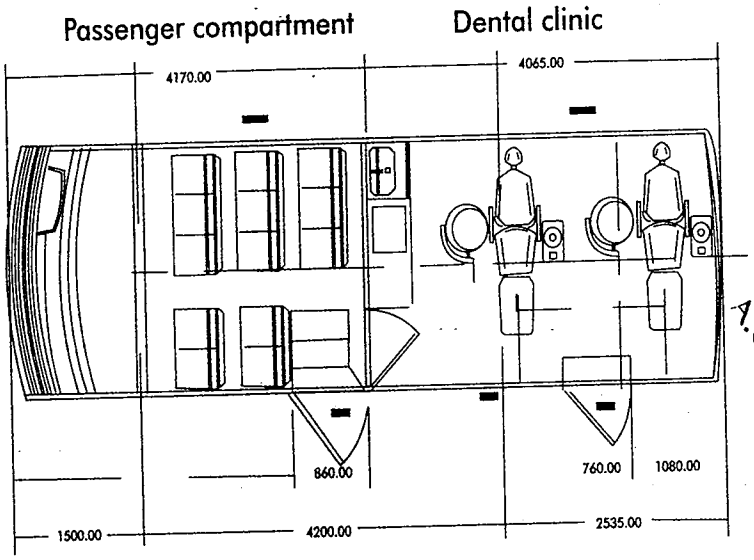
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8. Stabilizer:
   Highly accurate stabilizer of 4 KV. It should have high correction speed with the input r ange of 170 V to 270 V and output range of 220/230V +/- 1%.
9. Generator:
   It should be a portable generator with 4 KVA capacity with petrol start & run
10. Water Tank; 400 Litres capacity.
11. Oxygen cylinder
12. Public address system
13. TV & DVD player
14. Health education models

The mobile clinic requires a garage with proper security. The driver has to be full time and an integral part of the care delivery team. He is required to assist with the unit set-up, shepherding school children between classrooms and the dental clinic and stowing equipment at the end of the day.

DESIGN OF A MOBILE DENTAL VAN (The dimensions are in mm)



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Advantages of mobile clinics	Disadvantages of mobile clinics
Moderate start up costs	High maintenance costs
It addresses the problem of transportation to the clinics.	Difficult to access and store patient record
It decreases missed appointments when run in conjunction with schools	Provides limited services and follow up may be difficult
Services can be made available at multiple sites	Requires permission for site use
Services are made available to the needy population	Difficult to use during monsoon

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SOME MOBILE DENTAL CLINICS

1. Across the smiles

(Generation Family Health Centre, Connecticut)

It is a 40 foot long flat - bed truck which is used for providing,

- Education
- Preventive care
- Restorative care
- Case management
- Screening and assistance for dental insurance application

It is used predominantly to deliver care through school districts in the rural northeastern part of the state.

2. Smiles 2 go

(The hospital of Saint Raphael, Connecticut)

It is a 65 foot articulated tractor- trailer, which is used for providing

- dental care for school children.
- dental care at community sites.

It includes a dental laboratory and is mainly associated with the New Haven inner-city school system.

3. Molar Express

(The Hartford City Public School, Connecticut)

It is a 30 ft Winnebago van which is used for providing dental services to the children of 17 schools

4. Miles for Smiles mobile dental clinic

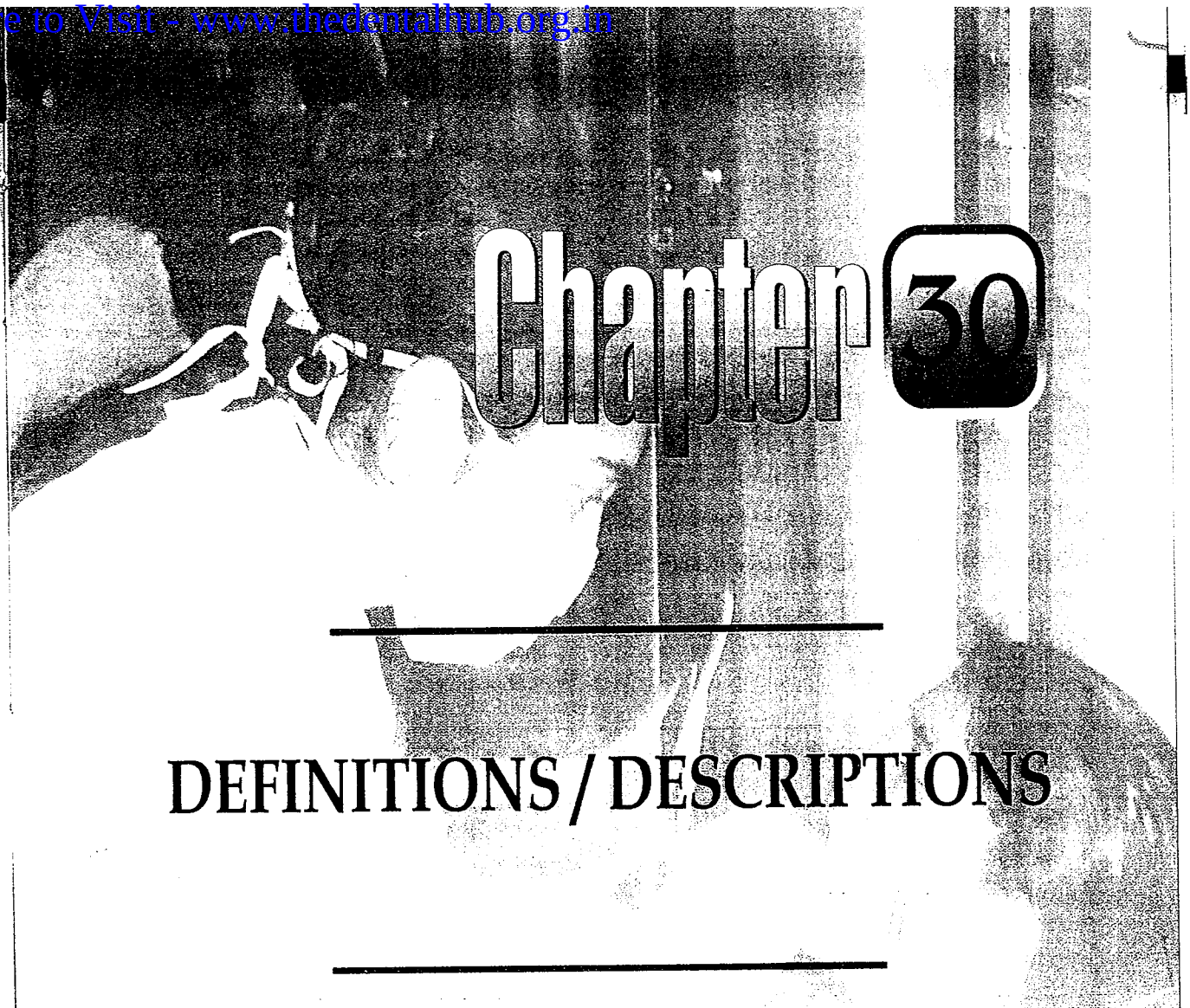
Miles for Smiles is a collaborative effort between Denver, Colorado-based KIND (Kids in Need of Dentistry), Southwest Community Resources (SCR) under which Miles for Smiles is housed, Montrose Memorial Hospital, which provides oversight of the mobile clinic and non-profit dental clinic, Northwest Colorado Dental Coalition and Catholic Charities.

