Third Edition

Textbook of Preventive and Community Dentistry

Public Health Dentistry



Joseph John

CBS Publishers & Distributors Pvt Ltd

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Preventive and Community Dentistry

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Foreword by

Dr Mahesh Verma

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Foreword



The problems related to oral health are often overlooked by the community primarily because these are usually not life-threatening conditions. One of the reasons for this attitude towards oral health neglect is the poor representation of dentists to the community and *vice versa.*

Several efforts have been persistently made in India by governing and statutory bodies like the Dental Council of India, Indian Dental Association and particularly the Indian Association of Public Health Dentistry, and several players in the field of dentistry to bridge the chasm between dental service delivery and the community. A peep into the past will remind us of the untiring works of several stalwarts. May I, infact dedicate this ode to Dr. Mohandas Bhat and Mr Orango who have been pioneers with their vision and efforts to start the first department of community dentistry (in 1971) at Government Dental College, Bangalore. I laud the efforts of one and all including Dr. Joseph John who has over the past decade worked relentlessly to set the bar higher and make community and public health dentistry more visible than what it was several decades ago by his contributions including the past edition of the book in context.

The need to emphasize on this specialty right in the formative years of dental graduates is obvious. It has been said, “A journey of thousand miles begins with first step”. This book on public health dentistry does just that is to place the right first step within the protocol of the undergraduate curriculum.

Additionally, the author identifies the fact that the addressal of issues (in dentistry) in our Indian subcontinent requires a different perspective when compared to the rest of the world. This may be attributed to shifting demographic status, evolving economic trends, changing dental services and newer policies attributed to health care. This constant state of flux makes it a herculean task to perform. Yet this task has been carried out flawlessly by the ardent specialty of public health dentistry. May we rightly say this specialty

is the “guardian of dentistry” in all aspects? In truth of the aforementioned statement, it can also be said that this book is the pole star to attain the same effect.

Apart from drafting policies and administering tasks to meet the unmet needs of people, the game changers in this field of public health dentistry are also sharing the onus to align the education in dentistry, in laying down the principles and guidelines of ethics in dentistry, coming up with solutions of insurance and payment policies, defining the legalities of duty, demystifying the enigma of infection control and sterilization policies and much more—primarily to append the existing status of dental research and practice. For the undergraduates, the current edition of this book can be considered an essential elemental documentation, converged in a lucid manner not only nuance of the subject but also cultivate in them a sense of responsibility towards serving the public in a disciplined, assertive and dogmatic manner.

An interesting aspect of this book is that even for those of us who belong to a specialty other than community dentistry (like me) find this book elucidative and enlightening about several issues.

As is said, the ‘loftier the building, the deeper must its foundation be laid’. If we wish to raise dentistry on a still higher pedestal, we need to ensure our future generation is made robust and endowed. This edition does just that it passes the legacy to the younger generation in a simplistic and comprehensive manner and empowers them to put India on a global map in the field of dentistry!

Kudos and read on ...!

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Preface to the Third Edition

It has been a pleasure to work on the third edition of *Textbook of Preventive and Community Dentistry* because it has presented me an opportunity to provide a framework for students to learn the subject and bring into focus some of the newer concepts in preventive dentistry. Much of the materials in several chapters have been completely rewritten or revised by selected contributors from their areas of expertise. In writing the third edition, I have tried hard to be precise while at the same time being reader friendly. The focus of the third edition of this book has not changed from previous editions. I am, therefore, confident that the undergraduate students will find the book useful.

As in the previous edition, the book has been divided into seven sections:

Section A: This part presents fundamental aspects of public health and a historical perspective of history of medicine, public health and its practice with health education. A brief overview of health care delivery system of India is also discussed.

Section B: Broadens understanding of the role of epidemiology, linking it with other core public health disciplines, and highlighting the core diseases in oral health which are of prime importance in the real-world practice of public health.

Section C: Deals with infection control procedures and precautions taken in health care settings to prevent the spread of disease. The transmission of infection in a dental practice is one of the most serious issues the industry can face, which is why it is so important that everyone in the dental office be aware of the most recent protocols to reduce the overall risk.

Section D: This section introduces the core principles of dental public

health, and its application to population-based oral health. Differences in the roles of a private dental practitioner and a dental public health specialist are addressed. The importance of core public health functions, indices, planning of oral health status and payment to dental care is highlighted.

Section E: The caries preventive mechanisms of fluoride, materials and methods for rational use of fluorides for self-care and professional along with minimally invasive procedures are highlighted in this section.

Section F: This section on biostatistics is casual in tone and sometimes a bit demanding where mathematical and statistical tests are introduced. We have made an attempt to simplify statistical methods in the best possible manner.

Section G: The last part of the section sits at the crossroads of health. Social sciences are intimately connected to the health and socioeconomic welfare of individuals, families, and communities. As a result, efforts to improve oral health must consider both the consequences and causes of underlying social, political, cultural and economic factors that affect oral health.

About the Book

The subject of preventive and community dentistry public health dentistry | has become an important component of dental education and training today. Keeping pace with the evolving technologies, and acknowledging the dynamicity of the subject, the third edition of textbook has been conceptualized to make learning easy for undergraduate students. The text has been completely reorganized and edited by experts from around the globe. The entire syllabus is divided into seven sections covering: • Public Health, • Epidemiology, • Infection Control, • Dental Public Health, • Preventive Dentistry, • Health Statistics and • Social Sciences.

Salient Features

- The user-friendly format of presentation
- A clearly written narrative style
- Over 200 illustrations
- High value multiple choice questions (MCQs)
- Updates on recent advances in preventive dentistry
- Basic tenets of biostatistics and research methodology to enable students to become familiar with the art of using research methods and techniques
- Ready reckoner for both undergraduate and postgraduate students

About the Author



Joseph John MDS is Professor and Head, Department of Public Health Dentistry, Saveetha Dental College, Chennai. He received his training at Manipal University and completed his postgraduation from SDM College of Dental Sciences, Dharwad. His interests include minimal invasive dentistry, epidemiology and preventive dentistry. He has received numerous awards, has authored over 50 peer-reviewed scientific articles, has given invited lectures, and holds leadership positions in many scholarly societies. He has handled both academic and administrative positions successfully. He was a member of University's institutional review board for several years and was later appointed to serve as chairperson in 2012. He has been the controller of examinations at Meenakshi University and later at Saveetha University. He was Associate Dean of Administration during which he ensured the continuous accreditation of the college. He also served as Associate Dean of faculties at Saveetha Dental College, Chennai.

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CHAPTER

1

Health, Disease and Infection

Kindness, concern and love for the art of healing earned "**Hippocrates**" the immortal title of "Father of Medicine". Medicine has evolved after a series of false theories, misinformation, mistaken interpretations, inventions and discoveries. Medical knowledge in fact has been derived, to a very great degree, from the intuitive and observational propositions and cumulative experiences gleaned from others.

VARIOUS SYSTEMS OF MEDICINE

From time immemorial, man has been interested in trying to control the disease. The medicine man, the priest, the herbolist and the magician, all undertook in various ways to cure man’s disease and bring relief to the sick.[3]

Medicine in Antiquity

Medicine was dominated by magical and religious beliefs, which were an integral part of ancient culture and civilization. In ancient times, health and illness were interpreted in a cosmological and anthropological perspectives.

Primitive Medicine

The primitive man attributed disease and in fact all human sufferings and other calamities to the wrath of the gods, the invasion of body by “evil spirits” and the influence of the stars and planets. The concept of disease in which the ancient man believes is known as the “supernatural theories of disease”. In the prehistoric times, medicine was intermingled with superstition, religion, magic and witchcraft.

Indian Medicine

The medical systems those are truly Indian in origin and developments are the Ayurveda and Siddha systems. Ayurveda is practiced throughout India, but the Siddha system is practiced in the Tamil speaking areas of South India. These systems differ very little in theory and practice. Ayurveda implies “knowledge of life” or the knowledge by which life may be prolonged. Its origin is traced back to Vedic times. During this period, the medical history was associated with mythological figures, sages and seers. The celebrated authorities in Ayurvedic medicine were Atreya, Charaka, Susruta and Vaghbhatt. The Indian sago (rauwolfia) was employed for centuries by the Indian physicians, before reserpine was extracted from the root and found effective in the treatment of hypertension. Susruta was also called as the “father of Indian surgery”. His work was mainly devoted to surgery, which also included medicine, pathology, anatomy, midwifery, ophthalmology, hygiene and bedside manners. The early Indians set fractures, performed amputations, excised tumors, repaired hernias and excelled in cataract operations and plastic surgeries. The golden age of Indian medicine was between 800 BC and 600 AD. Other indigenous systems of medicine practiced in India include Unani-Tibb and Homeopathy.[3]

Chinese Medicine

Chinese medicine claims to be the world's first organized body of medical knowledge dating back to 2700 BC. Hygiene, dietetics, hydrotherapy, massage, drugs were all used by Chinese physicians. Chinese were the early pioneers of immunization. The Chinese systems of barefoot doctors and acupuncture have attracted worldwide attention in recent years.

Egyptian Medicine

In Egyptian times, the art of medicine was mingled with religion. Egyptian physicians were co-equals of priest, trained in schools within the temples. They often helped priests to care for the sick who were brought to the temples for treatment. Egyptian medicine was far from primitive. They believed that pulse was the “speech of the heart”. Diseases were treated with enema, bloodletting and wide range of drugs. In the field of public health also, Egyptians excelled. They built planned cities, public baths, and underground drains. They had also some knowledge of inoculation against smallpox, the value of mosquito nets and the association of plague with rats.

Mesopotamian Medicine

The basic concepts of medicine were religious, and taught and practiced by herb doctors and knife doctors and spell doctors—a classification that roughly parallels our own internists, surgeons and psychiatrists. Medical students were busy in classifying ‘demons’, the causes of the diseases. Laws relating to medical practice including fees payable to the physicians for satisfactory services and penalties for harmful therapy are contained in Babylonian Code of Hammurabi, the very first codification of medical practice.[2]

Greek Medicine

The Greeks enjoyed the reputation of “the civilizers of the ancient world”. They taught men to think in terms of “why and how”. By far the greatest physician in Greek medicine was Hippocrate who is called the ‘Father of Medicine’. He studied and classified diseases based on observation and reasoning. He challenged the tradition of magic in medicine, and initiated radically new approach to the medicine, i.e. application of clinical methods in medicine. Hippocratic concept of health and disease stressed the relation between the man and the environment. In short, the Greeks gave a new direction to medical thought. They rejected the supernatural theory of disease and looked upon disease as a natural process, not a visitation from the God.[2]

Roman Medicine

The Romans were more practical-minded people than the Greeks. They had a keen sense of sanitation. Public health was born in Rome with the development of baths, sewers and aqueducts. The Romans made fine roads, throughout the empire, brought pure water to all the cities through aqueducts, drained marshes to combat malaria, built seweage systems and established hospitals for the sick. Galen was an outstanding figure among Roman medical teachers. About the disease, Galen observed that disease is due to three factors—predisposing, exciting and environmental factors.

HEALTH

All communities have their concepts of health, as part of their culture. Health continues to be a neglected entity despite lip service. At the individual level, it cannot be said that health occupies an important place, it is usually subjugated to other needs defined as more important, e.g. power, prestige, wealth, knowledge and security. Health is often taken for granted and its value is not fully understood until it is lost.

Definition

Health is one of those terms, which most people find it difficult to define although they are confident of its meaning. One of the oldest definitions of health is “absence of disease”.

Webster defined health as “the condition of being sound in body, mind or spirit, especially freedom from physical disease or pain”.

WHO defined as “a state of complete physical, mental and social well-being and not merely an absence of disease or infirmity”.[4a]

Changing Concepts of Health

1. Biomedical Concept

Health has been viewed as an “absence of disease” and if one was free from disease, then the person was considered healthy. This is known as the biomedical concept. This concept was, however, found inadequate to solve some of the major health problems like malnutrition, chronic diseases, accidents, etc.[4f]

2. Ecological Concept

The ecologists put forward a hypothesis, which viewed health as a dynamic equilibrium between man and his environment, and disease a maladjustment of the human organism to environment.

3. Psychosocial Concept

Health is influenced by social, psychological, cultural, economic and political factors. These factors need to be considered while defining and measuring health.

4. Holistic Concept

This concept implies that all sectors of society have an effect on health, in particular agriculture, food, industry, education and other sectors. This view corresponds to the view held by ancients that health implies a sound mind, in a sound body, in a sound family, in a sound environment.[4f]

Dimensions of Health

Health is multidimensional. WHO envisages three specific dimensions, namely the physical, mental and the social. The others include, spiritual, emotional, vocational and political dimensions.

Physical Dimension

The state of physical health implies the notion of “perfect functioning” of the body. It conceptualizes health biologically as a state in which every cell and every organ is functioning at optimum capacity and in perfect harmony with the rest of the body.

At the community level, such indicators, as death rate, infant mortality rate and expectation of life, may assess the state of health.

Mental Dimension

Mental health is not mere absence of mental illness. Mental health is defined as “a state of balance between the individual and the surrounding world, a state of harmony between oneself and others, a coexistence between the realities of the self and that of other people and that of the environment”.

Assessment of mental health at the population level may be made by administering mental status questionnaires by trained interviewers.

Social Dimension

It has been defined as “quantity and quality of an individual’s interpersonal ties and the extent of involvement with the community”.

Social well-being implies harmony and integration within the individual, between each individual and other members of society and between individuals and the world in which they live.

Spiritual Dimension

It includes integrity, principles and ethics, the purpose in life, commitment to some higher being and belief in concepts that are not subject to “state of the art” explanation.

Emotional Dimension

Mental and emotional dimensions have been seen as one element, however, psychobiology relates emotional health, to “feeling” and mental health towards “knowing” and “cognition”.

Others

A few other dimensions have also been suggested such as:

- Vocational dimension
- Philosophical dimension
- Cultural dimension
- Socioeconomic dimension
- Environmental dimension
- Educational dimension
- Nutritional dimension
- Preventive dimension.

Indicators of Health

Indicators are required not only to measure the health status of a community, but also to compare the health status of one country with that of another, for assessment of health care needs, for allocation of scarce resources, and for monitoring and evaluation of health services, activities and programs. Indicators help to measure the extent to which the objectives and the targets of a program are being attained.[1]

Characteristics of Indicators

Ideal indicators should be:

1. ***Valid***—should measure what they are supposed to measure.
2. ***Reliable***—answer should be the same when measured by different people in similar circumstances.
3. ***Sensitive***—should be sensitive to the changes in the situation concerned.
4. ***Specific***—should reflect changes only in the situation concerned.
5. ***Feasible***—should have the ability to obtain data needed.
6. ***Relevant***—should contribute to the understanding of the phenomenon of interest.

Classification

The indicators of health may be classified as:

1. Mortality indicators
2. Morbidity indicators
3. Disability rates
4. Nutritional status indicators
5. Health care delivery indicators
6. Utilization rates
7. Indicators of social and mental health
8. Environmental indicators

9. Socioeconomic indicators
10. Health policy indicators
11. Indicators of quality of life
12. Other indicators

1. Mortality Indicators

i. *Crude death rate*: It is defined as number of deaths per 1000 population per year in a given community.

ii. ***Expectation of life*****:** Life expectancy at birth is 'the average number of years that will be lived by those born alive into a population, if the current age-specific mortality rate persists.

iii. ***Infant mortality rate*****:** Infant mortality rate is the ratio of deaths under 1 year of age in a given year to the total number of live births in the same year, usually expressed as a rate per 1000 live births.

iv. ***Child mortality rate*****:** It is defined as the number of deaths at age 1–4 years in a given year per 1000 children in that age group at the midpoint of the year concerned.

v. Under 5 proportionate mortality rate.

vi. Maternal mortality rate.

vii. Disease-specific mortality rate.

viii. Proportional mortality rate.

2. Morbidity Indicators

The following morbidity rates are used for assessing ill health in community.

i. Incidence and prevalence.

ii. Notification rates.

iii. Attendance rates at out-patient departments, health centres, etc.

iv. Admission, readmission and discharge rates.

v. Duration of stay in hospital.

vi. Spells of sickness or absence from work or school.

3. Disability Rates

The commonly used disability rates fall into two groups:

i. Event-type indicators.

ii. Person-type indicators.

Sullivan's index: This index is computed by subtracting from the life expectancy the probable duration of bed disability and inability to perform major activities, according to crosssectional data from the population surveys.

4. Nutritional Status Indicators

They are:

i. Anthropometric measurements of preschool children

ii. Heights of children at school entry

iii. Prevalence of low birth weight.

5. Health Care Delivery Indicators

The frequently used indicators are:

i. Doctor-population ratio.

ii. Doctor-nurse ratio.

iii. Population-bed ratio.

iv. Population per health/subcentre.

v. Population per traditional birth attendant.

6. Utilization Rates

Utilization of services or actual coverage is expressed as the proportion of people in need of a service who actually receive it in a given period, usually a year.

7. Indicators of Social and Mental Health

These include suicide, homicide, other acts of violence and other crimes; road traffic accidents, alcohol and drug abuse, smoking, consumption of tranquilizers and obesity.

8. Environmental Indicators

Environmental indicators reflect the quality of physical and biological environment in which diseases occur and in which the people live. They include pollution of water and air, radiation, solid wastes, noise, and exposure to toxic substances in food and drink.

9. Socioeconomic Indicators

These include:

i. Rate of population increase
ii. Level of unemployment
iii. Family size.

10. Health Policy Indicators

The single most important indicator of political commitment is “allocation of adequate resources.”

11. Indicators of Quality of Life

It consolidates three indicators, namely:

i. Infant mortality
ii. Life expectancy at age one
iii. Literacy.

12. Other Indicators

i. Social indicators
ii. Basic needs indicators
iii. Health for all indicators.

DISEASE

Webster defined disease as “a condition in which body’s health is impaired, a departure from a state of health, an alteration of the human body interrupting the performance of vital functions”.[2]

The simplest definition is, of course, that disease is just the opposite of health, i.e. any deviation from normal functioning or state of complete physical or mental well-being.

Concepts of Causation

Up to the time of Louis Pasteur, various concepts of disease causation were in vogue, e.g. the supernatural theory of disease, the theory of humors, etc. Discoveries in microbiology marked a turning point in our aetiological concepts.

1. Germ Theory of Disease

This concept gained momentum during the 19th and the early part of the 20th century. The emphasis had shifted from empirical causes (bad air) to microbes as the sole cause of disease. The concept in the germ theory of disease is generally referred to as one-to-one relationship between causal agent and disease. The disease model is as follow:

Disease agent → Man → Disease

It is now recognized that a disease is rarely caused by a single agent alone, but rather depends upon a number of factors, which contribute to its occurrence. Therefore, modern medicine has moved away from the strict adherence to the germ theory of disease.

2. Epidemiological Triad

The germ theory of disease has many limitations. For example, not everyone exposed to tuberculosis develops tuberculosis. The same exposure, however, in an undernourished or otherwise susceptible person may result in clinical disease. There are other factors relating to the host and environment, which are equally important to determine whether or not disease will occur in the exposed host. This demanded a broader concept of disease causation that synthesized the basic factors of agent, host and environment.

The causative factors of disease may be classified as *agent*, *host* and *environment*. These three factors are referred as epidemiological triad. The mere presence of agent, host and favourable environmental factors in the prepathogenesis phase is not sufficient to start a disease in man. What is required is interaction of these three factors to initiate the disease process in man (Fig. 1.1). The agent, host and environment operating in combination determine not only the onset of disease which may range from a single case

to epidemics but also the distribution of disease in community.[4c]

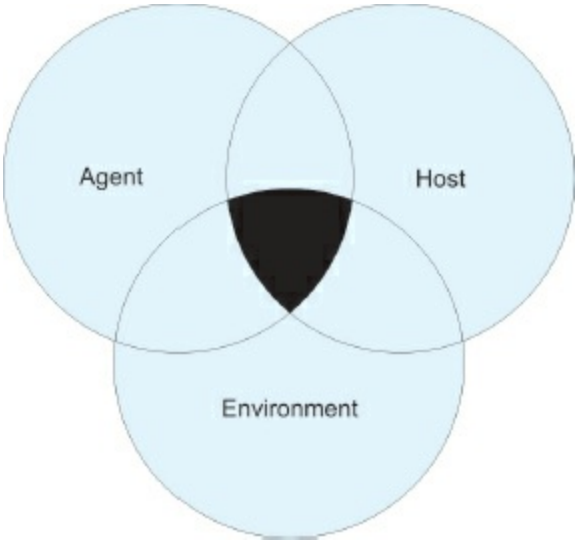


Fig. 1.1: Interaction of agent, host and environment

1. ***Agent factors*:** Agent is defined as a substance, living or non-living, or a force, tangible or intangible, the excessive presence or relative lack of which may initiate or perpetuate a disease process.

   Disease agents are classified as:

   i. *Biological agents*: These agents include virus, bacteria, fungi, rickettsiae, protozoa and metazoa. These exhibit infectivity, pathogenicity and virulence.

   ii. *Nutritional agents*: These can be proteins, fats, carbohydrates, vitamins, minerals and water. Any excess or deficiency results in nutritional disorder.

   iii. *Physical agents*: Exposure to excessive heat, cold, humidity, pressure, radiation, electricity and sound may result in illness.

   iv. *Chemical agents:*

      a. *Endogenous*: Chemicals produced in the body such as urea, ketones, uric acid, etc.

      b. *Exogenous*: Agents arising outside the human host, e.g. metals, allergens, fumes, dust and gases.

   v. *Mechanical agents*: Exposure to chronic friction and other mechanical forces may result in crushing, tearing, sprains,

dislocations and even death.

vi. *Social agents*: These include smoking, poverty, abuse of drugs and alcohol, unhealthy lifestyles, social isolation, maternal deprivation, etc.

2. ***Host factors*****:** Host is defined as a person or other animal, including birds and arthropods that affords subsistence or lodgment to an infectious agent under natural conditions.

The host factors can be classified as:

i. Demographic characteristics such as age, sex.

ii. Biological characteristics such as genetic factors.

iii. Social and economic characteristics such as education, occupation, and marital status.

iv. Lifestyle factors such as personality traits, living habits, and physical exercises.

3. ***Environmental factors*****:** Environment is defined as man's external surroundings.

It is divided into three components:

a. *Physical environment*: This is applied to non-living things and physical factors with which man is in constant interaction, e.g. air, water, soil, housing, climate, heat, light, noise, debris, and radiation.

b. *Biological environment*: The biological environment is the universe of living things, which surrounds man, including man himself.

c. *Psychosocial environment*: It is difficult to define psychosocial environment due to the varied social, economic and cultural contexts. It includes a complex of psychosocial factors which are defined as those factors affecting personal health, health care and community well-being that stem from the psychosocial make-up of an individual and the structure and functions of social groups. A stable and harmonious equilibrium between man and his environment is needed to reduce man's vulnerability to diseases and to permit him to lead a more productive and satisfying life.

3. Multifactorial Causation

Pettenkofer of Munich was an early proponent of this concept. As a result of advances in public health, chemotherapy, antibiotics and vector control, communicable diseases began to decline—only to be replaced by new types of diseases, the so-called "modern" diseases of civilization, e.g. lung cancer, coronary heart disease, chronic bronchitis, mental illness, etc. These diseases could not be explained on the basis on the germ theory of disease nor could they be prevented by the traditional methods of isolation, immunization or improvements in sanitation. The realization began to dawn that the "single cause idea" was an over simplification and that there are other factors in the aetiology of diseases—social, economic, cultural, genetic and psychological which are equally important.

Diseases such as coronary heart disease and cancer are due to multiple factors. For example, excess of fat intake, smoking, lack of physical exercise, and obesity are all involved in the pathogenesis of coronary heart disease. Most of these factors are linked to lifestyle and human behaviour. Thus this model de-emphasizes the concept of disease "agent" and stress multiplicity of interactions between host and environment. The multifactorial concept offers multiple approaches for the prevention and control of disease.

4. Web of Causation

This model of disease causation was suggested by Mac Mahon and Pugh. This model is ideally suited in the study of chronic disease, where the disease agent is often not known, but is the outcome of interaction of multiple factors.

The "web of causation" considers all the predisposing factors of any type and their complex interrelations with each other. The web of causation does not imply that the disease cannot be controlled unless all the multiple causes or chains of causation or at least a number of them appropriately controlled or removed. Sometimes removal or elimination of just one link or chain may be sufficient to control disease, provided that link is sufficiently important in the pathogenetic process.

Natural History of Disease

Disease results from a complex interaction between man, an agent and the environment. The term natural history of disease is a key concept in epidemiology.[1] It signifies the way in which a disease evolves over time from the earliest stage of its prepathogenesis phase to its termination as recovery, disability or death, in the absence of treatment or prevention. Each disease has its own unique natural history, which is not necessarily the same in all individuals, so much so, any general formulation of the natural history of disease is necessarily arbitrary.

It is customary to describe the natural history of disease as consisting of two phases:

a. Prepathogenesis

b. Pathogenesis.

a. Prepathogenesis Phase

This refers to the period preliminary to the onset of disease in man. The disease agent has not yet entered man, but the factors which favour its interaction with the human host are already existing in the environment. This situation is frequently referred to as ‘man in midst of disease’ or ‘man exposed to risk of disease’. Potentially, we are all in the prepathogenesis phase of many diseases, both communicable and non-communicable.[4c]

b. Pathogenesis Phase

The pathogenesis phase begins with the entry of disease ‘agent’ in the susceptible human host. The further events in the pathogenesis phase are clear-cut in infectious diseases, i.e. the disease agent multiplies and induces tissue and physiologic changes, the disease progresses through a period of incubation and later through early and late pathogenesis. The final outcome of the disease may be recovery, disability or death. The pathogenesis phase may be modified by intervention measures such as immunization and chemotherapy.

Risk Factors

When the disease agent is not firmly established, the aetiology is generally discussed in terms of “risk factors”. The term risk factor means an attribute or exposure that is significantly associated with the development of a disease.

The presence of a risk factor does not imply that the disease will occur, and in its absence, the disease will not occur. The important thing about risk factors is that they are observable or identifiable prior to the event they predict. The combination of risk factors in the same individual may be purely additive or synergistic. For example, smoking and occupational exposure (dye and leather industry) 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 factors such as hypertension and high blood cholesterol. Risk factors may be truly causative or merely contributory. Some risk factors can be modified (smoking); others cannot be modified (age, sex). Epidemiological methods (case control and cohort studies) are needed to identify risk factors and estimate the degree of risk. The detection of risk factors will help in the prevention and intervention of diseases.

Spectrum of Disease

The term “spectrum of disease” is a graphic representation of variations in the manifestations of disease. At one end of the disease, spectrum are subclinical infections, which are not ordinarily identified and at the other end are fatal illnesses.

In the middle of the spectrum, lie illnesses ranging in severity from mild to severe. These different manifestations are simply reflections of individual’s different states of immunity and receptivity. Leprosy is an excellent example of the spectral concept of disease. The sequence of events in the spectrum of disease can be interrupted by early diagnosis and treatment or by preventive measures.

Iceberg of Disease

A concept closely related to the spectrum of disease is the concept of the iceberg phenomenon of disease. According to this concept, disease in a community may be compared with an iceberg (Fig. 1.2). The tip of the iceberg represents what the physician sees in the community, i.e. clinical cases. The vast submerged portion of the iceberg represents the hidden mass of disease, i.e. latent, inapparent, presymptomatic and undiagnosed cases and carriers in the community. The "water line" represents the demarcation between apparent and inapparent disease. In some diseases [e.g. hypertension, diabetes, anaemia, malnutrition, mental illness], the unknown morbidity [i.e. the submerged portion of the iceberg] far exceeds the known morbidity. The hidden part of the iceberg thus constitutes an important, undiagnosed reservoir of infection or disease in the community, and its detection and control is a challenge to modern techniques in preventive medicine.

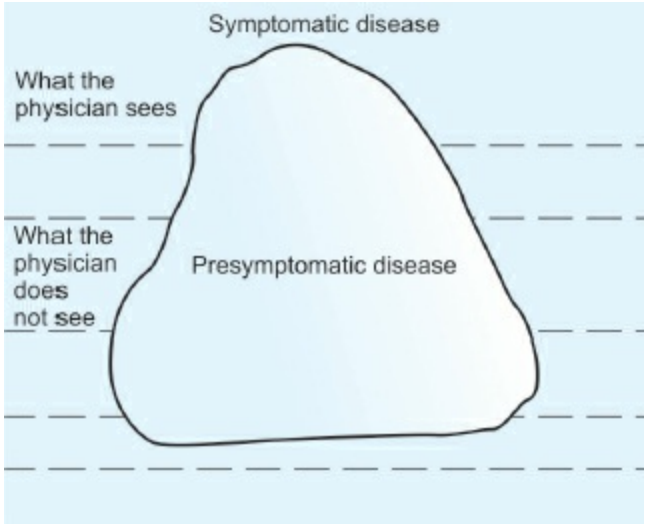


Fig. 1.2: The iceberg of disease

Disease Control

The term “disease control” describes operations aimed at reducing:

i. The incidence of disease

ii. The duration of disease, and consequently the risk of transmission

iii. The effects of infections, including both the physical and psychosocial complications; and

iv. The financial burden to the community.

Control activities may focus on primary prevention or secondary prevention; most control programmes combine the two.

In disease control, the disease ‘agent’ is permitted to persist in the community at a level where it ceases to be a public health problem according to the tolerance of the local population. A state of equilibrium becomes established between the disease agent, host and environment components of the disease process.

Disease Elimination

The term “elimination” is used to describe interruption of transmission of disease, as for example, elimination of measles, polio and diphtheria from large geographic regions or areas.

Disease Eradication

Eradication literally means to “tear out by roots”. Eradication of disease implies termination of all transmission of infection by extermination of the infectious agent. The word eradication is reserved to cessation of infection and disease from the whole world.

Totally, smallpox is the only disease that has been eradicated. Three diseases have been seriously advanced as candidates for global eradication within the foreseeable future; polio, measles and dracunculiasis. The feasibility of eradicating polio appears to be greater than that of others.

SCREENING FOR DISEASES

Screening has been defined as “the search for unrecognized disease or defect by means of rapidly applied tests, examinations or other procedures in apparently healthy individuals”.

The original screening programmes were for individual diseases such as tuberculosis, syphilis, etc. Over the years, the screening tests have steadily grown in number. Today screening is considered a preventive care function, and some consider it a logical extension of health care.

Screening differs from **periodic health examinations** in the following respects:

1. Capable of wide application.
2. Relatively inexpensive
3. Requires little physician-time. In fact the physician is not required to administer the test, but only to interpret it.

A screening test is not intended to be a diagnostic test. It is only an initial examination. Those who are found to have positive test results are referred to a physician for further diagnostic work-up and treatment.

Aims and Objectives of Screening

The basic purpose of screening is to sort out from a large group of apparently healthy persons those likely to have the disease or at increased risk of the disease under study, to bring those who are “apparently abnormal” under medical supervision and treatment.

Criteria for Screening

The criteria for screening are based on two considerations: The *disease* to be screened, and the *test* to be applied.

Disease

The disease to be screened should fulfil the following criteria before it is considered suitable for screening:

1. The condition sought should be an important health problem (in general, prevalence should be high).
2. There should be a recognizable latent or early asymptomatic stage.
3. The natural history of the condition, including development from latent to declared disease, should be adequately understood (so that we can know at what stage the process ceases to be reversible).
4. There is a test that can detect the disease prior to the onset of signs and symptoms.
5. Facilities should be available for confirmation of diagnosis.
6. There is an effective treatment.
7. There should be an agreed-on policy concerning whom treat as patients (e.g. lower ranges of blood press borderline diabetes).
8. There is good evidence that early detection and treatment reduces morbidity and mortality.
9. The expected benefits (e.g. the number of lives saved early detection) exceed the risks and costs.

When the above criteria are satisfied, then it would be appropriate to consider a suitable screening test.

Screening Test

The test must satisfy the criteria of acceptability, repeatable and validity, besides others such as yield, simplicity, safety rapidity, ease of administration and cost.

1. Acceptability

Since a high rate of cooperation is necessary, it is important that the test should be acceptable to the people at whom it is aimed. In general, tests that are painful, discomforting and embarrassing (e.g. rectal or vaginal examinations) are not in likely to be acceptable to the population in mass campaign.

2. Repeatability

An attribute of an ideal screening test or any measurement (e.g. height, weight) is its repeatability (sometimes called reliability, precision or reproducibility). That is, the test must give consistent results when repeated more than once on the same individual or material, under the same conditions. The repeatability of the test depends upon three major factors namely observer variation, biological (or subject) variation and errors relating to technical methods. For example, the measurement of blood pressure is poorly, producible because it is subjected to all these three major factors.

3. Validity (Accuracy)

The term validity refers to what extent the test accurately measures which it purports to measure. In other words, validity expresses the ability of a test to separate or distinguish those who have the disease from those who do not.

Validity has two components—sensitivity and specificity. When assessing the accuracy of a diagnostic test, one must consider both these components. Both measurements are expressed as percentages. Sensitivity and specificity are usually determined by applying the test to one group of persons having the disease, and to a reference group not having the disease (Table 1.1). Sensitivity and specificity, together with “predictive accuracy” are inherent properties of a screening test.

Table 1.1: Screening test result by diagnosis

Screening	*Diagnosis*		*Total*
Test result	*Diseased*	*Not diseased*	
Positive	a (true positive)	b (false positive)	a+b
Negative	c (false negative)	d (true negative)	c+d
Total	a+c	b+d	a+b+c+d

The letter “a” (Table 1.1) denotes those individuals found positive on the test who have the condition or disorder being studied (i.e. true positives). The group labelled “b” includes those who have a positive test result but who do not have the disease (i.e. false positives). Group “c” includes those with negative test results but who have the disease (i.e. false negatives). Finally, those with negative results who do not have the disease are included in group “d” (i.e. true negatives).

Evaluation of a Screening Test

The following measures are used to evaluate a screening test:

a. Sensitivity = a/(a + c) × 100

b. Specificity = d/(b + d) × 100

c. Predictive value of a positive test a/(a + b) × 100

d. Predictive value of a negative test = d/(c + d) × 100

Let us rewrite Table 1.1 substituting hypothetical figures (Table 1.2) and calculate the above measures:

Table 1.2: Screening test result by diagnosis

Screening	*Diagnosis*		*Total*
Test result	*Diseased*	*Not diseased*	
Positive	40 (a)	20 (b)	60 (a+b)
Negative	100 (c)	9840 (d)	9940 (c+d)
Total	140 (a+c)	9860 (b+d)	10,000 (a+b+c+d)

a. Sensitivity (true positive)
= (40/140) × 100 = 28.57%

b. Specificity (true negative)
= (9840/9860) × 100 = 99.79%

c. Predictive value = (9840/9940) × 100 = 98.9% of a negative test.

The term sensitivity was introduced by Yerushalmy in 1940s as a statistical index of diagnostic accuracy. It has been defined as the ability of a test to identify correctly all those who have the disease, that is "true positive". A 90% sensitivity means that 90% of the diseased people screened by the test will give a "true positive" result and the remaining 10% a "false negative" result.

Specificity

It is defined as the ability of a test to identify correctly those who do not have the disease, i.e. "true negatives". A 90% specificity means that 90% of the

non-diseased persons will give “true negative” result, 10 per cent of nondiseased people screened by the test will be wrongly classified as “diseased” when they are not.

Sensitivity

Sensitivity may be increased only at the expense of specificity and vice versa. An ideal screening test should be 100% sensitive and 100% specific. In practice, this seldom occurs.

Predictive Value of Test Result

For interpreting the test result (done on an individual), the predictive value of positive test and predictive value of negative test are useful.

Predictive Value of Positive Test

Predictive value of positive test is the probability that a person actually has the disease given that he or she tests positive. It is the probability that the disease is present when the test result is positive. It is calculated as the number of true positive results divided by true positive results and false positive results. For the same test (for a given sensitivity, and specificity) the predictive value of positive test will be higher when the test is done in a population where the disease prevalence is higher compared to when the test is done in a population where the disease prevalence is lower.

Predictive Value of Negative Test

Predictive value of negative test is the probability that an individual is truly disease-free given that he or she tests negative. It is the probability that the disease is not present when the test result is negative. It is calculated as the number of true negative results divided by the true negative results and false negative results.

The above test characteristics answer the following questions:

1. If the disease is present, what is the probability that the test result will be positive? (Sensitivity)
2. If the disease is absent, what is the probability that the test result will be negative? (Specificity)

3. If the test result is positive, what is the probability that the disease is present? (Predictive value of positive test)
4. If the test result is negative, what is the probability that the disease is not present? (Predictive value of negative test).

Uses of Screening

a. ***Case detection*:** It is the identification of unrecognised disease, which does not arise from a patient's request, e.g. diabetes mellitus, iron deficiency anaemia.

b. ***Control of disease*:** People are examined for the benefit of others, e.g. screening of immigrants from infectious diseases such as tuberculosis and syphilis to protect the home population.

c. ***Research purposes*:** Screening may sometimes be performed for research purposes. For example, there are many chronic diseases whose natural history is not fully known (e.g. cancer, hypertension). Screening may aid in obtaining more basic knowledge about the natural history of such diseases, provides a prevalence estimate and subsequent screening, an incidence figure.

d. ***Educational opportunities*:** Screening provides opportunities for creating public awareness and for educating health professionals.

INFECTION

Definition

The entry and development or multiplication of an infectious agent in the body of man or animals.[2]

Dynamics of Disease Transmission

Communicable diseases are transmitted from the reservoir or source of infection to susceptible host. Basically, there are three links in the chain of transmission, viz. the reservoir, modes of transmission and the susceptible host.

Sources and Reservoir

The starting point for the occurrence of a communicable disease is the existence of a reservoir source of infection.

Source of infection is defined as “the person, animal, object or substance from which an infectious agent passes or is disseminated to the host.”

A reservoir is defined as “any person, animal, arthropod, plant or substance or (combination of these) in which an infectious agent lives and multiplies, on which it depends primarily for survival, and where it reproduces itself in such manner that it can be transmitted to a susceptible host.”[2]

The reservoir may be of three types:

1. Human reservoir
2. Animal reservoir
3. Reservoir in non-living things

1. Human Reservoir

By far the most important source or reservoir of infection for humans is man himself. He may be a case or carrier. Man is often described as his own enemy because most of the communicable diseases, which man contracts, are from human sources.

a. ***Cases*****:** A case is defined as “a person in the population or study group identified as having the particular disease, health disorder or condition under investigation.”[1]

b. ***Carriers*****:** A carrier is defined as “an infected person or animal that harbours a specific infectious agent in the absence of discernible clinical disease and serves as a potential source of infection for others.”

The elements in a carrier state are:

a. The presence in the body of the disease agent.

b. The absence of recognizable symptoms and signs of disease.

c. The shedding of the disease agent in the discharges or excretions, thus acting as a source of infection for other persons.

2. Animal Reservoir

The source of infection may sometimes be animals and birds. The diseases and infections which are transmissible to man from vertebrates are called zoonoses. These are over 100 zoonotic diseases which may be conveyed to man from animals and birds. The best known examples are rabies, yellow fever and influenza.

3. Reservoir in Non-living Things

Soil and inanimate matter can also act as reservoirs of infection. For example, soil may harbour agents that cause tetanus, anthrax, coccidioidomycosis and mycetoma.

Modes of Transmission

Communicable diseases may be transmitted from the reservoir or source of infection to a susceptible individual in many different ways, depending upon the infectious agent, portal of entry and the local ecological conditions.

The mode of transmission of infectious diseases may be classified as below:

A. Direct transmission
   1. Direct contact
   2. Droplet infection
   3. Contact with soil
   4. Inoculation into skin or mucosa
   5. Transplacental (vertical)

B. Indirect transmission
   1. Vehicle-borne
   2. Vector-borne
      a. Mechanical
      b. Biological
   3. Air-borne
      a. Droplet nuclei
      b. Dust
   4. Fomite-borne
   5. Unclean hands and fingers

A. Direct Transmission

1. ***Direct contact*:** Infection may be transmitted by direct contact from skin-to-skin, mucosa-to-mucosa, or mucosa to skin of the same, or another person. This implies direct and essentially immediate transfer of infectious agents from the reservoir or source to a susceptible individual.

Diseases transmitted by direct contact includes STD and AIDS,

leprosy, leptospirosis, skin and eye infections.

2. ***Droplet infection*:** This is direct projection of a spray of droplets of saliva and nasopharyngeal secretions during coughing, sneezing, or speaking and spitting, talking into the surrounding atmosphere.

   In infectious diseases, these droplets, which may contain millions of bacteria and viruses can be a source of infection to others. When a healthy susceptible person comes within the range of these infected droplets he is likely to inhale some of them and acquire infection.[1]

   Diseases transmitted by droplet spread include many respiratory infections, eruptive fevers, many infections of the nervous system, common cold, diphtheria, whooping cough, tuberculosis, meningococcal meningitis, etc.

3. ***Contact with soil*:** The disease agent may be acquired by direct exposure of susceptible tissue to the disease agent in soil, compost or decaying vegetable matter in which it normally leads a saprophytic existence, e.g. hookworm larvae, tetanus, mycosis, etc.

4. ***Inoculation into skin or mucosa*:** The disease agent may be inoculated directly into the skin or mucosa, e.g. rabies virus by dog bite, hepatitis B virus through contaminated needles and syringes, etc.

5. ***Transplacental or vertical transmission*:** Disease agents can be transmitted transplacentally. This is another form of direct transmission. Examples include the so-called TORCH agents *(Toxoplasma gondii* rubella virus, ctyomegalovirus and herpes virus).