It provides comprehensive dental services and school-based dental education to children and families residing in the western slope region of Colorado. Utilizing a fully equipped coach bus, the unit travels year round and covers a service area of 16 rural and frontier counties equaling 31,019 square miles. The program targets children aged 0-18 from low-income (working poor) families who would not otherwise have access to dental services. To foster community involvement and support, Miles for Smiles was designed with full partnership from local communities and is a collaboration of multiple entities.

CONCLUSION

The focus should be on reducing the major disparities in oral health status and inequities in access to oral health care, while providing the highest caliber of dentistry for patients in a highly efficient manner. The key to a successful dental practice is a cohesive dental team, which will create an atmosphere of co-operation resulting in the achievement of the goal of oral health for all at least by the year 2020.

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Chapter 30

DEFINITIONS / DESCRIPTIONS

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1. Accretion : Accretion is a process where most of the fluoride is buried within the mineral crystallites during the period of crystal growth.

2. Aim: Aim is an overall statement of the reason for undertaking the study.

3. Assessment: A systematic or non-systematic way of gathering relevant information, analyzing and making judgment on the basis of the available information.

4. Association: Association is said to exist between two variables when a change in one variable parallels or coincides with a change in another.

5. Attributable risk: Attributable risk (AR) or risk difference is "the difference in incidence rates of disease (or death) between an exposed group and non- exposed group.

6. Balanced diet: Balanced diet is one which contains a variety of foods in such quantities and proportions that the need for energy, amino acids, vitamins, minerals, fats, carbohydrate and other nutrients is adequately met for maintaining health, vitality and general well-being and also makes a small provision for extra nutrients to withstand short duration of leanness.

7. Bias: Bias is any systematic error in the determination of the association between the exposure and disease.

8. Bimodality: Bimodality is the occurrence of two separate peaks in the age incidence of a disease.

9. Biostatistics: Biostatistics is that branch of statistics concerned with mathematical facts and data related to biological events.

10. Blood and Vulcanite dentistry: This is a stage in the evolution of dental services in the United States. The low income or ill-educated groups neither prevent dental disease nor conserve affected teeth resulting in extraction of broken down or painful teeth after varying periods of disfigurement and dental sepsis of the individual patient. Towards the end of the process, a number of good teeth are usually sacrificed By the time all teeth are gone, the patient has saved enough money to afford full dentures made of vulcanized rubber in the olden days.

11. Caries Activity: Caries Activity refers to the increment of active lesions (new and recurrent lesions) over a stated period of time. Caries activity is a measure of the speed of progression of a carious lesion.

12. Caries Susceptibility: Caries Susceptibility refers to the inherent tendency of the host and target tissue, the tooth, to be afflicted by the caries process. This is the susceptibility (or resistance) of a tooth to a caries-producing environment.

13. Census: It is the total process of collecting, compiling and publishing demographic, economic and social data pertaining at a specified time or times to all persons in a community.

14. Cohort: Cohort is defined as a group of people who share a common characteristic or experience within a defined time period.

15. Community dental health: It is that branch of dentistry which is practiced in relation to population and groups, which derives from epidemiology an awareness of services required and which includes the development of techniques necessary to organize the application of these services for the benefit of the population.

16. Community dentistry: It is concerned with dental disease prevention and dental health care services to all the people of the community; the rich, the poor, the educated, the disadvantaged, middle class, urban and rural persons of every racial, religious and ethnic group.

17. Community organization: It is the process by which community groups identify common problems or goals, mobilize resources and in other ways develop and

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implement strategies for reaching the goals they have set. Minkler 1990.

18. Community: Community is defined as a group, small or large, living together in such a way that the members share not one or more specific interests but rather the basic conditions of a common life.

19. Comprehensive dental care: Comprehensive dental care is the meeting of accumulated dental needs at the time a population group is taken into the program (initial care) and the detection and correction of new increments of dental disease on a semiannual or other periodic basis (maintenance care).

20. Confounding factor: Confounding factor is defined as one which is associated both with exposure and disease, and is distributed unequally in study and control groups.

21. Consent: When two or more persons agree upon the same thing in the same sense they are said to consent - section 13 of the Indian Contract Act, 1872.

22. Contract: Contract is defined as an agreement between two or more persons which creates an obligation to do or not to do a particular thing.

23. Cultural anthropology: Cultural anthropology is the branch dealing with man's behavior and products.

24. Culture: Culture is defined as a shared and organized body of customs, skills, ideas and values which is transmitted socially from one generation to the other.

25. Culture: Culture is defined as the training and refinement of mind, tastes and manners, the condition of being thus trained and refined. -The Oxford dictionary

26. Defluoridation: Defluoridation is defined as a downward adjustment of fluoride ion concentration in a public drinking water supply so that the level of fluoride is maintained at the normal physiological limit of 1ppm to prevent dental caries with minimum possibility of causing dental fluorosis.

27. Defluoridation: Defluoridation is the process of removing excess naturally occurring fluoride from drinking water in order to reduce the prevalence and severity of dental fluorosis.

28. Dental auxiliary: Dental auxiliary is a person who is given responsibility by a dentist so that he or she can help the dentist render dental care, but who is not himself or herself qualified with a dental degree.

29. Dental calculus: Dental calculus is a hard deposit that forms by mineralization of dental plaque and is usually covered by a layer of unmineralized plaque.

30. Dental caries: Dental caries is defined as an infectious, microbiologic disease of the teeth that results in localized dissolution and destruction of the calcified tissues.

31. Dental health: It is a state of complete normality and functional efficiency of the teeth and supporting structures and also the surrounding parts of the oral cavity and of the various structures related to mastication and maxillofacial complex.

32. Dental plaque: Dental plaque is a complex, metabolically interconnected, highly organized, bacterial ecosystem. It is a structure of vital significance as a contributing factor to the initiation of the carious lesion.

33. Dental plaque: Dental plaque is defined as a highly specific variable structural entity formed by sequential colonization of microorganism on the tooth surface, epithelium and restorations. The natural physiologic forces that clean the oral cavity are inefficient in removing dental plaque.

34. Dental plaque: Dental plaque is defined as a structured, resilient, yellow-grayish substance that adheres tenaciously to the

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intraoral hard surfaces, including removable and fixed restorations.

35. Dental Public Health: Dental Public Health is the science and art of preventing and controlling dental diseases and promoting dental health through organized community efforts. It is that form of dental practice which serves the community as a patient rather than the individual. It is concerned with the dental health education of the public, with applied dental research and with the administration of group dental care programs as well as the prevention and control of dental diseases on a community basis. - The American Board of Dental Public Health (by adapting Winslow's definition in May 1976)

36. Dentifrice: A dentifrice is a substance used with a toothbrush for the purpose of cleaning the accessible surfaces of the teeth. - American Dental Associations Council on Dental therapeutics

37. Diet: Diet is defined as the types and amounts of food eaten daily by an individual (FDI, 1994)

38. Disability: Disability is any restriction or lack of ability to perform an activity in the manner or within the range considered normal for a human being.

39. Disclosing agent: A disclosing agent is a preparation in liquid, tablet or lozenge from which contains a dye or other coloring agent, which is used for the identification of bacterial plaque, which might otherwise be invisible to the naked eye.

40. Effectiveness evaluation: Effectiveness evaluation refers to whether program results meet predetermined objectives.

41. Effectiveness: Effectiveness is defined as the ratio between the achievement of the program activity and the desired level which, during the planning process, the planners had proposed would result from the program. -- WHO 1974.

42. Efficiency evaluation: Efficiency evaluation relates the results obtained from a specific program to the resources expended to maintain the program.

43. Efficiency: Efficiency is defined as the result that might be achieved through expenditure of a specific amount of resources and the result that might be achieved through a minimum of expenditure. -- WHO 1974.

44. Endemic: It is the constant presence (usual or expected frequency) of a disease or infectious agent within a given geographic area or population group, without importation from outside.

45. Epidemic: It is the unusual occurrence in a community or region of disease, specific health-related behavior or other health related events clearly in excess of expected occurrence.

46. Epidemiologist: An epidemiologist is any person who researches into the occurrence of disease or disability in groups of people.

47. Epidemiology: Epidemiology is defined as the study of the distribution and determinants of health related states or events in specified populations, and the application of this study to the control of health problems. - John M. Last (1988)

48. Erythroplakia: Erythroplakia is defined as a red lesion of the oral mucosa that cannot be characterized as any other definable lesion.

49. Ethics: Ethics is defined as the science of the ideal human character and behavior in situations where distinction must be made between right and wrong, duty must be followed and good interpersonal relations maintained.

50. Ethics: Ethics is the philosophy of human conduct, a way of stating and evaluating principles by which problems of behavior can be solved

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51. Evaluation: Evaluation is defined as the collection and analysis of information to determine program performance.

52. Evaluation: Evaluation measures the degree to which objectives and targets are fulfilled and the quality of the results obtained. It measures the productivity of available resources in achieving clearly defined objectives. It measures how much output or cost-effectiveness is achieved. It makes possible the reallocation of priorities and of resources on the basis of changing health needs. - WHO 1967

53. Evaluation: It is the systematic assessment of the relevance, adequacy, progress, efficiency or effectiveness of a policy, program or project, in relation to its intended aims and objectives (EURO European Centre for Health Policy, ECHP, Brussels, 1999).

54. Express contract: Express contract is an actual agreement of the parties, the terms of which are openly uttered or declared at the time of making it, being stated in distinct and explicit language, either orally (oral agreement) or in writing (written agreement).

55. Expressed need: Expressed need (Demands for health care) arises out of attempts by members of the public to seek attention for their perceived needs.

56. Felt need: Felt need (Perceived need) is the requirement of or care as determined by the patient or the public.

57. Fissures: Fissures are long clefts between cusps or ridges.

58. Folkways: Folkways are the patterns of conventional behavior in a society, norms that apply to everyday matters

59. Formative: Formative evaluation is an examination of the activities of a program, as they are taking place.

60. Four-handed dentistry: Four-handed dentistry is the art of seating both the dentist and the dental assistant in such a way that both are within easy reach of the patient's mouth.

61. Gingivitis: Gingivitis is a disease characterized by inflammation restricted to the gingival soft tissues, with no loss of alveolar bone or apical migration of the periodontal ligament along the root surface.

62. Group practice: Group practice is defined as that type of dental practice in which dentists, sometimes in association with the members of other health professions agree formally between themselves on certain central arrangements designed to provide efficient dental health service. - ADA (1969)

63. Group: Group is defined as a gathering of two or more people who have a common interest.

64. Handicap: Handicap is a disadvantage for a given individual, resulting from an impairment or a disability, that limits or prevents the fulfillment of a role that is normal for that individual.

65. Health appraisal: Health appraisal is defined as the process of determining the total health status through such means as health histories, teacher and nurse observations, screening test; and medical, dental and psychological examinations.

66. Health behavior: Any activity undertaken by an individual, regardless of actual or perceived health status, for the purpose of promoting, protecting or maintaining health, whether or not such behavior is objectively effective towards that end. - WHO Health Promotion Glossary, 1986

67. Health care waste: Health care waste is defined as all the waste generated by health-care establishments, research facilities and laboratories.

68. Health communication: Health

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communication is defined as a key strategy to inform the public about health concerns and to maintain important health issues on the public agenda. The use of the mass and multi media and other technological innovations to disseminate useful health information to the public, increases awareness of specific aspects of individual and collective health as well as importance of health in development.- WHO Health Promotion Glossary, 1998

69. Health education: Health education comprises consciously constructed opportunities for learning involving some form of communication designed to improve health literacy, including improving knowledge, and developing life skills which are conducive to individual and community health. - WHO Health Promotion Glossary, 1998

70. Health education: Health education comprises consciously constructed opportunities for learning involving some form of communication designed to improve health literacy, including improving knowledge, and developing life skills which are conducive to individual and community health. - WHO Health Promotion Glossary, 1998

71. Health education: Health education is a process that informs, motivates and helps people to adopt and maintain healthy practices and lifestyles, advocates environmental changes as needed to facilitate this goal and conducts professional training and research to the same end. - National Conference on Preventive Medicine in USA

72. Health for all: Health for all is defined as the organized application of local, state, national and international resources to achieve health for all, i.e. attainment of all people of the world by the year 2000 of a level of health that will permit them to lead a socially economically productive life. - Formulated and adopted by the 34th World Health Assembly in1981.

73. Health literacy: Health literacy represents the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health. - WHO Health Promotion Glossary, 1998

74. Health Maintenance Organization: A Health Maintenance Organization (HMO) is defined as a legal entity which provides a prescribed range of health services to each individual who has enrolled in the organization, in return for a prepaid, fixed and uniform payments.

75. Health promoting school - A health promoting school can be characterized as a school constantly strengthening its capacity as a healthy setting for living, learning and working. - WHO TRS 870

76. Health promotion: Health promotion is the process of enabling people to increase control over, and to improve their health. - Ottawa Charter for Health Promotion, First International Conference on Health Promotion, Ottawa, 21 November 1986

77. Health promotion: Health promotion is the process of enabling people to increase control over, and to improve health".