B. Indirect Transmission

This embraces a variety of mechanisms including the traditional 5 Fs—"flies, fingers, fomites, food and fluid". An essential requirement for indirect transmission is that the infectious agent must be capable of surviving outside the human host in the external environment and retainits basic properties of pathogenesis and virulence till it finds a new host.

1. ***Vehicle-borne*:** Vehicle-borne transmission implies transmission of the infectious agent through the agency of water, food (including raw vegetables, fruits, milk and milk products), ice, blood, serum, plasma or other biological products such as tissues and organs. Of these, water

and food are the most frequent vehicles of transmission, because every one uses them. The infectious agent may have multiplied or developed in the vehicle. Diseases transmitted by water and food include chiefly infections of the alimentary tract, e.g. acute diarrhoea, typhoid fever, cholera.[2]

2. ***Vector-borne*:** In infectious disease epidemiology, vector is defined as an arthropod or any living carrier (e.g. snail) that transports an infectious agent to a susceptible individual. Transmission by a vector may be mechanical or biological. In the latter case, the disease agent passes through a developmental cycle or multiplication in the vector.

3. ***Air-borne*:**

   a. *Droplet nuclei*: "Droplet nuclei" are a type of particles implicated in the spread of air-borne infection. They are tiny particles that represent the dried residue of droplets. The droplet nuclei may remain air-borne for long periods of time, some retaining and others losing infectivity or virulence. Diseases spread by droplet nuclei include tuberculosis, influenza, chickenpox, measles.

   b. *Dust*: Some of the larger droplets which are expelled during talking, coughing or sneezing, settle down by their sheer weight on the floor, carpets, furniture, clothes, bedding, linen and other objects in the immediate environment and become part of the dust. A variety of infectious agents (e.g. streptococci, other pathogenic bacteria, viruses and fungal spores) and skin squamae have been found in the dust of hospital wards and living rooms. Dust particles may also be blown from the soil by wind; this may include fungal spores.

4. ***Fomite-borne*:** Fomites are inanimate articles or substances other than water or food contaminated by the infectious discharges from a patient and capable of harbouring and transferring the infectious agent to a healthy person. Fomites include soiled clothes, towels, linen, handkerchiefs, cups. The fomites play an important role in indirect infection. Diseases transmitted by fomites include diphtheria, typhoid fever, bacillary dysentery, hepatitis A, eye and skin infections.

5. ***Unclean hands and fingers*:** Hands are the most common medium by

which pathogenic agents are transferred to food from the skin, nose, bowel, etc. as well as from other foods. The transmission takes place both directly (hand-to-mouth) and indirectly.

SUSCEPTIBLE HOST

Four stages have been described in successful parasitism:

a. First, the infectious agent must find a portal of entry by which it may enter the host. There are many portals of entry, e.g. respiratory tract, alimentary tract, genitourinary tract, skin, etc. Some organisms may have more than one portal of entry, e.g. hepatitis B, Q fever, brucellosis.

b. On gaining entry into the host, the organisms must reach the appropriate tissue or "Site of election" in the body of the host where it may find optimum conditions for its multiplication and survival.

c. Thirdly, the disease agent must find a way out of the body (Portal of exit) in order that it may reach a new host and propagate its species. If there is no portal of exit, the infection becomes a dead-end infection as in rabies, bubonic plague, tetanus and trichinosis.

d. After leaving the human body, the organism must survive in the external environment for sufficient period till a new host is found. In addition, a successful disease agent should not cause the death of the host but produce only a low-grade immunity so that the host is vulnerable again and again to the same infection. The best example is common cold virus.

Stages of an Infectious Disease

All infectious diseases pass through five stages.

1. Incubation Period

An infection becomes apparent only after a certain incubation period, which is defined as “the time interval between invasion by an infectious agent and appearance of the first sign or symptom of the disease in question.” During the incubation period, the infectious agent undergoes multiplication in the host. When a sufficient density of the disease agent is built up in the host, the health equilibrium is disturbed and the disease become overt.

Non-infectious diseases, such as cancer, heart disease and mental illness, also have incubation periods, which may be months or years. The term latent period is used in noninfectious diseases as the equivalent of incubation period in infectious diseases. Latent period has been defined as “the period from disease initiation to disease detection”.

2. The Onset or Prodromal Stage

This commences when the first symptoms appear and continue until the condition is well developed.

3. The Period of Advance or Fastigium

All the symptoms are now increasing in severity until a climax is reached.

4. Period of Defervescence

All the symptoms are now decreasing in severity.

5. Period of Convalescence

The patient has overcome completely the invaders and toxins.

Specific Defenses

Specific defenses come into play, once microorganisms have breached local defense mechanisms. By virtue of these defenses, the host is able to recognize, destroy and eliminate antigenic material (e.g. bacteria, viruses, proteins, etc.) foreign to his own. A person is said to be immune when he possesses "specific protective antibodies or cellular immunity as a result of previous infection or immunization, or is so conditioned by such previous experience as to respond adequately to prevent infection and/or clinical illness following exposure to a specific infectious agent."[2]

The specific defenses may be discussed for convenience under the following heads:

1. Active immunity
    a. Humoral immunity
    b. Cellular immunity
    c. Combination of the above
2. Passive immunity
    a. Normal human Ig
    b. Specific human Ig
    c. Animal antitoxins or antisera

1. Active Immunity

It is the immunity which an individual develops as a result of infection or by specific immunization and is usually associated with presence of antibodies or cells having a specific action on the microorganism concerned with a particular infectious disease or on its toxic.

Active immunity may be acquired in 3 ways:

i. Following clinical infection (e.g. chicken-pox, rubella and measles)
ii. Following subclinical or in apparent infection (e.g. polio and diphtheria)
iii. Following immunization with an antigen which may be a killed vaccine, a live-attenuated vaccine or toxoid.

a. ***Humoral immunity*:** Humoral immunity comes from the B cells (bone marrow derived lymphocytes) which proliferate and manufacture specific antibodies after antigen presentation by macrophages. The antibodies are localized in the immunoglobulin fraction of the serum.

These antibodies circulate in the body and act directly by neutralizing the microbe, or its toxin or rendering the microbe susceptible to attack by the polymorphonuclear leucocyte and the monocytes. The complement system, together with antibodies is necessary for efficient phagocytosis of bacteria.

b. ***Cellular immunity*:** It is now well-recognized that cellular immunity plays a fundamental role in resistance to infection. It is mediated by the T cells which differentiate into subpopulations able to help B lymphocytes. The T cells do not secrete antibody, but are responsible for recognition of antigen. On contact with antigen, the T cells initiate a chain of responses. For example, activation of macrophages, release of cytotoxic factors, mononuclear inflammatory reactions, delayed hypersensitivity reactions, secretion of immunological mediators (e.g. immuno interferon), etc. There is growing evidence that cellular immunity is responsible for immunity against many diseases including tuberculosis, brucellosis and also for the body's rejection of foreign material, such as skin grafts. The importance of cell-mediated immunity can be appreciated from the fact that a child born with a defect in humoral antibody production may survive for as long as 6 years without replacement therapy, but a severe defect in cell-mediated immunity will result in death within the first 6 months of life.

c. ***Combination of the above*:** In addition to the B and T lymphoid cells which are responsible for recognizing self and nonself, very often, they co-operate with one another and with certain accessory cells such as macrophages and human K (killer) cells, and their joint functions constitute the complex events of immunity.

Active immunity takes time to develop. It is superior to passive immunity because:

i. The duration of protection, like that of the natural infection is frequently long-lasting.

ii. With few exceptions, severe reactions are rare.

iii. The protective efficacy of active immunization exceeds that of passive immunization, and in some instances, approaches 100%.

iv. Active immunization is less expensive than passive immunization. Vaccines are cheaper to produce than are antisera.

2. Passive Immunity

When antibodies produce in one body (human or animal) are transferred to another to induce protection against disease, it is known as passive immunity. In other words, the body does not produce its own antibodies but depends upon ready-made antibodies. Passive immunity may be induced:

a. By administration of an antibody-containing preparation (immunoglobulin or antiserum)

b. By transfer of maternal antibodies across the placenta. Human milk also contains protective antibodies (IgA)

c. By transfer of lymphocytes, to induce passive cellular immunity—this procedure is still experimental.

Immunoglobulins

a. Normal human Ig

Normal human Ig is an antibody-rich fraction (Cohn fraction II). Obtained from a pool of at least 1000 donors. The WHO has laid down definite standards for its preparation. For example, the preparation should contain at least 90 percent intact IgG; it should be as free as possible from IgG aggregates; all IgG subclasses should be present; there should be a low IgA concentration; the level of antibody against at least two bacterial species and two viruses should be ascertained.

Normal human Ig is used to prevent measles in highly susceptible individuals and to provide temporary protection (up to 12 weeks) against hepatitis A infection for travelers to endemic areas and to control institutional and household outbreaks of hepatitis A infection.

b. Specific human Ig

The specific (hyper immune) human Ig should contain at least 5 times the antibody potential of the standard preparation per unit volume. These preparations are made from the plasma of patients who have recently recovered from an infection or are obtained from individuals who have been immunized against a specific infection. They therefore have a high antibody content against an individual infection and provide immediate protection, e.g. specific human Igs are used for chickenpox prophylaxis of highly susceptible individuals and for postexposure prophylaxis of hepatitis B, and rabies and for tetanus prophylaxis in the wounded.

Antisera or Antitoxins

The term antiserum is applied to materials prepared in animals. Originally passive immunization was achieved by the administration of antisera or antitoxins prepared from non-human sources such as horses. Since human immunoglobulin preparations exist only for a small number of diseases, antitoxins prepared from non-human sources (against tetanus, diphtheria, botulism, gas gangrene and snake bite) are still the mainstay of passive immunization. Administration of antisera may occasionally give rise to serum sickness and anaphylactic shock due to abnormal sensitivity of the recipient.

***Passive immunity differs from active immunity in the following respects*:**

a. Immunity is rapidly established.

b. Immunity produced is only temporary (days to months) till the antibody is eliminated from the body.

c. There is no education of the reticuloendothelial system.

Passive immunization is useful for individual who cannot form antibodies or for the normal host who takes time to develop antibodies following active immunization.

Conclusion

Health, disease, infection and their concepts have evolved over the years after a series of trials and errors. There is bound to be changes in the future and we will each have an opportunity to reject the existing and take advantage of new knowledge of newer diseases, their diagnosis, prevention and treatment. Whatever the new technological developments one saying is sure to stay "*Health is Wealth*".

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CHAPTER

2

The Practice of Public Health

People's health in India needs substantial improvement. The situation is similar across the developing world, Bangladesh, Pakistan or beyond such as Indonesia, Thailand, Kenya, Brazil, etc. all have regrettably poor public health.[1] In India, little attention is paid to public health issues such as availability of clean drinking water, the sewerage system.[1] There is an urgent need to improve public health in India even though the task is overwhelming and undeniably complex.

Public health deals with 'protecting and improving the health of communities'. Broadly speaking, it includes actions, such as preventing the outbreak of infections, e.g. cholera or the spread of communicable diseases like HIV or preventing injuries due to road traffic accidents, falls and/or violence. It also includes promoting healthy lifestyle such as educating the public about (a) the importance of exercise or (b) the harmful effect of smoking or (c) harmful effect of secondhand smoking or (d) the importance of oral hygiene.[2–6]

Governments use public health initiatives or programmes to achieve their goals. These programmes or initiatives include—detecting and controlling outbreak of infectious diseases, proper town planning, providing clean drinking water, sewerage systems, garbage collection systems, provision of a road and traffic system that prevents road traffic accidents, provision of clean air and water, etc.[3–6] Some examples of national health programmes in India include the Integrated Child Development Scheme (ICDS), National Malaria Control Programme, National Cancer Control Programme, etc.[15–19]

Definition

Public

Knutson defined *PUBLIC* as ‘of or pertaining to the people of a community, state, or nation.’[2]

Public Health

Given the difficulty in defining public health, the definition proposed by Charles Edward Amory Winslow in 1920 is still the most widely accepted.[3–5]

Winslow (1920) defined public health as **“The science and art of preventing disease, prolonging life and promoting physical and mental efficiency through organized community efforts for the sanitation of the environment, the control of communicable infections, the education of the individuals 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 ensure 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.”**[3–5]

The focus of public health has expanded over time. Since its conception when the focus was asepsis to sanitary engineering, to preventative physical and mental health. Health promotion along with comprehensive health services and behavioural interventions are important tools of community medicine.

HISTORY OF MEDICINE AND PUBLIC HEALTH IN EUROPE AND AMERICA

Ancient Greek physician Hippocrates spoke of the relationship of one's environment, i.e. water, nutrition, climate and lifestyle and one's health. He was able to distinguish between disease that happened at an 'expected rate', i.e. endemic and diseases that occurred at a 'higher than expected rate', i.e. epidemic in a population.[3] Archaeological excavations of the Roman civilization show water and sanitation systems and point towards their awareness of public health.

The European middle ages (500–1400) were marked by high mortality rates due to widespread diseases, including bubonic plagues. Poor living conditions, overcrowded cities contributed to many of the diseases witnessed at this time.[3,4] Towards the end of the middle ages, many European cities passed laws to improve the living conditions of their citizens. Some of the public health practices from the middle ages survive even today. For example, *quarantine*, a practice that involves isolating people those with illness from those who are healthy. The word *quarantine* comes from the Italian word '*quarantenaria*' which means forty days.[3]

The middle ages were followed by the Renaissance period. Giolamo Fracastoro (1478–1533) proposed that infection is caused by agents that are not visible to the naked eye. However, his proposition was not accepted until Anton von Leeuwenhock (1632–1723) demonstrated the presence of these microscopic organisms. Even then it would be another 200 years before the 'Germ Theory' was accepted in the late nineteenth century. The Renaissance period was marked by revolutions in every sphere political, industrial, religious, scientific, medical and public health. Some public health experts think that the French revolution which called for equality for all, also brought a social understanding of health. It had an effect across Europe. The English made enquiries into the higher death rate among certain professions such as miners or vulnerable groups such as infants. These were small steps in some areas of public health. Other areas of health were still neglected. For example, mental illness was stigmatized and people with mental illness were commonly institutionalized.[3–5]

The industrial revolution (1700–1900) which followed was marked by mass migration from rural areas to the cities. This mass migration led to overcrowding and contributed to an increase in diseases. Cities were unplanned and had few amenities. There were few toilets, poor sewerage and garbage removal systems. This further added to the health woes of the people and epidemics were common. It was during one of these outbreaks that John Snow (1813–1858) a British physician conducted his investigation. He mapped the cholera cases in London and showed that the cluster of cholera cases was related to the poor quality of water.[3–5] John Snow used statistics to show that the ‘mortality rate among those drinking water from lower (river) Thames was 8.5 times greater than those drinking from upper Thames’. Thus showing that contaminated water was responsible for the cholera outbreak.

The increasing incidence of diseases and poor environmental conditions led to the Public Health Act of 1848 in England. The actions that followed were brought about by collective social responsibility and marked the beginning of a government taking the responsibility of safeguarding the health of its citizens. It is commonly referred to as the “Great Sanitary Awakening” which took place in England in the mid-19th century. This had a tremendous impact in modifying the behaviour of people and ushering an era of public health. A new thinking began to take shape, i.e. the state has a direct responsibility for the health of the people. The Public Health Act of 1848 was thus a fulfillment of a dream.[3–5] By the beginning of the 20th century, the broad foundations of public health—clean water, clean surroundings, wholesome condition of houses, control of offensive trades, etc., were laid in England, America and the European nations.[16–18]

Since its independence, India has taken rather slow steps in achieving its public health goals. Health indicators of infant, 5-year and maternal mortality rates show a small improvement. These improvements reflect some of these achievements. However, India has a long way to go and many issues to resolve before the Indian citizens can enjoy the same level of public health services as the developed world.

WORLD HEALTH ORGANIZATION (WHO) AND PUBLIC HEALTH MILESTONES

World Health Organization (WHO) has declared a number of public health milestones and can be easily accessed via their website. However, the key milestones that would interest a professional or student of Community Dentistry are listed below.[20]

1945:	The United Nations Conference in San Francisco unanimously approves the establishment of a new, autonomous international health organization.
1947:	The World Health Organization Constitution launched on 7th April.
1950:	The World Health Assembly establishes World Health Day on 7th April annually.
2003:	The World Health Assembly adopts the Framework Convention on Tobacco Control.

Given the burden of oral cancer in India, this treatise deserves a special mention.

HISTORY OF MEDICINE AND PUBLIC HEALTH IN INDIA

From time immemorial man has been trying to control disease and live a healthy life. India being an ancient civilization has witnessed many invasions and with it came different systems of medicine. India's alternative medicine comprise of six systems, namely Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy. Popularly known as AYUSH, these systems were in use at the time Western medicine arrived in India.[6–11]

Ayurveda, Siddha, Yoga and Naturo-pathy—the indigenous systems have been in existence for centuries. Experts date the existence of Ayurveda, Siddha, Naturopathy and Yoga back to 3000 to 1400 BC. There is further historical evidence indicating that Ayurveda was taught formally at the ancient Universities of Taxila and Nalanda between 600 BC and 600 AD.[6–11]

The Unani system of medicine originated in Greece and was further developed by the Arabs before it being introduced to India in 1350 (by the Arabs). The Unani system has flourished since then and is still being used.

Homeopathy was developed by Samuel Hahnemann in Germany 200 years ago and arrived in India in early 19th century. It flourished in Bengal before spreading to the rest of India. It is based on the two theories 'like cures like' and 'law of minimum dose'.

These complimentary forms of medicine are supported by the National Rural Health Mission (NRHM), which was introduced in 2005 in India.[7–9] AYUSH is mainly practiced in India and the neighbouring countries. A survey found out that approximately 30% of the Indian population used AYUSH.[7] However, recent years have seen increasing popularity of some of these systems such as Yoga and Ayurveda world-wide.[9–11]

The role of AYUSH in promoting and maintaining public health over the past centuries is unclear and needs further investigation. There is archaeological evidence indicating that ancient Indians were aware of environmental sanitation. The Indus Valley civilization has been dated to 4500 to 3000 BC. At the excavation sites of Mohenjodaro and Harappa (cities now in Pakistan), show relics of planned cities with drainage, houses and

public baths built of baked bricks.[12] These ancient excavations provide the earliest evidence about the awareness of environmental sanitation in India.

Besides AYUSH, there were other unorganized forms of relief provided by the medicine man, the priest, the herborist, folk medicine and the magician. With changes in the political conditions in India, the torch, which was lighted thousands of years ago by the ancient sages grew dim, medical education and medical services became static and the ancient universities and hospitals disappeared.

India’s Public Health Milestones since Mid–1800s

1859:	Commission of Public Health established.
1880:	The Vaccination Act was passed.
1909:	The Central Malaria Bureau was founded at Kasauli, Himachal Pradesh.
1930:	The All India Institute of Hygiene and Public Health was established in Calcutta.
1943:	The Health Survey and Development Committee was formed with Sir Joseph Bhore appointed as Chairperson of the Committee. It came to be known as the Bhore Committee. It laid emphasis on integration on curative and preventative medicine at all levels.[14]
1947:	The central and state ministries of health were established in independent India.
1948:	India became a member of World Health Organization (WHO).
1951:	The 1st five-year plan began.
1953:	The National Malaria Control Programme was commenced.
1955:	The National Filaria Control Programme and the National Leprosy Control programme were commenced.
1959:	The Mudaliar Committee was appointed to survey progress in the field of health.
1962:	Central Family Planning Institute was established in Delhi.
1977:	Eradication of smallpox was declared.
1981:	India adopted the Global strategy for Health for All.
1983:	National Leprosy Eradication Programme launched.
1989:	The Blood Safety Programme was launched.
1992:	Child Survival and Safe Motherhood Programme was launched.
1995:	ICDS renamed as Integrated Mother and Child Development Services.
1996:	Pulse Polio Immunization programme was introduced.
2000:	National Population Policy was announced.
2005:	National Rural Health Mission was announced.
2014:	National Health Portal launched by the Centre for Health

Informatics, National Institute of Health and Family Welfare (NHIFW). *http://www.nhp.gov.in*

It provides a single point access for information about health and related services in languages, namely English, Hindi, Bangla, Gujarati and Tamil. It provides information for public, the healthcare professionals, students and researchers. It also provides health-related tips, helpline numbers, blood bank details, health apps and information about insurance schemes and first aid.[13]

CHANGING CONCEPTS IN PUBLIC HEALTH

In the history of public health, four distinct phases may be demarcated.[16–19]

a. Disease Control Phase (1880–1920)

Public health during the 19th century was largely a matter of sanitary legislation and reforms aimed at the control of the physical environment. These measures included providing clean drinking water, proper sewerage and drainage systems and greatly improved the health of the people.

b. Health Promotional Phase (1920–1960)

The concept of health promotion began to take shape at the beginning of 20th century. The World Health Organization (WHO) describes health promotion as “the process of enabling people to increase control over, and to improve, their health. It moves beyond the focus on individual behaviour towards a wide range of social and environmental interventions”.

c. Social Engineering Phase

Public health entered a new phase in the 1960s described as the social engineering phase. A new concept '*risk factors*' came into existence as chronic diseases such as cancer, diabetes or behavioural problems such as alcoholism, addiction, overweight and obesity could not be explained by the germ theory. With this new concept, public health moved into preventive and rehabilitative phase.

d. Health for All Phase (1981–2000 AD)

In 1981, the WHO members pledged themselves to an ambitious target to provide Health for All by the year 2000, that is “attainment of a level of health that will permit all peoples, to lead a socially and economically productive life”.[3–5,16]

‘Health for All’ is a holistic concept. It implies the removal of obstacles to attaining health, including elimination of malnutrition, ignorance, etc. and the supply of clean water, air and proper sewerage system, etc. It symbolizes the determination of the countries of the world to provide an acceptable level of health to all people.[3–5,16]

PUBLIC HEALTH DISCIPLINES

Public health is multidisciplinary. It includes the disciplines of epidemiology, biostatistics, sociology, public health law and regulation, health economics, anthropology, health behaviour and education, public health engineering, public health research, etc.