78. Health: Health is a standard of health of the oral and related tissues which enables an individual to eat, speak and socialize without active disease, discomfort or embarrassment and which contributes to general well-being.- U.K Department of Health (1994)

79. Health: Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. -WHO, Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June, 1946; signed on 22 July 1946 by the representatives of 61 States and

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entered into force on 7 April 1948.

80. Health: Health is defined as the soundness or the general wholesomeness of the body. - The Webster's English Dictionary

81. Health: The extent to which an individual or a group is able to realize aspirations and satisfy needs, and to change or cope with the environment. Health is a resource for everyday life, not the objective of living; it is a positive concept, emphasizing social and personal resources as well as physical capabilities (Health Promotion: A Discussion Document, Copenhagen: WHO 1984)

82. Hypothesis: A hypothesis can be defined as a tentative prediction or explanation of the relationship between two or more variables.

83. Hypothesis: Hypothesis is defined as "a supposition arrived at from by observation or by reflection".

84. Immunization: Immunization is the process by which an individual's immune system becomes fortified against an agent (known as the immunogen).

85. Impact evaluation: Impact evaluation refers to the long term outcomes of the program.

86. Impairment: Impairment is any loss or abnormality of psychological, physiological or anatomical structure or function.

87. Implementation: Implementation is the process of putting the plan into operation.

88. Implied contract: Implied contract is one inferred from conduct of parties and arises where one person renders services under circumstances indicating that he expects to be paid there for, and the other person knowing such circumstances, avails himself of the benefit of those services.

89. Incidence: Incidence is defined as the number of new cases of a specific disease occurring in a defined population during a specified period of time.

90. Incremental care: Incremental care is defined as periodic care so spaced that increments of dental disease are treated at the earliest time consistent with proper diagnosis and operating efficiency, in such a way that there is no accumulation of dental needs beyond the minimum.

91. Index: Epidemiologic indices are attempts to quantitate clinical conditions on a graduated scale, thereby facilitating comparison among populations examined by the same criteria and methods. - Irving Glickman

92. Index: Epidemiologic indices are attempts to quantitate clinical conditions on a graduated scale, thereby facilitating comparison among populations examined by the same criteria and methods. - Irving Glickman

93. Index: Index is defined as a numerical value describing the relative status of a population on a graduated scale with definite upper and lower limits, which is designed to permit and facilitate comparison with other populations classified by the same criteria and methods. - Russell A.L.

94. Lecture: Lecture is defined as a carefully prepared oral presentation of facts, organized thoughts and ideas by a qualified person.

95. Leukoplakia: Leukoplakia is defined as a raised white part of the oral mucosa measuring 5mm or more which cannot be scraped off and which cannot be attributed to any other diagnosable disease.

96. Lifestyle / lifestyles conducive to health: Lifestyle is a way of living based on identifiable patterns of behavior, which are determined by the interplay between an individual's personal characteristics, social interactions, and socioeconomic and environmental living conditions. -WHO Health Promotion Glossary, 1998)

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97. Malnutrition: Malnutrition is a pathological state resulting from a relative or absolute deficiency or excess of one or more essential nutrients.

98. Matching: Matching is defined as the process by which we select controls in such a way that they are similar to cases with regard to certain pertinent selected variables (e.g., age) which are known to influence the outcome of disease and which, if not adequately matched for comparability, could distort or confound the results.

99. Medical negligence / malpractice: Medical negligence or malpractice is defined as lack of reasonable care and skill or willful negligence on the part of a doctor in the treatment of a patient whereby the health or life of a patient is endangered.

100. Monitoring: Monitoring is the regular observation, surveillance, or checking of changes in a condition or situation, or changes in activities.

101. Morbidity: Morbidity is defined as any departure, subjective or objective, from a state of physiological well-being. WHO

102. Mores: Mores are norms or customs which express fundamental values of society.

103. Mortality: Mortality is the condition of being mortal, or susceptible to death.

104. Motivation: Motivation is defined as the fundamental desire for learning in an individual.

105. Normative need: Normative need is the requirement for care as determined by expert opinion.

106. Nutrition: Nutrition is defined as the sum of the processes by which an individual takes in and utilizes food -FDI, 1994

107. Objectives: Objectives are the means to achieve the aim.

108. Odds Ratio (OR): Odds ratio is a measure of the strength of the association between risk factor and outcome.

109. Operating auxiliary: Operating auxiliary is a person who, not being a professional is permitted to carry out certain treatment procedures in the mouth under the direction and supervision of a professional

110. Operational definition: Operational definition is a definition with which the disease or condition can be identified and measured in the defined population with a degree of accuracy.

111. Oral health research: Oral health research refers to laboratory, clinical and field investigations that lead to improvement in the control of oral diseases and health care delivery.

112. Oral Health: Oral Health is defined as the retention throughout life of a functional, aesthetic and natural dentition of not less than 20 teeth and not requiring a prosthesis. - The World Health Organization (1982)

113. Oral precancer: Oral precancer is an intermediate clinical state with increased cancer risk, which can be recognized and treated, obviously with a much better prognosis than a full blown malignancy.

114. Pandemic: It is an epidemic usually affecting a large proportion of the population, occurring over a wide geographic area such as a nation, a continent or the world.

115. Pathfinder method: Pathfinder method is a stratified cluster sampling technique, which aims to include the most important population subgroups likely to have differing disease levels.

116. Periodontal disease: Periodontal disease is defined as an inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms or groups of specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone with pocket

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formation, recession or both.

117. Physical anthropology: Physical anthropology is the study of man as a biological organism.

118. Pits: Pits are small pin point depressions located at the junction of developmental grooves or at terminals of those grooves

119. Plan: A plan is a decision about a course of action. - E.C. Banfield

120. Plaque biofilm: Plaque biofilm is a well organized, cooperating community of microorganisms.

121. Plaque Control: Plaque Control is the removal of microbial plaque and the prevention of its accumulation on the teeth and adjacent gingival tissues. Besides, it also deals with the prevention of calculus formation.

122. Potable water: Potable water is defined as water that is free from pathogenic agents, free from harmful chemical substances, pleasant to taste, i.e.. free from color and odor and useful for all domestic needs.

123. Pre - cancerous lesion: Pre - cancerous lesion is defined as morphologically altered tissue in which cancer is more likely to develop than in its apparently normal counterpart.

124. Precancerous condition: Precancerous condition is a generalized state associated with a significantly increased risk of cancer.

125. Prevalence: Prevalence is defined as all current cases (both old and new) existing in a given population at a given point in time, or over a period of time.

126. Primary health care: Primary health care is defined as Essential health care based on practical, scientifically sound and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost that the community and the country can afford to maintain at every stage of their development in the spirit of self-determination.- Joint WHO-UNICEF International Conference at Alma Ata, USSR, on 12th September 1978.

127. Primary prevention: Primary prevention is defined as action taken prior to the onset of disease, which removes the possibility that a disease will ever occur.