Epidemiology

Epidemiology is the study of the causes, distribution and control of disease in population. The World Health Organization defines epidemiology as “the study of the distribution and determinants of health-related states and events (including diseases), and the application of this study to the control of diseases and other health problems”.[20]

Epidemiological methods include surveillance to understand the burden of a disease in a population, descriptive studies and analytical studies. It measures health, diseases (both acute and chronic) and assessing risk, exposure and interpreting data.[3–6]

Measuring Health

Measuring health of a population is not a simple task. How does one measure health of a population? Is the absence of any disease sufficient to label the population as healthy? If one were to take such a view, then how would one address the issues such as child neglect or abuse, overweight and obesity. Given the difficulties of measuring health, many countries still use mortality, morbidity or life expectancy rates as a measure of health.

Assessing Risk, Exposure and Interpreting Data

A public health risk assessment involves determining to what extent the given population has been or are being exposed to a ‘hazard’ and whether the exposure to this hazard is harmful. It involves assessing the likelihood of a harmful effect following exposure.

The public health risk assessment would involve determining whether and to what extent people have been or are being exposed to certain air pollutants, whether the exposure at the current level is harmful. The assessment involves defining the risk and protective factors. For example, suicide risk assessment among adolescents and young adults.[3–6]

Biostatistics

Biostatistics is an important aspect of epidemiology. It supports the population research by: (1) collecting and organizing data, e.g. distribution of

cases and controls, rates and proportions (2) analyzing data, e.g. regression, survival analysis.

Public Health Education

Public health education is an important aspect of public health as it promotes healthy behaviours and healthy lifestyles and in turn reduces diseases and injuries. For example, statutory statements about the health effects of smoking on cigarettes packets such as smoking causes cancer or smoking increases the risk of cancer.

Public Health Law

Public health law is a key component of public health. It assists the government in protecting and promoting the health of its citizens. It helps to formulate health policies, laws and regulations.[3–6] Examples of public health laws and regulations of India include:

1. Prevention of Food Adulteration Act
2. Prenatal Diagnostic Techniques Act and Rules
3. Consumer Protection Act and Medical Profession

A typical public health department would include a large number of specialists. A typical team could include maternal and child specialists, dental and other medical specialists, epidemiologists, biostatisticians, data analysists, engineers, town planners, local health workers, a disaster management team, laboratory personnel, radiation safety personnel, health economists, sociologists, law enforcement officers (e.g. drug-/alcohol-related issues), behavioural and environmental scientists, officers dealing with public affairs and other administration officers.[3–6]

The examples below are over simplified with the aim to an impression of the issues involved.

Example 1. As a public health officer of your town or city, you are concerned about the sudden increase of cases within your jurisdiction. You may ask the epidemiologist to find out ‘why’ because understanding the cause is important to formulate a plan.

Example 2. As a public health officer of your town or city, you are concerned that a local construction may have damaged a drinking water supply pipe. You would then formulate a plan. The plan could include: (1) Asking the engineer to find out, if the supply pipe has been damaged, (2) Getting the laboratory team to check the quality of water, (3) Alerting the medical team, (4) Informing other officers such as the public affairs in case a warning has to be issued to the public about a possible outbreak and how to deal with it.

It is important to know difference between public health and epidemiology. Epidemiology is but a tool of public health. It provides a better understanding of health, diseases, injuries and health outcomes by mapping

distribution and its determinants. Epidemiology, broadly speaking, measures health or the burden of disease and/injury in a population.

Understanding the Term Population

The term population in public health can vary depending upon what each particular public health programme aims to achieve.

For example, 'health programme for school children' can be for:

1. A particular school—in which case the term 'population' includes all the children currently attending that particular school.
2. A district—in which case the term 'population' includes all the currently attending a school—public or private in that particular district.
3. A country—in which case the term 'population' includes all the currently attending school—public or private in the country.

So the term population can be referring to a community or local area (e.g. Karol Bagh in New Delhi). It can refer to larger regions such as district, towns, cities or the entire country. WHO often refers to much larger geographical regions that include a number of countries, e.g. South-East Asia or Asia-Pacific.

CHARACTERISTICS OF PUBLIC HEALTH METHOD

i. ***Group responsibility*:** Public health work must be done in areas where group responsibility is recognized. For this reason, contagious diseases received some of the earliest attention, since it was obviously a group responsibility that a man be made safe from his neighbour. This concept led first to quarantine and isolation procedures, later to the mass preventive measures.

ii. ***Team work*:** This is done partly for the necessity of efficient handling of large groups of people and partly to the fact that many processes, which are involved in prevention lent themselves particularly well to team work.

iii. ***Prevention*:** Prevention is in itself a major objective in public health programmes. The three reasons being:

1. Prevention of disease is an even greater good in life than the cure of disease.
2. Advantage of team work.
3. Cost efficiency.

iv. ***Multifactorial*:** Public health methods have ability to deal with all sorts of problems involving the host population and the environment. The disease is recognized for what it really is a multifactorial problem. Epidemiologist will look for host factors and environmental factors and try to control them.

v. ***Medical indigence*:** As an aid to the medically indigent, the concept has arisen that health care is a right of citizenship and hence to be provided by government to the extent available.

vi. ***Biostatistics*:** Public health methods are dependent on biostatistics. Problems in a community require accurate measurement of rates and lead us to the question whether differences are real. Mathematical measurement of probability becomes necessary.

vii. ***Computer science*:** Computer science has vastly increased the ease of data analysis, even with small samples.

viii. ***Apparently healthy population*:** Public health work deals with apparently healthy population, which brings in a cheerful and hopeful atmosphere to the work. But the worker must go looking for minimal disease instead of waiting for frank disease to come to him.

ix. ***Education*:** Education of the public becomes a prime objective of public health work. Educating the public helps in active participation of the community in the public programmes conducted.

x. ***Logistics*:** Logistics requires attention here, with attention to the location of and transportation of health care facilities. Care should be brought as close as possible to where the people are normally concentrated.

xi. ***Insurance*:** Budgeting of payment in regular installments provides an aid, which closely resembles insurance to meet the technically demanding and expensive dental treatment.[1]

CHARACTERISTIC OF PUBLIC HEALTH TECHNIQUES

A number of techniques are characteristic of the public health method. The important ones are the:

- Use of the health centre
- Case finding
- Use of community health council

1. ***Use of health centre*:** Health centres are community buildings to house health administration and a number of outpatient or preventive services not easily housed in a hospital. It is usually located in the central part of a community. A small auditorium for public health meeting is a valuable addition. One health centre might be expected to serve a community of some 50,000 to 1,00,000 people. Health units may be present in certain public schools. A variant of the health unit is the school-based dental clinic seen occasionally in the US and Canada and predominantly in New Zealand and Australia.
2. ***Case finding*:** It is otherwise known as "Screening." It is important to search apparently healthy populations for cases of early disease. The object is to cover as large a population as possible with as simple a test as it will yield helpful results. Case finding procedures in dentistry are at times a matter of controversy. There are some public health officials who feel that because dental disease is almost universal all school children should be routinely referred to sources of dental treatment.
3. ***Community health council*:** It consists of members representing key people in the community from both voluntary and government agencies and the community at large. An essential feature of good public health practice is a broad desire on the path of people in all walks of life to see the health programmes as a good one to understand it. This can be attained by a community health council. These councils are often associated with
    - Community fund raising efforts
    - Provide a forum for the exchange of information between

various health agencies and the public for the development of new ideas.

- These councils not only serve as media for communication but also have approval or disapproval power over both new and existing institutional health services in their areas.[5]

Conclusion

Public health deals with the health of a population. Simply put, it refers to the health of every person. It aims to improve the health by preventing diseases and injuries and promoting healthy lifestyle. It is based on the philosophy of social justice and relies on the principles of prevention and health promotion to achieve its goal of ‘health for all’.

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CHAPTER

3

Environment and Health

Man is living in a dangerous and highly complicated environment, and he is becoming more ingenious. If these trends continue it is feared that the very "quality of life" we cherish may soon be in danger.

The purpose of environmental health is to create and maintain ecological conditions that will promote health and thereby prevent disease. Major factors contributing to ill health in India are unsafe drinking water, unhygienic disposal of solid wastes and human excreta, poor housing, sanitation, air and noise pollution.

The foremost step in any health programme would be to eliminate, through environmental control, those factors which are hazardous to health.

WATER

Water quality is as important as water quantity. Much of the ill health is largely due to lack of safe drinking water. There can be no state of positive community health and wellbeing without safe water supply.[2]

Safe and Wholesome Water

Water intended for human consumption should not only be ‘safe’ but also ‘wholesome’. A safe water is one that cannot harm the consumer, even when ingested over prolonged periods.

Safe, potable or wholesome water is defined as:

1. Free from pathogenic agents
2. Free from harmful chemical substances
3. Pleasant to taste
4. Usable for domestic purposes.

Sources of Water

Water sources conform to two criteria:

1. The quality of water must be acceptable.
2. The quantity must be sufficient to meet the present and future requirements.

There are three main sources of water:

1. Rain
2. Surface water
    a. Impounding reservoirs
    b. Rivers and streams
    c. Tanks, ponds and lakes
3. Ground water
    a. Shallow wells
    b. Deep wells
    c. Springs

1. Rain

Rain is the prime source of water. A part of rainwater sinks into the ground to form groundwater. A part of it evaporates back into the atmosphere, and some runs off to form streams and rivers which flow ultimately into the sea. Some of the water in the soil is taken up by the plants and evaporated in turn by the leaves. This event is water cycle.

Characteristics

- Rainwater is the purest water.
- Physically, it is clear, bright and sparkling.
- Chemically, it is very soft water.
- Bacteriologically, it is free from pathogenic agents.

Impurities

Rainwater tends to become impure by picking up the suspended impurities from the atmosphere such as dust, microorganisms, and gases.

2. Surface Water

Surface water originates from rainwater.

a. ***Impounding reservoirs*:** These are artificial lakes constructed usually of earthwork or, masonry in which large quantities of surface water are stored. Dams provide large reservoirs of surface water.

Characteristics:

- It is fairly good quality of water.
- Usually clear, palatable and ranks next to the rainwater in purity.
- Usually soft.
- Free of pathogenic organisms.
- Impurities
- Impurities are from human habitations and animal keeping or grazing.

b. ***River*:** Many rivers furnish a dependable supply of water.

Characteristics

- It is turbid during rainy season
- Clear during other season
- Contains dissolved and suspended impurities of all kinds
- Bacterial count may be very high.

***Impurities*:** Impurities are derived from surface washings, sewage and sullage water, industrial wastes, and drainage from agriculture areas.

c. ***Tanks*:** Tanks are large excavations in which surface water is stored. They are important sources of water in some villages. Tanks are often used for washing of cloths, cattle, humans, and cooking pots.

3. Groundwater

Groundwater is the cheapest and most practical means of providing water to the communities. It is superior to surface water, because the ground itself

provides an effective filtering medium.

Advantages

- It is likely to be free from pathogenic agents.
- It requires no treatment.

Disadvantages

- It is high in mineral content (e.g. salts of calcium and magnesium).
- It renders water hard.
- It requires pumping.

a. ***Shallow wells*****:** Tap the water from above the first impervious layer in the ground. Often grossly contaminated.

b. ***Deep wells*****:** Tap the water from below the first impervious layer in the ground and it is pure.

c. ***Springs*****:** A spring is groundwater, which finds its way to the surface because of certain topographical characteristics of the land. Four types of springs are shallow, deep, mineral and thermal springs.

Purification of Water

Purification of water is of great importance in community. It is considered under two headings:

1. Purification of water on a large scale.
2. Purification of water on a small scale.

Purification of Water on a Large Scale

1. Storage

Water is drawn out from the source and impounded in natural or artificial reservoirs. Storage provides a reserve of water from which further pollution is excluded. This is the natural method of purification.

a. ***Physical*:** 90% of suspended impurities settle down in 24 hours by gravity. The water becomes clearer.

b. ***Chemical*:** Certain chemical changes take place. As a result of storage, the content of ammonia is reduced and rise in nitrates occurs.

c. ***Biological*:** A tremendous drop of bacterial count occurs. The pathogenic organisms die out.

If the water is stored for a long period, there is likelihood of growth of algae which imparts bad smell and colour to the water.

2. Filtration

Two types of filters are used, the 'biological' or 'slow sand' filters and the 'rapid sand' or 'mechanical' filters.

a. Slow sand or biological filters

Elements of slow sand filters consists of:

1. Supernatant water.
2. A bed of graded sand
3. An under drainage system
4. A system of filter control valves.

1. ***Supernatant water*:** The supernatant water above the sand bed serves two important purposes; it provides a constant head of water and secondly, it provides waiting period of some hours for the raw water to undergo partial purification by sedimentation, oxidation and particle agglomeration.[4b]

2. ***Sand bed*:** The most important part of the filter is the sand bed. The sand should be clean and free from clay and organic matter. The sand

bed presents a vast surface area. The water is subjected to mechanical straining, sedimentation, adsorption, oxidation and bacterial action.

Vital layer: When the filter is laid newly, it acts merely as a mechanical strainer, and cannot truly be considered as “biological”. But very soon the surface of the sand bed gets covered with a slimy growth known as “schmutzdecke”, vital layer, zoogleal layer or biological layer. This layer is slimy and gelatinous and consists of threadlike algae and plankton, diatoms and bacteria. The formation of vital layer is known as “ripening” of filter. It may take several days for the vital layer to form. It extends 2 to 3 cm into the top portion of the sand bed. It is the “heart” of the slow sand filter. It removes organic matter, holds back bacteria and oxidizes ammonical nitrogen into nitrates and helps in yielding bacteria-free water. Until the vital layer is formed fully, the first few days filtrate is usually run to waste.

3. ***Under drainage system*:** At the bottom of the filter bed is the under drainage system. It consists of porous or perforated pipes which serve the dual purpose of providing an outlet for filtered water, and supporting the filter medium above.

   Filter box: The first three elements are contained in the filter box. The filter box is an open box, usually rectangular in shape, from 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 from top to bottom:

Supernatant water	1 to1.5 metres
• Sand bed	1.2 metres
• Gravel support	0.30 metres
• Filter bottom	0.16 metres

4. ***Filter control*:** The purpose of these devices is to maintain a steady rate of filtration.

   The advantages of slow sand filter are:

   1. Simple to construct and operate.
   2. The cost of construction is cheaper than that of rapid sand filters.
   3. The physical, chemical and bacteriological quality of filtered water is high.

4. They reduce total bacterial counts by 99.9 to 99.99%.

b. Rapid sand or mechanical filters

Rapid sand filters are of two types, the gravity type and the pressure type. The following steps are involved in the purification of water by rapid sand filters:[4b]

1. ***Coagulation*:** The raw water is first treated with chemical coagulant such as alum, the dose of which varies from 5–40 milligrams or more per litre, depending upon the turbidity and colour, temperature and pH of water.
2. ***Rapid mixing*:** The treated water is then subjected to violent agitation in a "mixing chamber" for a few minutes.
3. ***Flocculation*:** The next phase involves slow and gentle stirring of treated water for 30 minutes in a "flocculation chamber".
4. ***Sedimentation*:** The coagulated water is then led into the sedimentation tanks where it is detained for periods varying from 2 to 6 hours when the flocculent precipitate together with impurities and bacteria settle down in the tank.
5. ***Filtration*:** The partly clarified water is now subjected to rapid sand filtration.

Filtration

As the filtration proceeds, the suspended impurities and bacteria clog the filters. The filters soon become dirty and begin to lose their efficiency. When the "loss of head" approaches 7–8 feet, filtration is stopped and the filters are subjected to a washing process known as "back washing."

Back washing

Rapid sand filters needs 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. Back washing dislodges the impurities and cleans the sand bed. Compressed air is used as part of the back washing process.

Advantages

The advantages of a rapid sand filters over the slow sand filters are:

1. Rapid sand filter can deal with raw water directly.
2. The filter bed occupies less space.
3. Filtration is rapid—40 to 50 times that of slow sand filters.
4. Washing of the filter is easy.
5. There is more flexibility in operation.

3. Chlorination

Chlorination is one of the greatest advances in water purification. It is supplement, not a substitute to sand filtration. Chlorine kills pathogenic bacteria, but it has no effect on spores and certain viruses except in high doses. It oxidizes iron, manganese and hydrogen sulphide, it destroys some taste and odour producing constituents, it controls algae and slime organisms, and aids coagulation.

Action of chlorine

When chlorine is added to water, there is formation of hydrochloric and hydrochlorous acids. The hydrochloric acid is neutralised 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, and to small extent due to hypochlorite ions. The hypo-chlorous acid is the more effective (70–80 times) than the hypochlorite ions.[4a]

Method of chlorination

For disinfecting large bodies of water, chlorine is applied either as,

1. Chlorine gas
2. Chloramine or
3. Perchloron.

Chlorine gas is the first choice, because it is cheap, quick in action, efficient and easy to apply. Since chlorine gas is an irritant to the eyes and poisonous, a special equipment known as “chlorinating equipment” is required to apply chlorine gas to the water supplies.

Chloramines are loose compounds of chlorine and ammonia. They have less tendency to produce chlorinous taste and give more persistent type of residual chlorine. The greatest drawback of chloramine is that they have a slower action than chlorine and, therefore, they are not being used to any great extent in water treatment.

Perchloron or high test hypochlorite (HTH) is a calcium compound which carries 60–70% of available chlorine. Solutions prepared from HTH are also used for water disinfection.

Break point chlorination

When chlorine dose in the water is increased, a reduction in the residual chlorine occurs. The end products do not represent any residual chlorine. This fall in residual chlorine continues with further increase in chlorine dose, until after a stage residual chlorine begin to increase in proportion. The point at which it appears is called break point chlorination or dosage.[1]

Other agents

1. Ozonation
2. Ultraviolet radiation.

Purification of Water on a Small Scale

1. House hold purification of water.
   a. Boiling
   b. Chemical disinfection
      1. Bleaching powder
      2. Chlorine solution
      3. Chlorine tablets
      4. High test hypochlorite
      5. Potassium permanganate
      6. Iodine
   c. Filtration
2. Disinfection of wells. The cheapest method of disinfecting wells is by addition of bleaching powder.

Double Pot Method

The double pot method has been devised by National Environmental Engineering and Research Institute, Nagpur. This Method uses 2 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 (Fig. 3.1).

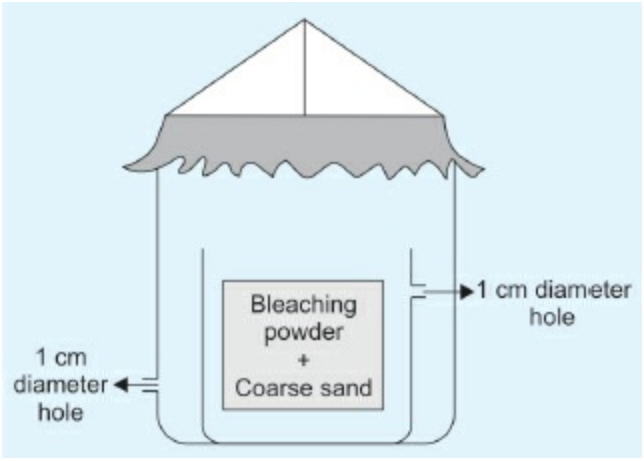


Fig. 3.1: Double pot method

A mixture of 1 kg of 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 polythene 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 satisfactory for 2–3 weeks in a well containing about 4500 litres of water.

Hardness of Water

Hardness may be defined as the soap-destroying power of water. The hardness in water is caused mainly by four dissolved compounds. [2] These are:

1. Calcium bicarbonates
2. Magnesium bicarbonates
3. Calcium sulfate
4. Magnesium sulfate.

Hardness is classified as carbonates and non-carbonates. The carbonate hardness formerly designated as ‘temporary’ hardness is due to the presence of calcium and magnesium bicarbonates. The non-carbonate hardness formerly designated as ‘permanent’ hardness is due to the presence of calcium and magnesium sulfates.