128. Primordial prevention: Primordial prevention is the prevention of the emergence or development of risk factors in countries or population groups in which they have not yet appeared.

129. Priority determination: Priority determination is a method of imposing people's values and judgements of what is important onto the raw data.

130. Private third party prepayment plans: Private third party prepayment plans is defined as payment for services by some agency rather than directly by the beneficiary of those services.

131. Process evaluation: Process evaluation refers to efforts made to assess the extent to which program implementation complies with the program plan.

132. Professional negligence: Professional negligence is defined as the breach of duty caused by the omission to do something which a reasonable man guided by those considerations which ordinarily regulate the conduct of human affairs would do or doing something which a prudent and reasonable man would not do.

133. Public Health: Public Health is defined as the science and art of preventing disease, prolonging life and promoting physical and mental efficiency hrough organized community effort for the sanitation of the environment, the control of communicable infections, the education of the individual in personal hygiene, the organization of medical and nursing services for the early

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diagnosis and preventive treatment of disease and the development of the social machinery to insure everyone a standard of living adequate for the maintenance of health, so organizing these benefits as to enable every citizen to realize his birthright of health and longevity. - Winslow (1920)

134. Public health: Public Health is peoples health. It is concerned with the aggregate health of a group, a community, a state or a nation. -Knutson

135. Public: Public is defined as of or pertaining to the people of a community, state or nation. -Knutson

136. Randomization: Randomization is a statistical procedure by which the participants are allocated into groups usually called "study" and "control" groups, to receive or not to receive an experimental preventive or therapeutic procedure or intervention.

137. Recommended dietary allowance: Recommended dietary allowance is the amount of nutrients sufficient for the maintenance of health in nearly all people.

138. Rehabilitation: Rehabilitation is the combined and coordinated use of medical, vocational, social and educational measures for training and retraining the individual to the highest possible level of functional ability.

139. Relative Risk: Relative Risk (RR) or risk ratio, is defined as the ratio between the incidence of disease among exposed persons and incidence among non-exposed.

140. Relevance evaluation: Relevance evaluation refers to activities designed to determine whether the program is needed or whether the program is targeting its efforts at the individuals in need.

141. Research problem: A researchable problem is a statement or question that poses an unknown relationship between variables and serves to focus the entire investigation.

142. Research: Research is the continual search for truth using the scientific method.

143. Risk behavior: Risk behaviors are specific forms of behavior which are proven to be associated with increased susceptibility to a specific disease or ill-health. -WHO health promotion glossary, 1998

144. Risk factor: Risk factors are social, economic or biological status, behaviors or environments which are associated with or cause increased susceptibility to a specific disease, ill health, or injury. -WHO health promotion glossary, 1998

145. Risk: Risk is defined as the probability that some harmful event will occur.

146. Russell's rule: Russell's rule states that "When in doubt assign the lesser score".

147. Salt fluoridation: Salt fluoridation is the controlled addition of fluoride, usually sodium or potassium fluoride, during the manufacture of salt for human consumption.

148. Sample: A sample is a part of a population, called the 'Universe', 'reference' or 'parent' population.

149. Sampling: Sampling is the process or technique of selecting a sample of appropriate characteristics and adequate size.

150. Scientific method: Scientific method refers to a series of standardized procedures used in research to increase the likelihood that information gathered will be relevant, reliable and unbiased.

151. Screening: is defined as the use of presumptive methods to identify unrecognized health risk factors or asymptomatic disease in persons determined by prior studies to be potentially at elevated risk and able to benefit from interventions performed before overt symptoms develop. WHO, 1994

152. Secondary prevention: Secondary prevention is defined as action which halts the progress of a disease at its incipient stage and

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prevents complications.

153. Sewage: Waste water from a community containing solid and liquid excreta, derived from houses, street and yard washings, factories and industries.

154. Social Norms: Social norms are the rules that a group uses for appropriate and inappropriate values, beliefs, attitudes and behaviors.

155. Society: Society is a system of uses and procedures of authority and mutual aid of many groups coupled with division of control of human behavior and liberty.

156. Sociology: Sociology is the science concerned with the organization or structure of social groups.

157. Spectrum of disease: Spectrum of disease is defined as the sequence of events that occur in the human host from the time of contact with the etiologic agent up to the point of the ultimate outcome, which maybe fatal in the extreme cases.

158. Statistics: Statistics is the science of compiling, classifying and tabulating numerical data and expressing the results in a mathematical or graphical form.

159. Sullage: Waste water which does not contain human excreta.

160. Summative evaluation: Summative evaluation judges the merit or worth of a program after it has been in operation.

161. Survey: Survey is a non-experimental type of research that attempts to gather information about the status quo for a large number of cases by describing present conditions without directly analyzing their causes

162. Taboo: Taboo is a strong social prohibition (or ban) against words, objects, actions, or discussions that are considered undesirable or offensive by a group, culture, society, or community.

163. Tertiary prevention: Tertiary prevention is defined as all measures available to reduce or limit impairments and disabilities, minimize suffering caused by existing departures from good health and to promote the patient's adjustment to irremediable conditions.

164. Tongue scraping: Tongue scraping is defined as the process of removing debris from the surface of the tongue with some form of scraper designed for this purpose.

165. Utilization: Utilization is the actual attendance by members of the public at health care facilities to receive care

166. Vaccine: Vaccine is an immuno-biological substance designed to produce specific protection against a given disease.

167. Variable (V): A variable is a state, condition, concept or event whose value is free to vary within the population."

168. Water fluoridation: Water fluoridation is defined as the upward adjustment of the concentration of fluoride ion in a public water supply in such a way that the concentration of fluoride ion in the water may be consistently maintained at one part per million (ppm) by weight to prevent dental caries with minimum possibility of causing dental fluorosis.

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INDEX

A

Acidulated phosphate fluoride - 258
Ackerman-Proffit system of classification - 164
Acquired immuno deficiency syndrome (AIDS) - 493
Across the smiles - 572
Action of fluoride - 249
Acute toxicity of fluorides - 279
Administration - 29
Agent - 4
Aim - 365
Aims of epidemiology - 44
Akshara dasoha - 227
Alban test - 436
Alcohol - 141
Alma-Ata declaration - 13
Alternative hypothesis - 366
Amine fluoride - 260
Analysis - 379
Analysis of variance - 386
Analytical epidemiology - 58
Anaplasia - 134
Anganwadi worker - 16
Angle's system of classification - 161
Animal studies - 97
Anterior cross bite - 162
Approaches to achieve health - 206
Appropriate technology - 14
Area sampling - 289
Artifact explanation -188
Askov dental demonstration - 230
Association - 80, 181
Atraumatic restorative treatment(ART) - 448
Attack rate - 48
Attributable risk - 69
Audio-visual aids - 215
Autoclave - 497
Autonomy - 134, 505
Ayutthaya declaration - 222