Hardness in water is expressed in terms of ‘milliequivalents per litre’(mEq/l).

Table 3.1: Classification of hardness of water

Classification	***Level of hardness (mEq/l)***
Soft water	Less than 1
Moderately hard	1–3
Hard water	3–6
Very hard water	Over 6

Disadvantages of Hardness

1. Hardness in water consumes more soap and detergents.
2. When hard water is heated, the carbonates are precipitated and bring about furring or scaling of boilers.
3. It affects cooking.
4. Fabrics washed in hard water with soap do not have a long life.

Removal of Hardness

The methods of removal of hardness are:

Temporary hardness

1. Boiling
2. Addition of lime
3. Addition of sodium carbonate.
4. Permutit process.

Permanent hardness

1. Addition of sodium carbonate.
2. Base exchange process.

Water Pollution

Water is never pure in a chemical sense. It contains impurities of various kinds—both dissolved and suspended impurities. These contain:

- Dissolved gases, e.g. hydrogen sulfide, carbon dioxide, ammonia, nitrogen.
- Dissolved minerals, e.g. salts of calcium, magnesium and sodium.
- Suspended impurities, e.g. clay, silt, sand, mud, and microscopic plants and animals.

Sources of Pollution

1. Sewages which contain decomposable organic matter and pathogenic agents.
2. Industrial and trade wastes which contain toxic agents.
3. Agricultural pollutants which comprise fertilizers and pesticides.
4. Physical pollutants and radioactive substances.

Hazards of Water Pollution

The hazards of water pollution is classified into two broad groups—biological and chemical.

1. ***Biological*:** This includes water-borne diseases caused by the presence of infective agent or an aquatic host in the water.

By the presence of infective agent:

a. Viral—viral hepatitis, poliomyelitis, hepatitis-E
b. Bacterial—cholera, typhoid, bacillary dysentry
c. Protozoal—amoebiasis, giardiasis.
d. Helminthic—roundworm, whipworm, threadworm.
e. Leptospiral—weil's disease.

By the presence of an aquatic host:

a. Cyclops—guineaworm, fish tapeworm
b. Snail—schistosomiasis.

2. ***Chemical*:** The chemical pollutants include detergents, solvents, cyanides, heavy metals, minerals, organic acids, nitrogenous substances, bleaching agents, dyes, pigments, sulfides, ammonia and toxic organic substances.

Water Quality—Criteria and Standards

The guidelines for drinking water quality recommended by WHO (2011) relate to following variables:

I. Acceptability aspects
II. Microbiological aspects
III. Chemical aspects
IV. Radiological aspects

I. Acceptability Aspects

a. Physical parameters

The provision of drinking water that is not only safe but also pleasing in appearance, taste and odour is a matter of high priority.

Constituents or characteristics	***Levels likely to give rise to consumer complaints***	***Reasons for consumer complaints***
Physical parameters		
Colour	15 TCU	Appearance
Taste and odour	—	Should be acceptable
Temperature	—	Should be acceptable appearance; for effective terminal disinfection, median turbidity ≤1 NTU
Turbidity	1 NTU	

b. Inorganic constituents

Constituents or characteristics	***Levels likely to give rise to consumer complaints***	***Reasons for consumer complaints***
Inorganic constituents		
Aluminium	0.2 mg/L	Depositions, discolouration

Ammonia	1.5 mg/L	Odour and taste
Chloride	250 mg/L	Taste, corrosion
Copper	1 mg/L	Staining of laundry and sanitary ware (health-based provisional guideline value 2 mg/l)
Hardness		High hardness: Scale deposition, scum formation; low hardness; possible corrosion
Hydrogen sulfide	0.05 mg/L	Odour and taste
Iron	0.3 mg/L	Staining of laundry and sanitary ware
Manganese	0.1 mg/L	Staining of laundry and sanitary ware (health-based provisional guideline value 0.4 mg/l)
Dissolved oxygen	—	Indirect effects
pH	—	Low pH: Corrosion; high pH: Taste, soapy feel preferably <8.0 for effective disinfection with chlorine
Sodium	200 mg/L	Taste
Sulphate	250 mg/L	Taste, corrosion
Total dissolved solids	1000 mg/L	Taste
Zinc	4 mg/L	Appearance, taste

II. Microbiological Aspects

a. Bacteriological indicators

Ideally, drinking water should not contain any microorganisms known to be pathogenic. It should also be free from bacteria indicative of pollution with excreta. Supplementary indicator organisms, such as faecal streptococci and sulphite-reducing clostridia, may sometimes be useful in determining the origin of faecal pollution as well as in assessing the efficiency of water

treatment processes.

Organisms	***Guideline value***
All water intended for drinking	
E. coli or thermotolerant coli form bacteria	Must not be detectable in any 100 ml sample
Treated water entering the distribution system	
E. coli or thermotolerant coli form bacteria	Must not be detectable in any 100 ml sample
Total coliform bacteria	Must not be detectable in any 100 ml sample
Treated water in the distribution system	
E. coli or thermotolerant coli form bacteria	Must not be detectable in any 100 ml sample
Total coliform bacteria	Must not be detectable in any 100 ml sample. In the case of large supplies, where sufficient samples are examined, must not be present in 95% of samples taken throughout any 12 month period

b. Virological aspects

Disinfection with 0.5 mg/l of free chlorine residual after contact period of at least 30 minutes at a pH of 8.0 is sufficient to inactivate virus.

c. Biological aspects

i. *Protozoa: Entamoeba histolytica*, *Giardia* spp. and rarely, *Balantidium coli*. Standard methods are not currently available for the detection of pathogenic protozoa in water supplies in the context of a routine monitoring programme.

ii. ***Helminths*****:** The methods for detection of parasitic roundworms and flatworms are unsuited for routine monitoring.

iii. ***Free-living organisms*****:** Free living organisms that may occur in water

supplies include fungi, algae, etc. The most common problem with these are their interference in the operation of waste-treatment process, colour, turbidity, taste and odour of finished water.

III. Chemical Aspects

The problem associated with chemical constituents of drinking water arises primarily from their ability to cause adverse health effects after prolonged periods of exposure; of particular concern are contaminants that have cumulative toxic properties, such as heavy metals and substances that are carcinogenic.

Health-related chemical constituents

a. ***Inorganic constituents*:** A provisional guideline value for arsenic in drinking water of 0.01 mg/litre is established.

Inorganic chemicals of health significance in drinking water.

Constituents	***Recommended maximum limit of concentration (mg/litre) (µg/litre)***	
Arsenic	0.01 (P)	10
Cadmium	0.003	0.3
Chromium	0.05(P)	50
Fluoride	1.5	1,500
Lead	0.01	10
Mercury (Total)	0.006	6
Nitrate (as NO_3)	50	50,000
Nitrite (as NO_2)	3(P)	3,000
Selenium	0.04	40

P: Provisional guideline value

b. ***Organic constituents*:** The guideline values of some of the organic chemical constituents in water are shown in Table 3.2.

Table 3.2: Guideline values for health related organic constituents

Organic constituents	***Upper limit of concentration***

	(µg/litre)
Chlorinated alkanes	
Carbon tetrachloride	2
Dichloromethane	20
Chlorinated ethenes	
Vinyl chloride	55
1. 1-dichloromethane	30
1. 2-dichloromethane	50
Aromatic hydrocarbons	
Benzene	10
Toluene	700
Xylenes	500
Ethylbenzene	300
Styrene	20
Benzolalpyrene	0.7

IV. Radiological Aspects

Radioactivity in drinking water should not only be kept within safe limits; it should also, within those limits, be kept as low as is reasonably possible.

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. Formerly, the unit of activity was curie (Ci).

The proposed guideline values are:

- Gross alpha activity 0.5 Bq/L
- Gross beta activity 1.0 Bq/L.

Uses of Water

Water is used for many purposes.

1. ***Domestic uses*:** Water is required for drinking, cooking, washing, and bathing.
2. ***Public uses*:** Water is required for public cleansing, fire fighting,

maintenance of public gardens, and swimming pools.

3. ***Industrial uses*:** Iron and steel, paper industry for processing and cooling.
4. ***Agricultural uses*:** Irrigation.

AIR

The immediate environment of man comprises of air on which depends all forms of life.

Air Pollution

Air pollution is one of the present-day problems throughout the world.

Sources of Air Pollution

1. Automobiles
2. Industries
3. Domestic combustion of coal, wood or oil
4. Tobacco smoke
5. Miscellaneous such as burning refuse, incinerators, pesticide spraying, wind-borne dust, fungi, moulds, etc.

Air Pollutants

More than 100 substances, which pollute air, have been identified. The important ones are carbon monoxide, carbon dioxide, hydrogen sulphide, sulphur dioxide, sulphur trioxide, nitrogen oxides, fluorine compounds, organic compounds, metallic contaminants, radioactive compounds and photochemical oxidants. Pollutants may be in the form of solids, liquids or gases. The combination of smoke and fog is called ‘smog’.

Effects of Air Pollution

Air pollution can affect in two ways:[2]

a. ***Health aspects*****:** The health effects of air pollution are both immediate and delayed. The immediate effect borne by the respiratory system is acute bronchitis. The delayed effects most commonly linked with air pollution are chronic bronchitis, lung cancer, bronchial asthma, emphysema, and respiratory allergies.

b. ***Social and economic aspects*****:** These comprise destruction of plant and animal life; corrosion of metals; damage of buildings; cost of cleaning and maintenance and repairs and aesthetic nuisance. Air pollution also reduces visibility in towns.

Prevention and Control of Air Pollution

WHO has recommended the following procedures for the prevention and control of air pollution.

1. ***Containment*:** Prevention of escape of toxic substances into ambient air.
2. ***Replacement*:** Replacing a technological process causing air pollution by a new process that does not cause air pollution.
3. ***Dilution*:** Dilution is valid so long as it is within the self-cleaning capacity of the environment.
4. ***Legislation*:** Air pollution is controlled in many countries by certain legislation, e.g. clean air acts.
5. ***International action*:** To monitor and study the air pollution.

In recent years, disinfection of air has received much attention. The methods employed are:

1. Mechanical ventilation
2. Ultraviolet radiation.
3. Chemical mists.
4. Dust control.

NOISE

Noise is often defined as “unwanted sound”. A better definition of noise is: ‘wrong sound, in the wrong place, at the wrong time.’[3]

Sources

The sources of noise are many and varied. These are automobiles, factories, industries, air-craft, etc. Noise levels are acute near railway junctions, traffic roundabouts, bus terminuses and airports. Domestic noises form the radios, transistors, TV sets.

Effects of Noise Exposure

The effects of noise exposure are of two types—auditory and non-auditory.

Auditory Effects

1. Auditory fatigue causing whistling and buzzing in the ears.
2. Deafness.

Non-auditory Effects

1. Interference with speech.
2. Annoyance.
3. Physiological changes—rise in blood pressure, an increase in heart rate, a rise in intracranial pressure, giddiness, nausea and fatigue.
4. Efficiency—reduction in noise has been found to increase work output.

Control of Noise

1. Careful planning of cities.
2. Control of vehicles.
3. To improve acoustic insulation of building.
4. Location of industries and railways away from cities.
5. Protection of exposed persons with the use of earplugs, earmuffs.
6. Legislation.
7. Education.

DISPOSAL OF SOLID WASTES

The term “solid waste” is applied to unwanted or discarded waste material from houses, street sweeping, commercial, industrial and agricultural operations, arising from man’s activities. In the cities, it is called refuse; in the countryside, it is called litter; and in general, it is called solid wastes.[4d]

Health Aspects

The accumulation of solid wastes in man's environment constitutes a positive health hazard because of the following reasons:[4d]

1. The organic portion of solid wastes ferments and favours fly breeding.
2. The garbage in the refuse attracts rats.
3. The pathogens may be conveyed to man through flies and dust.
4. There is possibility of water pollution, if rain, water passes through deposits of fermenting refuse.
5. There is risk of air pollution, if there is accidental or spontaneous combustion of refuse.
6. Piles of refuse are a nuisance from an aesthetic point of view.

Sources of Refuse

1. ***Street refuse*:** Refuse that is collected by the street cleansing service or scavenging is called street refuse. It consists of leaves, straw, paper, animal droppings and litter of all kinds.
2. ***Market refuse*:** Refuse collected from markets is called market refuse. It contains a large portion of putrid vegetable and animal matter.
3. ***Stable litter*:** Refuse collected from stables are stable litter and it contains mainly animal droppings and left over animal feeds.
4. ***Industrial refuse*:** It comprises of wastes ranging from completely inert materials such as calcium carbonate to highly toxic and explosive compounds.
5. ***Domestic refuse*:** It consists of ash, rubbish and garbage.

Ash is the residue from fire used for cooking and heating. Rubbish comprise of wood bits, paper, clothing, metal, glass, dirt and dust. Garbage consists of waste food, vegetable peeling and organic matter. It needs quick removal and disposal because it ferments on storage.

Methods of Disposal

There is no single method of refuse disposal in all circumstances. The choice of a particular method is governed by local factors such as cost and availability of land and labour. The principal methods of refuse disposal are:[3]

a. Dumping
b. Controlled tipping or sanitary land-fill
c. Incineration
d. Composting
e. Manure pits
f. Burial

a. Dumping

Refuse is dumped in low lying areas partly as a method of reclamation of land but mainly as an easy method of disposal of dry refuse. As a result of bacterial action, refuse decreases considerably in volume and is converted gradually into humus. The drawback of open dumping are: (1) the refuse is exposed to flies and rodents, (2) it is the source of nuisance from the site of smell and unsightly appearance, (3) the loose refuse is dispersed by the action of wind and (4) drainage from dumps contributes to the pollution of surface water and groundwater.

b. Controlled Tipping

Controlled tipping or sanitary landfill is the most satisfactory method of refuse disposal where suitable land is available. The material is placed in a trench or other prepared area, adequately compacted, and covered with earth at the end of working day. The term “modified sanitary landfill” has been applied to those operations where compaction and covering are accomplished once or twice a week. Three methods are used in this operation.

1. ***The trench method*:** Where level ground is available the trench method is used. A long trench is dug out 2–3 m deep and 4–12 m wide. The refuse is compacted and covered with excavated earth.
2. ***The ramp method*:** This method is well suited where the terrain is

moderately sloping. Some excavation is done to secure the covering material.

3. ***The area method*:** This method is used for land depressions, disused quarries and clay pits. The refuse is deposited, packed and consolidated in uniform layers up to 2 to 2.5 m deep.

Each layer is sealed on its exposed surface with mud cover at least 30 cm thick. Such sealing prevents infestation by flies and rodents and suppresses the nuisance of smell and dust. This method often has the disadvantage of requiring supplemental earth from outside sources.

c. Incineration

Refuse can be disposed of hygienically by burning or incineration. It is the best method where suitable land is not available. Hospital refuse is disposed by this method. The refuse is reduced to one-fourth its original weight and the residue is called "clinker" which is used for road making after mixing with lime.[1] The incinerator consists of:

1. A furnace or combustion chamber maintained at over 1200°C.
2. A platform for tipping the refuse.
3. Stokers for raking the refuse forward.
4. Baffle plate to drive out all fumes.

Types

1. Double cell meldrum
2. Single cell destructors

The chief advantage is that the cost of carting is minimized.

Disadvantages

1. Expensive
2. Moisture presence during rainy season affects burning of refuse.

d. Composting

Composting is a method of combined disposal of refuse and night soil and sludge. It is a process of nature whereby organic matter breaks down under

bacterial action resulting in the formation of relatively stable humuslike material, called the compost which has considerable manurial value for soil. The end-product—compost—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 following methods of composting are now used:

1. ***Bangalore method (Anaerobic method)*:** It is also called the hot fermentation process. It has been recommended as a satisfactory method of disposal of town wastes and night soil. Trenches are dug 3 ft deep, 5–8 ft broad and 15–30 ft long. It should be located not less than ½ mile from city limits. First a layer of refuse about 6 inches thick is spread at the bottom of the trench. Over this, night soil is added corresponding to a thickness of 2 inches. Then alternate layers of refuse and night soil are added in the proportion of 6 inches and 2 inches respectively, till the heap rises to 1 ft above the ground level. The top layer should be of refuse, at least 9 inches thickness. Then the heap is covered with excavated earth. Within 7 days, as a result of bacterial action, considerable heat is generated in the compost mass. This heat persists for 2 or 3 weeks, and serves to decompose the refuse and night soil and to destroy all pathogenic and parasitic organisms. At the end of 4 to 6 months, decomposition is complete and the resulting manure is well-decomposed, odourless, innocuous material of high manurial value ready for application to the land.
2. ***Mechanical composting (aerobic method)*:** Another method of composting becoming popular is the mechanical composting. In this, compost is literally manufactured on a large scale by processing raw materials and turning out into a finished product. The refuse is first cleared of salvable materials such as rags, bones, metal glass, and items, which are rendered to interfere in grinding. It is then pulverized in 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 night soil in a rotating machine and incubated. The entire process of composting is complete in 4 to 6 weeks.

e. Manure Pits

The problem of refuse disposal in rural areas can be solved by digging

‘manure pits’ by the individual householders. The garbage, cattle dung, straw and leaves should be dumped into the manure pits and covered with earth after each day’s dumping. In 5 to 6 months 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.

f. Burial

This method is suitable for small camps. A trench 1.5 m wide and 2 m deep is excavated and at the end of each day the refuse is covered with 20 to 30 cm of earth. When the level in the trench is 40 cm from ground level, the trench is filled with earth and compacted, and a new trench is dug out. The contents may be taken out after 4 to 6 months and used on the fields.

BIOMEDICAL WASTE MANAGEMENT IN INDIA 2011

The Gazette of India: Extraordinary Ministry of Environment and Forest notification dated 24th august 2011, issued in New Delhi amendments in biomedical waste rules (1998). Table 3.3 shows categories of BWM.

Table 3.3: Categories of BWM

Category	*Waste type*	*Treatment/disposal*
1.	Human anatomical waste (tissues, organ, body parts)	Incineration
2.	Animal waste	Incineration
3.	Micorbiology, biotechnology and other laboratory waste	Disinfection at source by chemical treatment or autoclaving/microwaving followed by mutilation/shredding Final disposal of above by secured landfill or dis-posal of disposable waste by authorised cycles
4.	Waste sharps (needle, syringes, blade, scalpel) *Note:* Glass syringes with fixed needle come in this category and disposable syringe with needle removed in category 7	Disinfection by chemical treatment or destruction by needle cutters Autoclaving/microwaving followed by multilation/shredding Final disposal of above by secured landfill or in designated concrete waste sharp pit
5.	Discarded medicine/cytotoxic drugs	Discarded in secured landfill/incineration

6.	Solid waste (items contaminated with body and blood fluids such as cotton, dressings, linen, soiled pops, beddings	Incineration
7.	Infectious solid waste (tubings, i.v. set, gloves, saline bottle, catheter)	Disinfection by chemicals/autoclaving/microwaving followed by mutilation/shredding Then finally sent for recycling
8.	Chemical waste (chemicals used in production of biological/used in disinfection)	Chemical treatment and discharge into drains, solid into secured landfills

Table 3.4 shows colour coding and type of container for BWM (note that colour used for tabulation of schedule has been done in accordance with the colour of container to be used).

Table 3.4: Colour coding and type of container used for disposal of biomedical waste

Colour coding	*Type of container to be used*	*Waste category no*	*Treatment option*
Yellow	Non-chlorinated plastic bags	1, 2, 5, 6	Incineration
Red	Non-chlorinated plastic bags/ puncture proof container	3, 4, 7	As per Table 3.3
Blue	Non-chlorinated plastic bags	8	As per Table 3.3
Black	Non-chlorinated plastic bags	Municipal waste	Municipal dump site

Table 3.5: Oral manifestations of occupational diseases

Structure affected	***Aetiologic agent***	***Manifestations***
Tooth enamel and dentin	Dust Pretension of instruments Acid Sugar	Staining Abrasion Abrasion Decalcification Caries

Gingiva	Dust, mercury compounds Dust, heavy metals Variation in atmospheric pressure, benzene Acid, mercurial compounds Mercurial compounds Dust, flour	Gingivitis Pigmentation Haemorrhage Ulceration Periodontitis Calculus
Periodontal membrane	Mercurial compounds Dust, flour	Periodontitis Calculus
Alveolar bone and jaws	As, Cr, Hg, P, Ra Fluorine	Osteomyelitis and necrosis Sclerosis
Lips	Low humidity Dust Aniline, carbon monoxide Tar	Dryness, fissure cheilitis, leukoplakia Colouration of lips Carcinoma
Oral mucosa	Dust chemicals	Pigmentation stomatitis
Tongue	Food tasting	Anaesthesia, paraesthesia
Salivary glands	Mercury compounds X-ray, radium Increased intraoral pressure	Ulceration, ptyalism, xerostomia, pneumatocele

OCCUPATIONAL HAZARDS

Occupational health is essentially preventive medicine. The joint ILO/WHO Committee gave the following, “occupational health should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations.”[2]

An industrial worker may be exposed to five types of hazards, depending upon the occupations:

1. Physical hazards
2. Chemical hazards
3. Biological hazards
4. Mechanical hazards
5. Psychosocial hazards

Physical Hazards

a. Heat and Cold

The common physical hazard in most industries is heat. The direct effect of heat exposure are burns, heat exhaustion, heat stroke and heat cramps. The indirect effects are decreased efficiency, increased fatigue and enhanced accident rates. Important hazards associated with cold work are chilblains, erythrocyanosis, immersion foot, and frostbite as a result of cutaneous vasoconstriction.

b. Light

The acute effects of poor illumination are eyestrain, headache, eye pain, lachrymation, congestion around the cornea, and the chronic effects on health includes “miner’s nystagmus”.