B

Backwashing - 465
Balanced diet - 481
Band and bar space maintainer - 171
Band and loop space maintainer - 169
Bangalore declaration - 222
Bangalore method - 469
Bar chart - 372
Bare foot doctors - 14
Barriers in communication - 213
Basic Oral Health Surveys - 292
Bass method - 125
Behavior learning theories - 195
Behavior management 200
Bennet's classification - 164
Bhore committee - 15
Bias - 63
Bimodality - 55
Biological environment - 5
Biomedical concept - 3
Biostatistics - 379
Blanket referral - 228
Blinding - 62, 73
Blood and vulcanite dentistry - 574
Bloomberg initiative - 147
Blue cross - 426
Blue shield - 426
Brantford-Sarnia - Stratford study - 265
Brudevold's solution - 258

C

Calculus - 116
Calibration - 291
Capitation plans - 428
Carbohydrates - 478
Caries activity test - 432
Caries prevention - 98
Caries risk assessment - 103
Caries susceptibility - 432
Cariogenic plaque - 92
Cariogram - 105
Cartograms - 373
Case - 59
Case - control studies - 58
Castration complex - 190
Causal association - 80
Census - 21, 370
Chalk and talk - 215
Changing concepts in public health - 8
Characteristics of primary health care - 12

Char
Char
Chen
Chi s
Chlor
Chlor
Chror
Class
Class
Class
Clinic
Clonc
Close
Cluste
Cohor
Cohor
Co-ins
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Confou
Consen
Constra
Consur
Content
Control
Controll
Cooper
everywh
Correlat

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Characteristics of public health work - 27
Charter's method - 126
Chemical plaque control - 130
Chi square test - 384
Chlorhexidine gluconate - 130
Chlorination - 465
Chronic fluoride toxicity - 280
Classical conditioning theory - 195
Classification of malocclusion - 161
Classification of indices - 315
Clinical trials - 74
Clonality - 134
Closed-panel - 426
Cluster sampling - 289
Cohort - 65
Cohort studies - 64
Co-insurance - 423
Colgate's bright smiles, bright futures - 233
Collection of data - 370
Colombo plan - 559
Colorado stain - 237
Communication - 211
Community - 181
Community dentistry - 27
Community fluorosis index (CFI) - 352
Community Health Center (CHC) - 17
Community participation - 14
Community periodontal index (CPI) - 342
Community periodontal index of treatment needs (CPITN) - 333
Community water fluoridation - 265
Composting - 469
Comprehension - 207
Comprehensive dental care - 235
Concept of causation - 4
Confidentiality - 507
Confounding bias - 64
Confounding factor - 60
Consent - 519
Constraints - 404
Consumer Protection Act - 521
Contents of health education - 209
Control - 59
Controlled tipping - 468
Cooperative for assistance and relief everywhere inc. (CARE) - 552
Correlation - 386
Counselling for tobacco cessation - 149
CPITN probe - 334
Credibility - 207
Crete declaration - 146
Criminal negligence - 521
Crippling fluorosis - 281
Criteria for selecting an index - 315
Cross-sectional studies - 283
Crown and loop space maintainer - 170
Cultural anthropology - 183
Culture - 183
Current trends in caries - 84
Customary fee - 424
Customs and habits - 182
Cyclic trends - 53

D

Dean's index for fluorosis - 239, 350
Declaration of Geneva - 509
Declaration of Helsinki - 510
Deductible - 423
def index - 346
Defluoridation of water - 273
Degree of freedom - 385
Degrees of supervision - 420
Delmopinol - 131
Delta dental plans - 424
Demographic data - 20
Denominator - 49
Dental aesthetic index - 353
Dental aide - 419
Dental auxiliary - 412
Dental caries - 84
Dental caries vaccine - 99
Dental Council of India (DCI) - 529, 544
Dental ethics - 504
Dental floss - 128
Dental fluorosis - 280
Dental health educator - 414
Dental hygienist - 417
Dental laboratory technician - 413
Dental licentiate - 419
Dental mechanic - 414
Dental plaque 115

Click here to Visit - www.thedentalhub.org.in

Dental public health -23
Dental secretary - 413
Dental surgery assistant - 412
Dental therapist - 416
Dentifrices - 123, 261
Dentist - 412
Dentists Act - 529
Dentition status and treatment need - 300
Denturist - 414
Descriptive epidemiology - 283
Dewey's modification - 163
Didactic - 213
Diet - 93, 477
Dilectic - 213
Dip slide method - 435
Disability - 19
Disclosing agent - 120
Disease control phase - 8
Disinfection - 499
Distal shoe space maintainer - 171
District forum - 522
DMFS index - 346
DMFT index - 343
Doctor patient contract - 516
Double pot method - 467
Dry feeder - 268
Dumping - 468
Duraphat - 255

E

Early diagnosis - 19
Ecological concept - 4
Ecological plaque hypothesis - 114
Educational approach - 206
Effectiveness - 407
Efficiency - 407
Elements of Primary Health Care - 13
Employees state insurance scheme (ESI) - 430
Encapsulation 475
Endemic - 576
Environment - 5
Epidemic - 52
Epidemiological triad - 4
Epidemiologist - 30
Epidemiology - 43
Equitable distribution - 13
Errors in sampling - 289, 370
Erythroplakia - 143
Estimated daily intake of fluoride - 242
Estimation of fluoride concentration - 248
Ethical principles - 505
Ethics - 504
Ethnic groups - 55
Etiology of dental caries - 87
Etiology of periodontal diseases - 114
Etiquettes - 182
Evaluation - 406
Evanston Oakpark study - 265
Excretion of fluorides - 247
Expanded function dental auxiliary (EFDA) - 418
Experimental epidemiology - 71
Exposure rates - 62
Express contract - 517

F

Family - 181
Fats - 478
FDI system - 313
Field trials - 51
Filter box - 464
Filtration - 463
Fixed space maintainers - 169
Fluoride analysis - 248
Fluoride and dental plaque - 247
Fluoride electrode - 266
Fluoride foams - 255
Fluoride gels - 264
Fluoride in blood plasma - 243
Fluoride in bone - 245
Fluoride in cementum - 246
Fluoride in dental plaque - 247
Fluoride in dentin - 246
Fluoride in enamel - 245
Fluoride in saliva - 245
Fluoride in soft tissues - 244
Fluoride in the environment - 240
Fluori
Fluori
Fluori
Fluori
Fluorp
Folkw
Fones
Food c
Food p
Ford F
Forma
Fosdic
Four -
Freque
Freque
Frontie

G

Gauss
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H

Habit -
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Handic
Hardne
Harvar
Head s
Health
Health
Health
Health
Health
Health
Health n

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Fluoride mouthrinse - 226, 263
Fluoride tablets - 226, 278
Fluoride varnish - 255
Fluorine - 237
Fluorprotector - 255
Folkways - 182
Fones method - 126
Food and Agriculture organization (FAO) - 553
Food pyramid - 481
Ford Foundation - 551
Formative evaluation - 408
Fosdick's test - 438
Four - handed dentistry - 413
Frequency distribution table - 372
Frequency polygon - 373
Frontier auxiliaries - 419

G

Gaussian distribution - 383
Germ theory - 3
Gingival index (GI) - 325
Glucosyltransferases - 100
Goals - 403
Grand Rapids Muskegon study - 265
Group insurance - 423
Guidelines for drinking water quality - 460
Guttman scale - 285

H

Habit - 176
Hand over mouth exercise - 202
Handicap - 19
Hardness of water - 462
Harvard style - 390
Head start program - 232
Health - 2
Health behavior - 184
Health care waste - 470
Health education - 205
Health for all - 9
Health literacy - 205
Health maintenance organizations (HMO) - 426
Health promoting schools - 234
Health promotion - 18, 217
Health promotional phase - 8
Hepatitis - 491
Hereditary fructose intolerance - 97
Herpes virus infection - 490
Hippocratic oath - 504
Histogram - 373
History of epidemiology - 43
Holistic concept - 4
Hopewood house study - 96
Host - 4, 116
Household purification of water - 466
Human immuno deficiency virus (HIV) - 493
Hypothesis - 57, 366

I

Iatrogenic disease - 505
Iceberg of disease - 7
Ideal requisites of an index - 314
Immunity - 489
Immunization - 99
Impact evaluation - 409
Impairment - 19
Implementation - 405
Implied contract - 516
Incidence - 47
Incineration - 469
Incremental dental care - 234
Index ages - 293
Index of orthodontic treatment needs - 354
Indian association of public health dentistry (IAPHD) - 40
Indian dental association (IDA) - 540
Indian penal code - 524
Indian Red Cross society - 548
Inertization - 475
Infection - 490
Informed consent - 506, 519
Instrumental error - 289
Insurance principles - 423
Interceptive orthodontics - 172

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Interdental cleaning aids - 128
Inter-examiner variability - 291
International code of medical ethics - 509
International labour organization (ILO) - 550
International Red Cross - 547
International variations - 54
Interproximal brushes - 128
Intersectoral coordination - 14
Intervention - 19
Intra-examiner variability - 291
Ionic toothbrushes - 123
ISO 3950 notation - 313

J
Justice - 506

K
Kaposi's Sarcoma - 490
Kappa statistic - 291
Kartar Singh committee - 15
Keyes diagram - 87
Known to unknown - 208
Knutson technique - 256

L
Lactobacillus colony count test - 432
Laws - 183
League of Nations - 550
Learning about your oral health - 228
Learning by doing - 208
Legal aspects of water fluoridation - 272
Legend of the worm - 86
Leonards method - 126
Leukoplakia - 143
Lichen planus - 144
Life-style - 185
Likert scale - 285
Line diagram - 373
Literature review - 364
Local dais - 16
Local distributions - 54
Longitudinal studies - 283
Loss of attachment - 341
Loss of head - 465
Lottery method - 288
Lower class - 190
Lower middle class - 190

M
Malnutrition - 477
Malpractice 520
Manpower - 420
Master table - 372
Matching - 60
Materia alba - 115
Mean - 381
Measures of central tendency - 381
Measures of dispersion - 382
Mechanical plaque control - 121
Median - 381
Medicaid - 429
Medicare - 428
Metabolism of fluoride - 243
Metastasis - 134
Methodology of estimation of fluoride - 266
Miasma theory - 3
Migrant studies - 54
Miles for smiles mobile dental clinic - 572
Milestones in dentistry - 23
Milk fluoridation - 276
Millennium development goals - 9
Miller's chemicoparasitic theory - 86
Mobile dental clinic - 570
Mode - 381
Modelling - 201
Models of health education - 206
Modes of intervention - 19
Modified bass technique - 125
Modified stillman's technique - 125
Molar express - 572
Monitoring - 406
Monopolies and restrictive trade practices (MRTP) act - 524
Morbidity - 47
Mores -
Mortality
Motivati
Motives
Mottled
Mouth
Moyer's
Mudalia
Muhler's
Multifact
Multipha
Multistag

N
Nalgond
National
National
National
National
Natural h
Need - 1
Neutral s
Newburgl
Nicotine
No tobac
Noise - 2
Non-rand
Non-spec
Normal c
Normal d
North Ca
health prc
Null hypot
Numerato
Nurember
Nutrition -

O
Objectives
Objectives
Observer
Occupatio
(OSHA) -

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Mores - 182
Mortality - 46
Motivation - 207
Motives - 207
Mottled enamel - 238
Mouth breathing - 177
Moyer's classification - 164
Mudaliar committee - 15
Muhler's technique - 258
Multifactorial causation - 5
Multiphase sampling - 289, 369
Multistage sampling - 289, 370

N

Nalgonda technique - 273
National commission - 523
National health insurance - 429
National oral health policy - 39
National variations - 54
Natural history of disease - 6
Need - 193
Neutral sodium fluoride - 256
Newburgh - kingston study - 265
Nicotine replacement therapy - 151
No tobacco day- 156
Noise - 213
Non-randomized trial - 77
Non-specific plaque hypothesis 114
Normal curve - 383
Normal distribution - 383
North Carolina statewide preventive dental health program - 231
Null hypothesis - 384
Numerator - 49
Nuremberg code - 508
Nutrition - 93, 477

O

Objectives - 365, 404
Objectives of health education - 205
Observer error - 289
Occupational Safety and Health Act (OSHA) - 495
Odds ratio - 63
Office international D'hygiene publique - 549
Open panels - 426
Operant conditioning theory - 195
Opportunistic infection - 493
Ora test - 438
Oral cancer - 134
Oral health - 23
Oral health goals - 34
Oral health unit of WHO - 558
Oral hygiene index (OHI) - 316
Oral submucous fibrosis - 144
Over matching - 61

P

Paint-on technique - 259
Pan American sanitary bureau (PASB) - 549
Pandemic - 580
Panel - 289
Panel discussion - 216
Papillary-Marginal-Attachment Index - 324
Pathfinder surveys - 292
Period prevalence - 49
Periodontal Disease Index (PDI) - 328
Periodontal Index (PI) - 326
Permutit process - 463
Person distribution - 55
Physical environment - 5
Pictogram- 373
Pie diagram - 373
Pilot survey - 293
Pit & fissure sealant - 441
Place distribution - 53
Plan - 401
Planning - 401
Plaque - 92
Plaque biofilm - 115
Plaque control - 119
Plaque hypotheses - 114
Plaque index (PII) - 321
Point prevalence - 49
Political science - 184
Positive health - 4
Post hoc bias - 70
Post payment plans - 422