Table 3.6: Physical hazards in dentistry and their prevention strategies

S. No.	Physical hazards	Characteristics	Prevention strategies
1.	Eye injuries	a. Bits of calculus striking the eye during scaling b. Splatters from body fluids (bacterial and viral aerosols) while using high speed handpieces c. Use of intense dental curing light	To employ the use of protective eyewear
2.	Needle stick injuries or cut from sharp instruments	a. Puncture wounds from needles or cuts from sharp objects and instruments (percutaneous injuries)	a. Careful handling of sharps b. Safe work procedures
3.	Musculoskeletal problems	a. Working in a fixed working position using a continuous repetitive motion predisposes to wrist ache, lower back ache and neck ache	Guidelines for good-seated posture: a. Feet should be flat on the floor b. The angle between calf and thigh should be more than 90° c. The torso should be vertical d. The patient head should normally be at the operator's mid chest
4.	Vibration injuries	a. Sensory loss over the web between thumb and forefinger, induced by vibration from a dental air-rotor	Wrist and hand exercises
5.	Fires and explosion	a. Incorrect use of flammable anaesthetic gases, vapour, oxygen and flammable fluids b. Autoclaves can be explosive risk, if the door is not secured or maintained properly	All pressure vessels, including autoclaves should be regularly maintained
6.	Heat burns	a. Instruments just removed from autoclave or hot air oven retain heat for many minutes caused burns to dentists and severe orofacial burns to patients b. Hot wax knives, Bunsen burners, hot gutta-percha, hot wax, lasers or diathermy	Safe work procedures.
7.	Cold burns	Spillage of liquid nitrogen while using cryosurgical equipment	Safe handling procedures
8.	Accident	a. Annoyance of hitting the head or face on the dental light b. Trapping of fingers or limbs when moving dental chair c. Slipping or tripping over objects such as carpets, wires and so on	Ergonomically designed work-station chairs and equipment
9.	Electrical accidents	Static discharges in areas where there are flammable vapours have caused severe explosion	a. Periodic maintenance b. Use of earth leakage circuit breakers

Exposure to excessive brightness is associated with discomfort, annoyance

and visual fatigue.

c. Noise

Auditory effects which consist of temporary or permanent hearing loss. Non-auditory effects which consist of nervousness, fatigue, interference with speech.

d. Vibration

Vibration affects hands and arms. After some months or years of exposure, the fine blood vessels of the fingers may be increasingly sensitive to spasm.

e. Ultraviolet Radiation

Occupational exposure to ultraviolet radiation occurs mainly in arc welding. Such radiation affects the eye, causing intense conjunctivitis and keratitis.

f. Ionizing Radiation

Ionizing radiations are finding increased application in medicine and industry. X-rays and radioactive isotopes are widely used. The radiation hazards comprise of genetic changes, malformation, cancer, leukaemia, ulceration and sterility and in extreme cases the death (Table 3.7).

Table 3.7: Radiation hazards in dentistry and their prevention strategies

S. no.	*Radiation hazards*	*Characteristics*	*Prevention strategies*
1.	Exposure to ionizing radiation while taking dental X-rays	a. Radiation burns b. Damage to eyes	a. Keep well away from the X-ray source b. Use shielding–use of lead aprons c. Use fast film d. Follow radiation protection regulations

Chemical Hazards

Chemical agents act in three ways—local action, inhalation, and ingestion (Table 3.8).

Table 3.8: Chemical hazards in dentistry and their prevention strategies

S. no.	*Chemical hazards*	*Characteristics*	*Prevention strategies*
1.	Powdered natural rubber latex gloves	Hand dermatitis, contact dermatitis, contact uticaria and allergic dermatitis	Substitution with less harmful products or latex free gloves
2.	Solvents (acrylic monomer like methyl-methacrylate)	a. Transient dermatitis b. Rarely causes occupational asthma or dermatitis c. White hand syndrome—numbness or paraesthesia of finger and palms, with pain as a result of monomer penetrating into the skin	Enclosed mixing devices
3.	Disinfectants	a. Glutaraldehyde, formaldehyde causes allergic reactions to the skin, ocular and respiratory irritation	a. Educate the workers in the nature of the hazard b. Reduce exposure to toxic agents
4.	X-ray processing chemicals	a. Fixer and developer which contains acetic acid and sodium thiosulphate can cause dermatitis, conjunctivitis or bronchitis	a. Skin should never come into contact with processing fluids b. Any spillages should be washed off immediately in running water
5.	Mercury in dental amalgam	a. Elemental mercury vapour can be absorbed via skin and lung b. Mercury allergy and neurological symptoms such as depression, undue fatigue c. Contact hypersensitivity to mercury—rare condition	a. Routine use of gloves and coverage of arms b. Proper disposal of mercury waste
6.	Plaster of Paris	a. Dry hand syndrome—dryness of crackling of the skin	Education in the nature of the hazard

a. Local Action

Some chemicals are absorbed through the skin and cause systemic effects. Occupational dermatitis are due to machine oil, rubber, X-rays, caustic alkalies and lime.

b. Inhalation

1. ***Gases*:** Carbon dioxide, carbon monoxide, cyanide gas, sulphur dioxide, etc. cause gas poisoning.

2. ***Dusts*:** Inorganic dusts, such as coal dust, silica, asbestos, iron, cause anthracosis, silicosis, asbestosis, cancer lung, siderosis. Organic dusts such as cane fibre, cotton dust, tobacco, hay or grain dust. Causes bagassosis, byssinosis, tobacossis and farmer's lung.

3. ***Metals and their compounds*:** Toxic hazards occur from lead, mercury, cadmium, manganese, arsenic, chromium, etc.

c. Ingestion

Occupational diseases may also result from ingestion of chemical substances such as lead, mercury, arsenic, zinc, cadmium, phosphorous, etc.

Biological Hazards

Worker may be exposed to infective and parasitic agents at the place of work. The occupational diseases include leptospirosis, anthrax, tetanus, hydatidosis, fungal infections, etc. (Table 3.9).

Table 3.9: Biological hazards in dentistry and their prevention strategies

S. no.	*Biological hazards*	*Characteristics*	*Prevention strategies*
1.	Hepatitis virus infection	a. Viruses survive well outside the body on surfaces and instruments in the dental surgery and are relatively resistant to disinfectants b. Minute amount of body fluids can transmit infection c. Infection can lead to chronic active hepatitis, cirrohosis and death from liver failure	a. Universal precautions b. Gloves should be worn for all clinical dental work c. Nedle stick injuries must be avoided d. Immunization against hepatitis B virus infection
2.	HIV	Transmitted by infected blood and its products	a. Universal precautions b. Proper disposal of infected waste material c. Availability of sharp containers for disposal
3.	Herpes simplex virus infection	a. Saliva from patients who have had a primary infection b. Vesicle fluid from recurrent infection	a. Obtain medical history of patients b. Compliance with all infection prevention and control

Mechanical Hazards

The mechanical hazards in industry centre around machinery, protruding moving parts and the like. About 10% of accidents in industry are said to be due to mechanical causes.

Psychosocial Hazards

The psychosocial hazards arise from the worker’s failure to adapt to an alien psychosocial environment. Frustrations, lack of job satisfaction, insecurity, emotional tension are some of the psychosocial factors that undermine the physical and mental health of the workers.

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CHAPTER

4

Nutrition in Health and Disease

Oral tissues, like all other tissues in the human body, are dependent on their trophic environment to supply the nutrients essential for growth, development and maintenance of health. Nutrients in the diet can influence oral disease in the following ways.[5]

a. Modifying the biochemical environment of cells responsible for formation of tissues such as enamel.

b. Altering the biosynthetic reactions (proteins and lipids).

c. Altering the quantity and flow of saliva and its physical, chemical or immunologic properties.

d. Influencing implantation, colonisation and metabolic activity of plaque flora on the tooth surface or in the gingival crevice.

Definition

Nutrition may be defined as the science of food and its relationship to health. It is concerned primarily with the part played by nutrients in body growth, development and maintenance.[3]

Good nutrition means, “maintaining a nutritional status that enables us to grow well and enjoy good health.”

Nutrients

Nutrients are organic and inorganic complexes contained in food. They are divided into

i. ***Macronutrients*:** Proteins, fats, carbohydrates are called as macronutrients because they form the main bulk of food.

Proteins	7–15%
Fats	10–30%
Carbohydrates	65–80%

ii. ***Micronutrients*:** Vitamins, minerals. They are called micronutrients because they are required in small amounts.

1. PROTEINS

Proteins are complex organic nitrogenous compounds. They are composed of carbon, hydrogen, oxygen, nitrogen and sulphur in varying amounts. Proteins are made up of smaller units called amino acids. There are essential and non-essential amino acids. Essential amino acids have important biological functions, e.g. formation of niacin from tryptophan. New tissues cannot be formed unless all the essential amino acids are present in the diet.[3]

Non-essential amino acids include arginine, asparaginic acid, serine, glutamic acid, proline and glycine.

Sources

***Animal source*:** Milk, meat, eggs, cheese, fish and fowl.

***Vegetable source*:** Pulses, cereals, beans, nuts, oil-seed cakes.

Functions

Proteins are needed by the body for:

a. Body building
b. Repair and maintenance of body tissues
c. Maintenance of osmotic pressure
d. Synthesis of certain substances like antibodies, plasma proteins, haemoglobin, enzymes, hormones and coagulation factors.

Daily Requirements

The average daily requirement of proteins is 75 gm.

Deficiency

1. Kwashiorkor (Fig. 4.1) is the result of protein deficiency.



Fig. 4.1: Deficiency of proteins—Kwashiorkor

2. Delayed eruption and hypoplasia of deciduous teeth.
3. Cementum deposition is retarded.
4. Resorption of alveolar bone.

2. FATS

Fats are solid at 20°C. They are called “oils”, if they are liquid at the temperature. Fats and oils are concentrated sources of energy. Fats yield fatty acids and glycerol on hydrolysis. Fatty acids are divided into saturated fatty acids and unsaturated fatty acids. Essential fatty acids are those that cannot be synthesized by humans. The most important essential fatty acid is linoleic acid.

Source

***Animal fats*:** Ghee, butter, milk, cheese, eggs and fat of meat and fish.

***Vegetable fats*:** Ground nut, mustard, sesame, coconut. They are sources of vegetable oils.

Functions

1. They are high energy foods thus provide energy.
2. Serve as vehicles for fat-soluble vitamins.
3. Fats in the body support viscera such as heart, kidney and intestine.
4. Essential fatty acids are needed by body for growth, for structural integrity of cell membrane and decreased platelet adhesiveness.

Fats and Disease

a. ***Obesity*:** A diet rich in fat can pose a threat to human health by encouraging obesity (Fig. 4.2).

b. ***Phrenoderma*:** Deficiency of essential fatty acids in the diet is associated with rough and dry skin.



Fig. 4.2: Excessive fat intake—obesity

c. ***Coronary heart disease*:** High fat intake has been identified as a major risk factor foi coronary heart disease.

d. ***Cancer*:** Diets high in fat increase the risk of colon cancer and breast cancer.

Requirements

The average daily requirement of fats—55 gm

3. CARBOHYDRATE

The main source of energy providing consti tuent (4 kcal per gram). Carbohydrates provide 50% energy and heat required by the body. They are stored in liver as glycogen.

Functions

1. Essential for oxidation of fats.
2. Essential for synthesis of certain nonessential amino acids.

Sources

***Starch*:** Cereals, roots and tubers.

***Sugars*:** Monosaccharides (glucose, fructose and galactose).

Disaccharides (sucrose, lactose and maltose)

***Dietary fibres*:** Vegetables, fruits and grains.

Requirement

The average daily requirement is 400 gm.

4. VITAMINS

Vitamins are a class of organic compounds categorized as essential nutrients. They are required by the body in very small amounts Vitamins are divided into two groups:

1. ***Fat-soluble vitamins*:** Vitamins A, D, E and K
2. ***Water-soluble vitamins*:** Vitamins of B group and C.

Vitamin A

Source

Animal foods—liver, eggs, butter, cheese whole milk, fish and meat. Fish liver oils are the richest sources of retinol.

***Plant foods*:** Spinach and amaranth, papaya, mango, carrots.

Deficiency

1. Night blindness
2. Bitot's spots
3. Corneal xerosis
4. Keratomalacia
5. Hyperkeratosis and hyperplasia of gingival tissue
6. Atrophy of odontoblasts
7. Atrophy of salivary glands

Functions

1. It is indispensable for normal vision.
2. Necessary for maintaining the integrity and normal functioning of glandular and epithelial tissues which lines intestinal, respiratory and urinary tracts.
3. It supports growth especially skeletal growth.

Daily Requirement

***Adults*:** 5000 IU.

***Toxicity*:** Nausea, vomiting, anorexia, sleep disorders. Skin desquamation, enlarged liver, papillar oedema.

Vitamin D

The important forms of vitamin D in man are calciferol (vitamin D_2) and cholecalciferol (vitamin D_3).

Source

1. ***Sunlight*:** Vitamin D is synthesized by the body by action of ultraviolet rays of sunlight on 7-dehydrocholesterol, which is stored in large abundance in the skin.
2. ***Foods*:** Liver, egg yolk, butter, cheese, milk, fish fat.

Functions

1. It helps in absorption of calcium.
2. Used in maintenance of calcium homeostasis and skeletal integrity.

Deficiency

1. *Rickets*—observed in young children (Fig. 4.3).



Fig. 4.3: Deficiency of vitamin D—rickets

2. *Osteomalacia*—observed in adults.

Daily Requirement

***Adults*:** 2.5 µg (100 IU)

***Infants and children*:** 5.0 µg (200 IU)

***Pregnancy and lactation*:** 10.0 µg (400 IU)

Vitamin E

Vitamin E is the generic name for a group of closely related and naturally occurring fat-soluble compounds, the tocopherols.

Sources

Vegetable oils, cotton seed, sunflower seed, egg yolk and butter. Foods rich in polyunsaturated fatty acids are also rich in vitamin E.

Functions

This is one group of anti-oxidants that serves to scavenge free radicals formed in redox reactions throughout the body.

Deficiency

1. Anatomic changes in nervous system: Ataxia, dysarthria, loss of pain sensation, depressed tendon reflexes.
2. Haemolytic and hypoplastic anemia.
3. Degenerative lesions in skeletal muscles and heart.

Requirement

***Adult*:** 10 mg per day.

Vitamin K

Vitamin K occurs in at least two major forms—vitamin K_1 and vitamin K_2.

Sources

***Vitamin K_1*:** Fresh green vegetables, Cow's milk.

***Vitamin K_2*:** Synthesized by intestinal bacteria.

Function

To stimulate the production and the release of certain coagulation factors.

Deficiency

a. Prothrombin content of blood is markedly decreased and the blood clotting time is considerably prolonged.
b. Bleeding

Vitamin B Groups

Thiamine (B_1)

Vitamin B_1 is a water-soluble vitamin.

Source

Whole grain cereals, wheat, gram, yeast, pulses, oil seeds and nuts.

Meat, fish, eggs, vegetables and fruits contain smaller amount.

Functions

Essential for utilization of carbohydrates. It is involved in direct oxidative pathway for glucose.

Deficiency

Beriberi and Wernick's encephalopathy.

Dry beriberi form is characterized by nerve involvement. Wet beriberi form is characterized by heart involvement. Infantile beriberi seen in infants between 2 and 4 months of life. Wernick's encephalopathy characterized by ophthalmoplegia, polyneuritis, ataxia and mental deterioration.

Daily Requirement

The average daily requirement is 1.5 mg

Riboflavin (Vitamin B_2)

Sources

Milk, eggs, liver, kidney and green leafy vegetables. Meat and fish contain small amounts.

Functions

1. It has a fundamental role in cellular oxidation.
2. It is a cofactor in a number of enzymes involved with energy metabolism.

Deficiency

- Angular stomatitis (Fig. 4.4)



Fig. 4.4: Deficiency of vitamin B_2—angular stomatitis

- Cheilosis
- Glossitis

Daily Requirement

The average daily requirement is 18 mg.

Niacin (B_3)

Source

Liver, kidney, meat, poultry, fish, legumes and ground nut.

Functions

Niacin is essential for the metabolism of carbohydrate, fat and protein.

Essential for normal functioning of the skin, intestinal and nervous system.

Deficiency

- Pellagra.
- It is characterized by three Ds—diarrhoea, dermatitis and dementia.
- Glossitis
- Stomatitis

Daily Requirement

The average daily requirement of vitamin B_2 is 1.5 mg.

Pyridoxine (B_6)

Pyridoxine exists in three forms: Pyridoxine, pyridoxal and pyridoxamine.

Source

Milk, liver, meat, egg yolk, fish, whole grain cereals, legumes and vegetables.

Functions

It plays an important role in metabolism of amino acids, fats and carbohydrates.

Deficiency

Peripheral neuritis.

Daily Requirement

***Adults*:** 2 mg/day.

***Pregnancy and lactation*:** 2.5 mg/day

Folate

Source

Liver, meat, dairy products, eggs, milk, fruits and cereals.

Functions

1. Plays a role in the synthesis of the nucleic acids.
2. It is also needed for the normal development of blood cells in the marrow.

Deficiency

- Megaloblastic anaemia
- Glossitis (Fig. 4.5)



Fig. 4.5: Deficiency of folate—glossitis

- Cheilosis
- Gastrointestinal disturbances.

Requirements

***Adults*:** 100 µg per day.

***Pregnancy*:** 300 µg per day.

***Lactation*:** 150 µg per day.

***Children*:** 100 µg per day.

Vitamin B_{12}

Source

Liver, kidney, meat, fish, eggs, milk and cheese.

Vitamin B_{12} is not found in foods of vegetable origin. It is also synthesized by bacteria in colon.

Functions

Vitamin B_{12} has a separate biochemical role in synthesis of fatty acids in myelin.

It co-operates with folate in the synthesis of DNA.

Deficiency

- Megaloblastic anaemia (pernicious anaemia).
- Demyelinating neurological lesions in the spinal cord.
- Infertility.

Requirement

- Adults 1 µg per day.
- Pregnancy and lactation 1.5 µg per day.
- Infants and children 0.2 µg per day.

Vitamin C

Vitamin C is a water-soluble vitamin. It is the most sensitive of all vitamins to heat.

Source

Fresh fruits and green leafy vegetables. Germinating pulses contain good amounts. Amla or gooseberry and guava are the richest sources of vitamin C.

Functions

1. Vitamin ‘C’ has an important role to play in tissue oxidation.
2. It is needed for the formation of collagen.

Deficiency

Scurvy—signs of which are swollen and bleeding gums, subcutaneous bruising or bleeding into the skin or joints, delayed wound healing, anaemia and weakness.

Daily Requirement

***Adults*:** 40 mg.

***Children*:** 40 mg.

***Infants*:** 20 mg.

***Lactation*:** 80 mg.

5. MINERALS

Calcium and Phosphorus

These are most abundant minerals in the body. They make up most of the skeletal structure. Calcium comprises of 1.5 to 2% and phosphorous about 1% of body height. They provide rigidity and strength to bone and teeth.

Sources

***Calcium*:** Milk, milk products, eggs, fish.

***Phosphorous*:** Vegetables.

Deficiency

1. Altered calcification.
2. Increased dental caries.
3. Reduction in alveolar bone formation.

Daily Requirement

***Calcium*:** adults—400 to 500 mg

***Phosphorous*:** 1.5 mg.

Magnesium

It is a constituent of bones and is present in all body cells. Magnesium is essential for the normal metabolism of calcium and potassium.

Source

Vegetables.

Deficiency

Irritability, tetany, hyperreflexia.

Daily Requirement

***Adults*:** 200 to 300 mg per day.

6. TRACE ELEMENTS

WHO has recognized 14 trace elements, which should be present in human nutrition? These are iron, iodine, fluorine, copper, zinc, cobalt, chromium, manganese, molybdenum, tin, nickel, silicon, selenium, and vanadium.

Iron

Sources

Liver, meat, poultry, fish, cereals, green leafy vegetables, legumes, nuts.

Deficiency

- Gingivitis
- Glossitis
- Stomatitis
- Delayed wound healing

Iodine

Sources

Seafood, cod liver oil, milk, meat and vegetables.

Deficiency

- Hypothyroidism
- Small jaw
- Retarded eruption of teeth
- Root resorption

Zinc

Sources

Liver, kidney, green leafy vegetables.

Deficiency

1. Thickening of skin.
2. Loss of hairs.

Copper

Widely distributed in nature.

Deficiency

- Neutropenia
- Hypocupremia occurs in patients with nephrosis, Wilson’s disease.

Requirement

Estimated copper requirement is 2 µg per day.

Trace Elements in Dental Caries

Trace elements in human dental enamel are derived from the environment during mineralization and during and after maturation of tooth.

Navia (1972) summarized the cariogenic effect of many of the minerals in a list complied to indicate relative cariogenicity.

***Cariostatic elements*:** F, P

***Mildly cariostatic*:** Mo, V, Cu, Sr, B, Li, Au

***Caries inert*:** Ba, Al, Ni, Fe, Pd, Ti

***Caries promoting*:** Se, Mg, Cd, Pt, Pb, Si.

BALANCED DIET

A balanced diet is defined as one, which contains a variety of foods in such quantities and proportions that the need for energy, amino acids, vitamins, minerals, fats, carbohydrates and other nutrients is adequately met for maintaining health.[2]

Dietary Goals[4]

The dietary goals (Prudent diet) recommended by the various expert committees of WHO are as below:

a. Dietary fat should be limited to approximately 15–30% of total daily intake.

b. Saturated fats should contribute no more than 10% of the total energy intake; unsaturated vegetable oils should be substituted for the remaining fat requirement.

c. Excessive consumption of refined carbohydrate should be avoided; some amount of carbohydrate rich in natural fibre should be taken.

d. Sources rich in energy such as fats and alcohol should be restricted.

e. Salt intake should be reduced to an average of not more than 5 g per day; (salt intake is more in tropical countries. In India, it averages 15 g per day).

f. Protein should account for approximately 10–15% of the daily intake.

g. Junk foods such as colas, ketchups and other foods that supply empty calories, should be reduced.

My PYRAMID[7]

MyPyramid, released by the United States Department of Agriculture (USDA) on April 19, 2005, is an update on the American food guide pyramid. The new icon stresses activity and moderation along with a proper mix of food groups in one's diet. Significant changes from the previous food pyramid include (Fig. 4.6):



Fig. 4.6: MyPyramid

- *Inclusion of a new symbol*—a person on the stairs—representing physical activity. Measuring quantities in cups and ounces instead of servings.

  MyPyramid contains eight divisions. From left to right on the pyramid are a person and six food groups.
- *Physical activity*, represented by a person climbing steps on the pyramid, to illustrate moderate physical activity every day, in addition to usual activity. The *key recommendations* for 2005 (other specific recommendations are provided for children and adolescents, pregnant and breastfeeding women, for older adults and for weight maintenance) are:

- Engage in regular physical activity and reduce sedentary activities to promote health, psychological well-being, and a healthy body weight. (At least 30 minutes on most, and if possible, every day for adults and at least 60 minutes each day for children and teenagers, and for most people increasing to more vigorous-intensity or a longer duration will bring greater benefits.)
- Achieve physical fitness by including cardiovascular conditioning, stretching exercises for flexibility, and resistance exercises or calisthenics for muscle strength and endurance.

DIET COUNSELLING[8]

- It deals with providing guidance in the art of food planning and food preparation and food services.
- It assists a person to adjust food consumption to his or her health needs.
- ***Diet diary*****:** It is a 3-, 5-, 7-day record in which the client records all foods and drinks consumed within the defined period. If the 24-hour diet history sweet score and dental health diet score indicate the need for nutritional counselling, the dental hygienists ask the client to complete a 3-, 5-, 7-day diet diary. A food diary that includes a weekend is more likely to represent the individual's normal eating habits. All foods consumed in a 24-hour period should be recorded including type of food eaten, manner in which it was prepared, exact amount of each food eaten, and time of day in which eaten. The client should be encouraged to adhere to his or her normal diet regimen during assessment period.
- ***Diet history evaluation*****:** The patient's 5-day diary is analysed for (1) adequacy of intake of food from all the food groups. (2) The amount and type of food sweetened with sugar and the frequency of eating them.
- The patient is asked to do the following:
  - *Step 1*: Circle in red all the foods in the 5-day diary that are sweetened with sugar. This includes concentrated forms of sweets such as dried fruits.
  - *Step 2*: The total number of exposures of the teeth to sweets, their form and when they were eaten are determined. This value is multiplied by 20. 20 denote the number of minutes the teeth are subjected to acid demineralization after each, sugar consumption.
  - *Step* 3: The adequacy of the diet in terms of the desirable number of servings of each of the food groups is determined.
- ***Dental health diet score*****:** The dental health diet score gives points earned as a result of an adequate intake of foods from each of the food

groups plus points for ingesting foods especially recommended because they are the best sources of the ten nutrients essential for achieving and maintaining dental health. From this sum, points are subtracted for frequent ingestion of foods that are overtly sweet—whose sweetness is derived from added refined sugar or concentrated natural sugars. The difference is the dental health diet score. A score of 60 to 100 is acceptable and dietary counselling is not usually given unless the patient requests it. If the sum points are 56 or less, counselling is indicated.

Steps in Calculating a Dental Health Diet Score

- *Step 1*: To ascertain the average daily intake, everything one eats and drinks on an ordinary weekday including snacks is listed. The time of meal or snack consumption, the method of food preparation and the number of teaspoons of sugar added are noted.
- *Step 2*: Circle the foods in the diary that have been sweetened with added sugar or concentrated natural sweets. Classify the encircled foods or mixed foods into one of the appropriate food groups.
  - For each of the foods listed in the food intake dairy, place a check mark in the appropriate food group block.
  - Add the number of checks and multiply by the number shown. The maximum number of point's credit for the milk and meat group is 24 each and for the fruit vegetable bread cereal group is 24 each.
  - Add the points. The sum is the food group score. 96 are the highest score.
- *Step 3*: In each of the 8 columns of food, check the one or more eaten on this weekday. If a food is checked, circle the number (7) beside the nutrient that heads the column. The same food such as broccoli, may be found in several columns also, in a column more than one food may be checked. Regardless of the number of times, the score of seven is given only once. 56 is the perfect score. Add the numbers circled to obtain the nutrient score.
- *Step 4*: List the sweets and sugar sweetened foods and the frequency with which they are consumed in a typical day.
  - Classify each sweet into the liquid, solid and sticky, or slowly dissolving category.
  - Place a check mark in the frequency column for each item as long as they are eaten at least 20 minutes apart.
  - Add the number of checks. If the sweets are liquid, multiply by 5. If solid, multiply by 10 and if slow dissolving, multiply by 15.
  - Write the products in the point's column and total them. This is the sweet score.

- *Step 5*: Now put it all together. If the 4 food groups score is barely adequate or not adequate and or the sweet score is in the watch out zone—nutrition counselling is indicated.

NUTRITIONAL PROBLEMS IN PUBLIC HEALTH

There are many nutritional problems, which affect vast segments of our populations.[2]

1. Low Birth Weight

Low birth weight (i.e. birth weight less than 2500 g) is a major public health problem. About 30% of babies born in India have low birth weight.

Causes of Low Birth Weight

1. Maternal malnutrition and anaemia
2. Physical labour during pregnancy
3. Illness especially infection, etc.

2. Protein Energy Malnutrition

It has been identified as a major health and nutrition problem in India.[1] The current concept of PEM is its clinical forms—kwashiorkor and marasmus. Protein energy malnutrition was due to protein deficiency.

Causes

1. Inadequate intake of food both in quantity and quality.
2. Infections notably diarrhoea, respiratory infections, measles, etc.
3. Other contributory factors are poor environmental conditions, large family size, poor maternal health, failure of lactation, premature termination of breastfeeding.

3. Xerophthalmia

It refers to all the ocular manifestations of vitamin A deficiency in man.

Xerophthalmia is most common in children aged 1–3 years, and is often related to weaning. The younger the child, the more severe the disease. The victims belong to the poorest families.

4. Nutritional Anaemia

Nutritional anaemia is a disease syndrome caused by malnutrition in its widest sense.

It has been defined by WHO as “a condition in which the haemoglobin content of blood is lower than normal as a result of a deficiency of one or more essential nutrients regardless of the cause of such deficiency.”[6]

Causes

1. Iron deficiency
2. Frequently folate or vitamin B_{12} deficiency.

5. Iodine Deficiency Disorders (IDD)

Iodine deficiency is yet another major nutrition problem in India.[1] Iodine deficiency was equated with goitre (Fig. 4.7).



Fig. 4.7: Deficiency of iodine—goitre

The most obvious consequence of iodine deficiency is goitre. There is much wider spectrum of disorders such as:

1. Hypothyroidism.
2. Retarded physical development.
3. Impaired mental function.
4. Increased rate of spontaneous abortion.
5. Neurological cretinism.

Iodine deficiency disorder (IDD) refers to all the effects of iodine deficiency on human growth and development, which can be prevented by correction of iodine deficiency.

6. Endemic Fluorosis

In many parts of the world, where drinking water contains excessive amounts of fluorine, endemic fluorosis has been observed.

a. Dental Fluorosis

Fluorosis of dental enamel which occurs when excess fluoride is ingested during the years of tooth calcification is characterized by “mottling” of dental enamel.

Teeth lose their shiny appearance and chalky-white patches develop on them. White patches become yellow and sometimes brown or black.

In severe cases, loss of enamel gives the tooth a corroded appearance.

Mottling is best seen on the incisors of the upper jaw.

b. Skeletal Fluorosis

There is heavy deposition of fluoride in the skeleton. When a concentration of 10 mg/l is exceeded, crippling fluorosis can ensue leading to permanent disability.

c. Genu Valgum

A new form of fluorosis characterized by genu valgum and osteoporosis of lower limits.

7. Lathyrism

It is a paralyzing disease of humans and animals.

In humans—neurolathyrism affecting nervous system.

In animals—osteolathyrism resulting in skeletal deformities because of pathological changes occurring in bones.

ORAL MANIFESTATIONS ASSOCIATED WITH MALNUTRITION

The clinical evaluation of a patient may show specific pathologic changes in oral tissues caused by malnutrition.[5]

1. Lips

The changes in lips are usually observed on exposed mucosa and angles of the mouth. Riboflavin, niacin and iron deficiencies are associated with these lesions. The most common lesions are:

a. Cheilosis

b. Angular lesions.

2. Teeth

The conditions seen in teeth are:

a. Mottled enamel
b. Linear hypoplasia
c. Melanodontia
d. Malposition.

3. Gums

The conditions seen are:

a. Scorbutic type
b. Gingivitis
c. Hypertrophic gingivitis.

Table 4.1: Nutrition assessment schedule[4]

Serial no.	:	Date	:
Name	:	Age	:
Address	:	Sex	:
District	:	Village	:

Clinical:

1. General appearance	:	Normal built/thin built/sickly
2. Hair	:	Normal/lack of luster/depigmented thin and sparse/easily pluck able/flag sign
3. Face	:	Diffuse depigmentation/nasolabial dyssebacea/moon face
4. Eyes	:	Conjuctiva—normal/dry on exposure for ½ minute/dry and wrinkled/Bitot's spots/brown pigmentation/angular conjunctivitis. Pale conjunctiva. Cornea—normal/dryness/hazy or opaque
5. Lips	:	Normal/angular stomatitis/cheilosis
6. Tongue	:	Normal/pale and flabby/red and raw/fissured/geographic
7. Teeth	:	Mottled enamel/caries/attrition
8. Gums	:	Normal/spongy/bleeding
9. Glands	:	Thyroid enlargement/parotid enlargement
10. Skin	:	Normal/dry and scaly/follicular hyperkeratosis/petechial/pellagrous dermatosis/flanky paint dermatosis/scrotal and vulval dermatosis
11. Nail	:	Koilonychia
12. Oedema	:	Independent parts
13. Rachitic changes	:	Knock-knees or bow legs/epiphyseal enlargement beading of the ribs/pigeon chest
14. Internal systems	:	Hepatomegaly/psychomotor change/mental confusion/sensory loss/muscle wasting/motor weakness/loss of position sense/loss of vibration sense/loss of ankle and knee jerks/calf tenderness/cardiac enlargement/tachycardia

Anthropometric:

Weight (kg)	:
Head circumference (cm)	:
Height (cm)	:
Chest circumference (cm)	:
Mid-upper-arm circumference (cm)	:
Skin fold	:

Laboratory:

1. Haemoglobin: (Specify method)
2. Stool: Negative/ascariasis/ancylostomiasis/giardiasis amoebiasis/strongyloides/others
3. Blood smear: Negative/MT/BT/filaria

4. Tongue

The conditions seen are:

a. Filiform and fungiform papillary atrophy
b. Papillary hypertrophy or hyperemia
c. Magenta tongue
d. Scarlet red glossitis
e. Beefy red glossitis.

Conclusion

Oral health cannot be exclusively maintained through one approach, i.e. through nutritional guidance, dietary manipulations, chemo-thrapeutic agents, or restorative procedures. The chances for preserving oral health, however, are improved by lifelong disciplined dedication of the individuals who understands the benefits to be derived from the combined effects of oral hygiene, fluorides, and adequate nutrition and diet and who incorporates this knowledge into their daily habits.

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CHAPTER

5

Health Education

Health education is the profession of educating people about health.[1] It involves a combination of learning experiences designed to help individuals and communities improve their health, by increasing their knowledge or influencing their attitudes.

Health education is the very foundation of every successful public health programme, thus is an essential part of community health, which is vital to the practice of prevention. The purpose of health education is to positively influence the health behaviour of individuals and communities as well as the living and working conditions that influence their health. Health education aims at bridging the gulf between the health knowledge and health practices among people.

Definition

Health education in simple can be defined as the principle by which individuals and groups of people learn to behave in a manner conducive to the promotion, maintenance, or restoration of health. However, there is no single acceptable definition of health education, a variety of definitions exist.

The Joint Committee on Health Education and Promotion Terminology of 2001 defined health education as any combination of planned learning experiences based on sound theories that provide individuals, groups, and communities the opportunity to acquire information and the skills needed to make quality health decisions.[2]

The most accepted and adopted definition given by the National Conference on Preventive Medicine [1997] in USA defines, “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 the goal and conducts professional training and research to the same end.”[3]

World Health Organization defines it as “any combination of learning opportunities and teaching activities designed to facilitate voluntary adaptations of behaviours, that are conducive to health”.[4]

Changing Concepts

The declaration of Alma-Ata (1978) emphasized the need for “individual and community participation” which gave a new meaning and direction to the practice of health education. Historically, health education has been committed to disseminating information and changing human behaviour. Following the Alma-Ata declaration in 1978 emphasis has shifted from:

- Prevention of disease to promotion of healthy lifestyles.
- Modification of individual behaviour to modification of social environment in which the individual lives.
- Community participation to community involvement.

OBJECTIVES

The three main objectives of health education are:

- ***Informing the people*:** The primary objective of health education is to inform the people or provide scientific knowledge about prevention of disease and promotion of health. Exposure to knowledge will melt away the barriers of ignorance, prejudices, and misconceptions, people may have about health and disease.[3]
- ***Motivating people*:** Informing people about health is not merely enough. They must be motivated to change their habits and the ways of living, since many present day problems of community health require alteration of human behaviour or changes in health practices which are detrimental to health, like pollution of water, cigarette smoking, physical activity, etc. The accent should be on motivating the "consumer" to make his own decision and choices about health matters, i.e. what kind of health actions to be taken, and when and under what conditions to take them.
- ***Guiding into action*:** People need help to adopt and maintain healthy practices and lifestyles, which may be totally new to them. Governments have a major responsibility to provide the necessary infrastructure of health services. People need to be encouraged "to use judiciously and wisely the health services available to them".[3] Governments are now beginning to realize that the services and facilities they provide to improve the socioeconomic and health status of the people will not be fully effective unless the people not only make use of the services but also undertake various practical self-help measures to improve their own health status and the communities in which they live in.

However, the final aim of health education is to make realistic improvements in the basic quality of life of people.

APPROACH TO HEALTH EDUCATION

There are basically four well-known approaches to health education. They are: (a) Regulatory or legal approach, (b) administrative or service approach, (c) educational approach and the recent, (d) primary health care approach.

- ***Regulatory approach*:** The regulatory or legal approach seeks to protect the health of the public through the enforcement of laws and regulations, e.g. Food Adulteration Act, Epidemic Diseases Act, etc.

  The major disadvantage with this approach is that it requires is a vast administrative machinery to enforce laws and also involves considerable expenditure. Another is it becomes useful only at certain times or in restricted situations.

- ***Service approach*:** This approach aims at providing all the health facilities needed by the community in the hope that people would use them to improve their own health. It proved a failure when it was not based on the "felt needs" of the people.

- ***Educational approach*:** This approach is one of the major means for achieving change in health practices and the recognition of health needs in the modern world. It involves motivation, communication and decision-making. The results, although slow, are permanent and enduring.

- ***Primary health care approach*:** This is a new approach starting from the people with their full participation and active involvement. The underlying objective is to help individuals to become self-reliant in matters of health. This, in turn, can be done, if the people receive the necessary guidance from health care providers in identifying their health problems and finding workable solutions.

Health Education and Propaganda

Health education and propaganda are not the same. They differ in a number of characteristics. Propaganda involves mainly publicity, whereas education is a process that facilitates the act of learning. The differences between these two drawn by the ***Central Health Education Bureau, Government of India*** are listed in Table 5.1.

Table 5.1: Differences between health education and propaganda

	Health education	***Propaganda or publicity***
1.	Knowledge and skills actively acquired	Knowledge instilled in the minds of the people
2.	Makes people think for themselves	Prevents thinking with the availability of readymade slogans
3.	Disciplines primitive desires	Arouses and stimulates primitive desires
4.	Develops reflective behaviour Trains people to use judgment before acting	Develops reflexive behaviour Trains people to aim at impulsive actions
5.	Appeals to reason	Appeals to emotion
6.	Develops individuality, personality and self-expression	Develops different patterns of attitude and behaviours according to the medium used
7.	Knowledge acquired through and self-reliant activity	Knowledge passively received and spoon fed
8.	The process is behaviour centred – aims at developing favourable attitudes, habits and skills	The process is information centred – no change in individual's attitude or behaviour

MODELS OF HEALTH EDUCATION

Medical Model

This model is primarily based in the recognition and treatment of disease curing and technological advancements to facilitate the process.

The assumption was people would act on the information provided by health professional to improve their health. However, since this model did not take into consideration the social, cultural and psychological factors and hence could not bridge the gap between knowledge and behaviour.

Motivation Model

It was noticed that mere provision of health information to people did not bring about any significant changes; hence health education started emphasizing “motivation” as the main force to translate health information to the desired health action.

Social Intervention Model

With rising public health problems being faced in today's world, it was impractical for the earlier approaches to achieve any behavioural changes. It was realized that in many instances, it is not the individual who needs to be changed but the social environment which shapes the behaviour of the individual and the community.

An effective health education model should be based on the precise knowledge of human ecology and understanding of the interaction between the cultural, biological, physical and socio-environmental factors.

CONTENTS OF HEALTH EDUCATION

The scope of health education extends beyond the conventional health sector. It covers every aspect of family and community health. While no definite training curricula can be proposed, the content of health education may be divided into the following divisions for the sake of simplicity.

Human Biology

Understanding health, demands an understanding of the human biology. The best place to teach human biology is the school, through its sequential health curriculum which can provide continuous in-depth learning experience for millions of students, as teaching of human biology starts from the lower classes itself. The provision of information and advice on human biology and hygiene is vital for each new generation.

Nutrition

The aim of educating people about nutrition is to inform them the importance of optimum and balanced diet. It also is a major intervention for the prevention of malnutrition, promotion of health and improving the quality of life.

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 within the surroundings where the people live. Measures of basic hygiene are taught here like bathing, washing, keeping good personal appearance, etc.

b. ***Environmental hygiene*:** This comprises of two aspects—domestic and community.

The 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.

The community hygiene includes the care of the surroundings where the person lives in, proper channels for waste disposal, avoidance of water stagnation, etc.

Family Health

The main aim is to strengthen and improve the health of the family as a unit rather than as an individual. Currently the focus has been mainly with regard to maternal and child health care, family planning, immunization, nutrition and other health, related activities.

Disease Prevention and Control

The aim is to provide knowledge about the nature of communicable and non-communicable diseases and methods of preventing them. People must be encouraged to actively participate in programmes directed towards disease prevention, health protection and promotion.

Mental Health

The aim is to help people to be mentally healthy and to prevent a mental breakdown. There are certain situations when mental health is of great importance—mother after child birth, child at entry into school for the first time, decision about a future career, starting a new family and at the time of widowhood. These are critical periods of life when external pressure tends to breakdown mental health. Health workers should help people achieve mental health by showing sympathy, understanding, and by social contact.