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Potable water - 459
Powered toothbrushes - 122
Practice management - 564
Precancerous conditions - 144
Precancerous lesions - 142
Prepaid group practice - 426
Presentation of data - 371
Pretest - 286
Prevalence - 49
Preventive orthodontics - 165
Preventive Resin Restorations (PRR) - 445
Price discrimination - 422
Primary prevention - 18
Primary health care - 12
Primary Health Centre (PHC) - 17
Primordial prevention - 18
Principles of epidemiology - 44
Principles of health education - 207
Principles of Primary Health Care - 13
Private fee for service - 422
Probability - 380
Procedural steps in dental public health - 32
Process evaluation - 408
Professionally applied topical fluorides - 252
Propaganda - 211
Prophylactic odontotomy - 441
Proportion - 45
Proportional bar chart - 373
Proteins - 477
Protocol - 72, 363
Proxy consent - 520
Psychoanalytical theory - 195
Psychodynamic theory - 195
Psychosocial concept - 4
Public health - 2
Public health dentist - 30
Public health measure - 31
Public health problem - 31
Public interest litigation - 524
Pyrolytic incinerator - 472

Q

Qualitative - 362, 370
Quantifiability - 315
Quantitative - 362, 370
Questionnaire survey - 284

R

Random sampling - 288
Randomization - 72
Randomized controlled trials - 72
Range - 382
Rapid sand filter - 465
Rate - 44
Ratio - 45
Reasonable fee - 424
Regression - 386
Regulatory approach - 206
Rehabilitation - 20
Reinforcement - 201, 208
Relative risk - 62
Relevance evaluation - 408
Reliability - 315, 388
Removable space maintainers - 168
Research - 361
Researchable problem - 363
Resources - 404
Risk approach - 7
Risk behavior - 191
Risk factor - 6, 135, 192
Risk groups - 7, 103
Risk ratio - 68
Rockefeller Foundation - 549
Role playing - 216
Roll technique - 127
Root caries index (RCI) - 348
Rotary kiln - 473
Rural health scheme - 15
Rural-urban variations - 54
Russel's rule - 326

S

Salivary buffer capacity - 435
Salivary reductase test - 436
Salt fluoridation - 275
Sample - 288, 368
Sample size - 367

Sampli
Sampli
Sampli
Saturat
Saturat
Scatter
School
School
School
(SHARE
School
School
Scot - s
Scrub r
Season
Second
Second
Secular
Self ap
Sensitiv
Sequen
Serial e
Service
Sewage
Shaded
Shoe le
Shrivast
Signific
Simon's
Simple
Simple
Simplifi
Skeletal
Slow sa
Smiles
Smith m
Smoker
Snyder
Social
Social e
Social e
Social i
Social l
Social r
Social s
Social v
Society

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Sampling - 288
Sampling error - 289
Sampling frame - 368
Saturation suspension cone - 270
Saturator system - 268
Scatter diagram - 373
School dental health programs - 224
School dental nurse - 415
School health additional referral program (SHARP) - 232
School health services - 222
School water fluoridation programs - 226
Scot - sanchis method - 266
Scrub method - 126
Seasonal trend - 53
Secondary attack rate - 48
Secondary prevention - 19
Secular trend - 53
Self applied topical fluorides - 261
Sensitivity - 315
Sequential sampling - 289
Serial extraction - 172
Service approach - 206
Sewage - 582
Shaded maps - 373
Shoe leather survey - 239
Shrivastav committee - 15
Significant caries index - 347
Simon's classification - 163
Simple random sampling - 369
Simple table - 372
Simplified oral hygiene index - 318
Skeletal fluorosis - 280
Slow sand filters - 464
Smiles 2 go - 572
Smith method - 127
Smokers palate - 143
Snyder test - 433
Social psychology - 184
Social engineering phase - 9
Social environment - 5
Social institutions - 181
Social learning theory - 195
Social norms - 181
Social stratification - 187
Social values - 183
Society - 181
Socio-drama - 216
Sociology - 181
Socratic - 213
Sodium fluoride mouthrinses - 263
Solid waste - 467
Solution feeder - 269
Sonic toothbrushes - 123
Sources of fluoride - 242
Space maintainer - 167
Specific plaque hypothesis - 114
Specific protection - 19
Spectrum of disease - 6
Spot map - 373
Squamous Cell Carcinoma - 145
Stages in the adoption of new ideas and practices - 211
Standard deviation - 382
Standard error - 383
Stannous fluoride - 257
State commission - 523
State dental councils - 533
Statistics - 379
Stephan curve - 87
Steps in planning - 402
Sterilization of instruments - 496
Stratified random sample - 289, 369
Stratified systematic sampling - 289
Streptococcus mutans level - 434
Streptococcus mutans - 99
Streptococcus mutans screening test - 437
Sullage - 583
Summative evaluation - 408
Surveillance - 406
Survey - 283
Swab test - 434
Symposium - 216
Systematic sampling - 289, 369
Systemic fluorides - 264

T

T test - 385
Table - 371
Table of allowances - 424
Table of random numbers - 288, 369
Taboo - 182

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Tacit consent - 519
Tattletooth program - 229
Teenage health education teaching assistants program (THETA) - 233
Tell show do - 201
Tertiary prevention - 19
Tests of significance - 383
Theory of cognitive development - 195
Thumb sucking - 176
Tiel - Culemborg fluoridation study - 266
Time distribution - 52
TNM system of tumor staging - 145
Tobacco - 135
Tokyo declaration - 222
Tongue scrapers - 130
Tongue thrusting - 176
Tools of dental public health - 29
Tools of measurement in epidemiology - 44
Tooth brushes - 121
Tooth brushing techniques - 123
Topical fluorides - 251
Toxicity of fluorides - 279
Tray technique - 259
Triclosan - 131
Truthfulness - 506
Tuberculosis - 494
Turesky-gilmore-glickman modification - 322
Turku sugar study - 96
Types of evaluation - 407
Types of examinations - 291
Types of survey - 283

U

Ultrasonic toothbrushes - 123
Unethical practices - 508
United nations children's fund (UNICEF) - 553
United nations development program (UNDP) - 559
United nations relief and rehabilitation administration (UNRRA) - 551
United states agency for international development (USAID) - 559
Universal precautions - 489
Universal system - 312
Upper lower class - 190
Upper middle class - 189
Uses of biostatistics - 379
Uses of epidemiology - 78
Uses of planning - 401
Usual fee - 424
Utilization of dental services - 193

V

Vaccine - 495
Validity - 314, 387
Vancouver style - 391
Variables - 380
Venturi fluoridator system - 269
Vipeholm study - 94
Vital layer - 464
Vitamins - 478

W

Waste management - 467
Water cycle - 459
Water irrigation devices - 129
Web of causation - 6
White and gardiner's classification - 165
WHO FCTC - 146
WHO global school health initiative - 233
WHO oral health assessment form - 294
WHO probe - 334
Womb to tomb - 235
Workshop - 216
World Bank - 552
World health assembly - 555
World Health Day - 559, 561
World health organization (WHO) - 554

Y

Yates correction - 396

Z

Z test - 385
Zsigmondy Palmer system - 312