Prevention of Accidents

Accidents have become a major feature of modern human life. People have to be taught on the prevention of accidents, which takes place in their homes, in their work place or on the road.

Use of Health Services

Individuals have to be educated and informed about the various health services and preventive programmes available to them. The community should always be encouraged to participate in various health education and preventive programmes.

PRINCIPLES OF HEALTH EDUCATION

Health education is a social science that draws its content mainly from biological, environmental, psychological, physical and medical sciences. The main principles of health education include:

- Credibility
- Interest
- Participation
- Motivation
- Comprehension
- Reinforcement
- Learning by doing
- Known to unknown
- Setting an example
- Soil, seed and sower
- Good human relations
- Social leaders
- Feedback

Credibility

It is the degree to which the message to be communicated is perceived as trustworthy by the receiver. Unless the people have trust and confidence in the communicator, no desired action will ensue after receiving the message.

Interest

Health education should be related to the interest of the people. If a health programme is based on “felt needs”, people will gladly participate in the programme and only then it will be a people’s programme.

Participation

It is a key word in health education. People should be encouraged to be a part of the health education programme. Participation is based on psychological principle of active learning; it is better than passive learning. Group discussion, panel discussion, workshop all provide opportunities for active learning.

Motivation

All individuals have a desire to learn. Awakening this desire is called motivation. There are of two types:

- *Primary*: These are inborn desires which initiate people to take action, e.g. hunger, survival, etc.
- *Secondary*: These motives are based on desires created by external forces or incentives, e.g. praise, reward, etc.

In health education, we make use of motivation to change behaviour. Motivation is contagious; once motivated person may spread motivation throughout the group.

Comprehension

In health education, we must know the level of understanding, education and literacy of people to whom the teachings are directed. One barrier to communication is using words, which cannot be understood. We should always communicate in the language people understand, and never use words, which are strange and new to them. Teaching should be within the mental capacity of the audience.

Reinforcement

Learning new things in a single period is difficult. This requires constant repetition. It is like a booster dose. This is because constant reinforcement leaves a stronger impression on mind and helps to understand and accept new principles.

Learning by Doing

Learning is an action process; not a memorizing one in a narrow sense. The Chinese proverb “if I hear, I forget; if I see, I remember; if I do; I know” illustrates the importance of learning by doing.

Known to Unknown

In health education work, we proceed from the known to unknown, i.e. start where the people are and with what they understand and then proceed to new knowledge. New knowledge will bring about a new, enlarged understanding, which can give rise to an insight into the problem.

Setting an Example

The health educator himself should set a good example in the things he is teaching which will help people to look upon him and lead a healthy lifestyle.

Soil, Seed and Sower

In the context of health education, soil refers to people to whom education is given. Seed refers to the health facts to be given to the people. The health facts must be truthful and based on scientific knowledge. Sower refers to the transmitting media. The transmitting media should be attractive, palatable and acceptable.

Good Human Relations

Good human relations are of utmost importance in learning. The health educator must be kind and sympathetic.

Leaders

We learn best from people whom we respect and regard. In the work of health education, we try to penetrate the community through the local leaders —the village headman, the school teacher or the political worker. If the leaders are convinced first about the programme the task of implementing the programme will be easy.

***The attributes of a leader are*:**

- He understands the needs and demands of the community
- Provides proper guidance
- Takes the initiative
- Is receptive to the views and suggestions of the people
- Self-less, honest, impartial, considerate and sincere
- Easily accessible to the people
- Able to control and compromise the various fractions in the community
- Possesses the requisite skill and knowledge of eliciting cooperation and achieving coordination of the various official and nonofficial organizations.

Feedback

Feedback is one of the key concepts of the systems approach. The health educator can modify the elements of the system (e.g. message, channel) in the light of feedback from his audience. For effective communication, the feedback is of paramount importance.

COMMUNICATION IN HEALTH EDUCATION

Communication plays an important part in the process of learning and education. It forms the basis for exchange of ideas or information and plays a significant role in human daily life. The health educator should know how to communicate effectively with the people to whom he imparts health education.

Communication can be regarded as a twoway process of exchanging or shaping ideas, feelings and information. The art and science of communication forms the principal foundation of health education and disease prevention.

Key Elements in Communication[5]

The entire process of communication is generally made up of four key elements which are the following:

- *Communicator*: He is the originator of the message. An effective communicator must know the objectives, understand the needs of the audience, identify the interests of the people and know the proper medium for communication to be used.
- *Audience*: They are the consumers of the message and may be the total population or specific groups. The audience should have the patience to listen to the communicator and should also clarify their doubts or matters which they have not understood.
- *Message*: It is the information a communicator wishes his audience to receive, understand, accept, and act upon. The message should be based or related to the interests of the people, clear and easily understandable, be specific and should be in conjunction with the objectives of the programme.
- *Channels of communication*: It is the medium of communication and an attempt should be made to provide variety in selecting the channels so as to keep the teaching process interesting and entertaining.

Types of Communication

- ***One-way communication (didactic method)*:** This involves flow of communication in one direction from the communicator to the audience. The most common example would be the lecture method in classrooms. The drawbacks of this method include:
  - Knowledge is imposed
  - Learning is authoritative
  - Does not influence human behaviour
  - No feedback
- ***Tzvo-zvay communication (socratic method):*** This method of communication involves both the communicator and the audience. The audience may raise questions, ideas and opinions to the subject. Here the process of learning is more active and democratic and is most likely to influence human behaviour than didactic method.
- ***Verbal communication*:** This is the traditional way of communication by word of mouth. Direct verbal communication may be loaded with hidden meanings and is persuasive.
- ***Non-verbal communication:*** This type of communication mainly involves a whole range of bodily movements and facial expressions. Silence is non-verbal communication. It can speak louder than words.
- ***Formal and informal communications:*** Formal communication follows lines of authority whereas informal communication is conversing with friends or colleagues. Informal communication may be more effective, if formal channels do not cater to the information needs.
- ***Visual communication:*** The visual form of communication comprise: charts and graphs, pictograms, tables, maps, poster, etc.

Barriers of Communication

Researchers have identified many barriers in communication that can be classified as follows:

- ***Physiological***: Difficulties in hearing, expression.
- ***Psychological***: Emotional disturbances and neurosis.
- ***Environmental***: Noise, invisibility, congestion.
- ***Cultural***: Levels of knowledge and understanding, customs, beliefs, attitudes.

The barriers should be identified and removed for achieving effective communication. Inability to do so will leave an impact upon the health message given to them.

EDUCATIONAL AIDS IN HEALTH EDUCATION

Health educators make use of various aids in the process of health education. They can be classified mainly into audio, video and a combination of both.[5]

1. ***Audio aids:*** These are based on the principle of sound and electricity. These include the following:
   - Tape recorder
   - Microphones
   - Amplifiers
   - Radio
   - Gramophones
2. ***Visual aids:***
   a. ***Not requiring projection:*** Models, blackboard, charts, leaflets, posters and exhibits.
   b. ***Requiring projection:*** Slides, film strip, bioscope and projectors.
3. ***Combined AV aids:***
   - TV
   - Sound films (cinema)
   - Slide-tape combination
   - Multimedia computers

A thorough knowledge of the advantages, disadvantages and limitations of each audiovisual aid is necessary in order to make proper use of them. AV aids are the means to an end, not an end in themselves.

METHODS IN HEALTH COMMUNICATION

The methods in health education may be grouped into three main types. These include individual, group and mass approach. Anyone or a combination of these methods can be used selectively at different times, depending upon the objectives to be achieved, the behaviour to be influenced and available funds.

Individual Approach

It may be given in personal interviews in the consultation room of the doctor or in health centre or in homes of the people. The people involved are the public health nurses, health visitors and health inspectors, Anganwadi workers.

Individual approach	***Group approach***	***Mass approach***
1. Personal contact	1. Lectures	1. Television
2. Home visit	2. Demonstrations	2. Radio
3. Personal letters	3. Discussion methods	3. News papers
	• Group discussion	4. Printed materials
	• Panel discussion	5. Direct mailing
	• Symposium	6. Posters
	• Workshop and conferences	7. Health museum and exhibition
	• Seminars	8. Folk methods
	• Role play	9. Internet

The biggest ***advantage*** of individual health teaching is that we can discuss, argue and persuade the individual to change his behaviour. It provides opportunities to ask questions in terms of specific interests.

The ***limitation*** of individual health teaching is that the numbers we reach are small, and health education is given only to those who come in contact with us.

Group Approach

Our society contains groups of many kinds.

- School children, mothers, industrial workers, patients, etc. Group teaching is an effective way of educating the community.
- The choice of subject in group health teaching is very important. It must relate directly to the interest of the group. A brief account of the various methods of group education is described below.

1. ***Chalk and talk (lecture)*****:** May be defined as—carefully prepared oral presentation of facts, organized thoughts and ideas by the qualified person. Lecture effectiveness depends on speaker's ability to write legibly and draw on black board. The group to whom the lecture is given should not be more than 30 and talk should not exceed 15–20 minutes.

The lecture method can be more effective by combining with suitable audiovisual aids as:

- *Flip charts*: Series of charts (or posters) 25 × 30 cm or more flashed or displayed. These flip charts should be brief and to the point, hold attention, help lecture to proceed.
- *Flannel graph*: Rough flannel or khadi fixed over a wooden board is used as a background, over this the cutout pictures, graphs, drawing, etc. are displayed. The pictures are made rough on back side by pasting a piece of sand paper which will make it adhere at once when put on flannel.
- *Exhibits*: Objects, models, specimens and films and charts.

Disadvantages of lectures

- Students are involved to a minimum extent
- Learning is passive
- Do not stimulate thinking or problem solving capacity
- The health behaviour of listeners are not necessarily affected.

2. ***Demonstration*****:** A demonstration is a carefully prepared presentation to show how to perform a skill or procedure. The demonstration is performed step by step in front of the audience making them

understand and involve in discussion. This upholds the principle of 'seeing is believing' and 'learning by doing'. This approach has a high motivational value.

3. ***Group discussion*:** It is a very effective method that permits to learn by freely exchanging their ideas, knowledge and opinions. For effective group discussions, the group should not be less than 6 and not more than 12 members. Here the participants are all seated in a circle.

   There should be a leader—initiates, avoids side conversations, encourages everyone to participate and sums up the discussion in the end. In group discussion, members should follow certain rules as:

   - Express ideas clearly and concisely
   - Listen to what others say
   - Do not interrupt when others are speaking
   - Accept criticism gracefully
   - Help to reach conclusions

   ***Limitations*:** Unequal participation of members and some may deviate from the subject

4. ***Panel discussion*:** Here about 4–8 persons who are qualified to talk about a topic will discuss the given problem in front of a large group or audience. The panel discussion comprises of a chairman or moderator and 4–8 speakers.

   There is no specific agenda, no order of speaking and no set speeches. After speaker's discussion, the audience is invited to take part. The discussion should be spontaneous and natural. This approach can be extremely useful method of education, provided it is properly planned and guided.

5. ***Symposium*:** It is a series of speeches on selected subjects. Each person or expert presents an aspect of the subject briefly. There is no discussion among speakers. Audience may raise questions. At the end, chairman makes a comprehensive summary.

6. ***Workshop*:** Consists of a series of meeting (4 or more) with emphasis on individual work, within the group, with the help of consultants and resource personnel. It provides opportunities to improve his effectiveness as a professional worker.

7. ***Role-playing (socio drama)*:** This approach is based on assumption that many values in situation cannot be expressed in words and the communication can be more effective, if dramatized by the group. The size of the group will be best at 25. This is followed by discussion of the problem.

8. ***Conferences and seminars*:** Usually held on a regional, state or national level and ranges from half a day to a week length. May cover single topic in depth or be broadly comprehensive. Here they use a variety of aids from self instruction to multimedia.

9. ***Colloquy*:** Audience gets the opportunity for direct participation. A group of experts on particular topic of discussion are selected and they listen to the problems or questions raised by the members of the audience. The experts give answers and comments on the particular problem.

Mass Approach—Education of the General Public

These are one-way communication approach and are useful in transmitting messages to the people even in remotest places. The numbers reached by this approach are usually millions. This is the approach that can give high returns for the time and money involved. These include:

- Television
- Radio
- Health magazine
- News papers
- Printed materials
- Direct mailing
- Posters, bill boards and signs
- Health museums and exhibitions
- Films

The mass media are only instruments. As such they are neither good nor bad; what matters is the message they carry and the way the message is delivered. However, this approach used when alone is inefficient in changing human behaviour, and has to be used in conjugation with other methods for it to be effective.

THE SITE OF ORAL HEALTH EDUCATION

1. ***In the office or clinic*:** The process of education for oral health applies in the one-to-one setting with a patient. First, of course, is the advantage of working with one person at a time. Second, the dental professional often sees these same persons periodically over longer periods of time, perhaps for many years permitting the development of high levels of trust and allowing reinforcement and gradually refinement of desirable skills, knowledge and attitudes.[6] It is not necessary to teach everything at once, a reasonable long-range educational plan can be developed and implemented for each patient.

2. ***In the school*:** An atmosphere in which the pursuit of knowledge prevails would seem the ideal location to bring about extensive changes in oral health behaviours, attitudes and knowledge. Recent teaching has focused on developing the knowledge and skills needed to brush and floss the teeth. Attention also has been directed to establishing desired habits by including supervised plaque removal in the class. Should a classroom session be planned, several factors must be remembered.

   First, the visit should be cleared with all persons who have responsibility for monitoring instructions by non-school personnel. Prior to the visit the process of planning, including a careful identification of needs for instruction should be conducted and appropriate objectives established-preferably jointly with the teacher and the students. Finally after instruction has been given, it should be evaluated against the objective.[6]

3. ***In the community*:** Education for oral health in the community often seems limited to activities such as puppet shows, smile contests or public service announcements on television, radio, or newspaper.

   The dental health professional should pursue the planning process particularly when the objective is to improve oral health status.[6] The content should emphasis the known effective preventive measures, e.g. fluorides and sealants, and educational methods should encompass activities such as community organization and community development.

PLANNING A DENTAL HEALTH EDUCATION PROGRAMME

1. ***Collect background information*:** The first stage is to collect relevant information on the problem. It is necessary to establish the correct scientific facts which are to be communicated.
2. ***Define the target population*:** The target population will ensure efficient utilisation of resources by preventing the inclusion of irrelevant groups.
3. ***Assessment of baseline knowledge*:** Too often health educators tell people what they already know and fail to give information that the target group wants.
4. ***Anchorage attitude*:** These are basic to a person's way of life and are a form of personal identity. People strongly resist the attempt to change them. Health educators should try to utilize these believes and opinions in a positive way.
5. ***Level of literacy*:** Before using visual or written presentation, it is essential to assess population levels of literacy so that the appropriate educational techniques are utilized.
6. ***Define objective*:** It is necessary to have precise objectives stated in terms of the knowledge or behaviour that are expected from the target group.
7. ***Assess resources*:** It is important to ensure that the necessary facilities and personnel are available to carry out the programme. It is necessary to consider the possible effects of programme on other professional groups.
8. ***Pilot study*:** Ideas are put into practice on a small scale so that problems can be discovered and necessary modifications made before the main programme is initiated.
9. ***Timing of a programme***: It is important to give careful consideration to the timing of a health education. This will reduce the possibility of the target population not being available and receptive.
10. ***Evaluation*:** This should occur during the conduct of the programme

and at the end.

a. *Mid-term evaluation*: It is important to monitor the programme as it is being conducted to ensure that it is proceeding as designed and planned.

b. *End-term evaluation*: The evaluation of the health education programme can be done at the end of the programme, provided the objectives of the programme are clearly defined. It is possible to measure the change in knowledge and attitudes by well-designed questionnaire.

CONCLUSION

Health education is the systematic application of a set of techniques to voluntarily and positively influence health through changing the antecedents of behaviors in individuals, groups, or communities. It is a complex activity which includes a variety of individuals who play a vital role. Effective health education is largely dependent upon detailed planning and team work.

It is important that all health education advice and support is based upon scientifically sound evidence. Health education the context exceeds beyond the conventional sectors and should be the concern of everybody engaged in any form of community related works.

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CHAPTER

6

Health Care Delivery Systems

India is a country of 28 states and 7 union territories. Under the Constitution of India, the states are largely independent in matters relating to the delivery of health care to the people. Each state, therefore, has developed its own system of health care delivery, independent of the Central Government. The Central responsibility consists mainly of policy making, planning, guiding, assisting, evaluating, and coordinating the work of the state health ministries, so that health services cover every part of the country, and no state lags behind for want of these services.

HEALTH SYSTEM IN INDIA

The health system in India has 3 main links, i.e. central, state and local or peripheral.[1]

I – At the Centre

The official "organs" of the health system at the national level consist of: (1) The Union Ministry of Health and Family Welfare, (2) The Directorate General of Health Services and, (3) The Central Council of Health and Family Welfare.

1. Union Ministry of Health and Family Welfare

1. Organization

A Cabinet Minister, a Minister of State and a Deputy Health Minister head the Union Ministry of Health and Family Welfare. These are political appointments. Currently, the Union Health Ministry has the following departments: (1) Department of Health and (2) Department of Family Welfare. A Secretary heads the Health Department to the Government of India as its executive head, assisted by joint secretaries, deputy secretaries and a large administrative staff. The Department of Family Welfare was created in 1966 within the Ministry of Health and Family Welfare. The Secretary to the Govt. of India in the Ministry of Health and Family Welfare is in overall charge of the Department of Family Welfare. He is assisted by an Additional Secretary and Commissioner (Family Welfare), and one Joint Secretary.

2. Functions

The functions of the Union Health Ministry are set out in the seventh schedule of Article 246 of the Constitution of India under (a) the Union lists and (b) the Concurrent lists.

a. *Union list*: The functions given in the Union list are—(1) International health relations and administration of port quarantine, (2) Administration of central institutes such as the All India Institute of Hygiene and Public Health, Calcutta; National Institute for the Control of Communicable Diseases, Delhi, etc. (3) Promotion of research through research centres and other bodies, (4) Regulation and development of medical, pharmaceutical, dental and nursing professions, (5) Establishment and maintenance of drug standards, (6) Census, collection and publication of other statistical data, (7)

Immigration and emigration, (8) Regulation of labour in the working of mines and oil fields and (9) Coordination with states and with other ministries for promotion of health.[1]

b. *Concurrent list*: The functions listed under the concurrent list are the responsibility of both the Union and State Governments. The concurrent list includes: (1) Prevention of extension of communicable diseases from one unit to another, (2) Prevention of adulteration of foodstuffs, (3) Control of drugs, poisons, (4) Vital statistics, (5) Labour welfare, (6) Economic and social planning, and (7) Population control and family planning.

2. Directorate General of Health Services

a. ***Organisation*:** The Director General of Health Services is the principal adviser to the Union Government in both medical and public health matters. An Additional Director General of Health Services, a team of deputies and a large administrative staff assist him. The Directorate comprises of three main units, e.g. medical care and hospitals, public health and general administration.

b. ***Functions*:** The general functions are surveys, planning, coordination, programming and appraisal of all health matters in the country. The specific functions are:

1. International health relations and quarantine
2. Control of drug standards
3. Medical store depots
4. Postgraduate training
5. Medical education
6. Medical research
7. Central govt. health scheme
8. National health programmes
9. Central health education bureau
10. Health intelligence
11. National medical library

3. Central Council of Health

The Central Council of Health was set up by a Presidential Order on 9 August 1952 under Article 263 of the Constitution of India. The Union Health Minister is the Chairman and the State Health Ministers are the members.[1]

***Function*:** The functions of the Central Council of Health are:

1. To consider and recommend broad outlines of policy in regard to matters concerning health in all its aspects such as the provision of remedial and preventive care, environmental hygiene, nutrition, health education and the promotion of facilities for training and research.
2. To make proposals for legislation in fields of activity relating to medical and public health matters and to lay down the pattern of development for the country as a whole.
3. To make recommendations to the Central Government regarding distribution of available grants-in-aid for health purposes to the state and to review periodically the work accomplished in different areas through the utilization of these grants-in-aid.
4. To establish any organization or organizations invested with appropriate functions for promoting and maintaining cooperation between the Central and State Health administrations.

II – At the State Level

The state is the ultimate authority responsible for all the health services operating within its jurisdiction. In all the states, the management sector comprises the State Ministry of Health and a Directorate of Health.

1. State Ministry of Health

A Minister of Health and Family Welfare and a Deputy Minister of Health and Family Welfare head the State Ministry of Health. The Health Secretariat is the official organ of the State Ministry of Health and is headed by a Secretary who is assisted by Deputy Secretaries, Under Secretaries and a large administrative staff.[1]

2. Directorate of Health

The Director of Health Services is the chief technical adviser to the State Government on all matters relating to medicine and public health. He is also responsible for the organization and direction of all health activities. With the advent of family planning as an important programme, the designation of Director of Health Services has been changed in some states and is now known as Director of Health and Family Welfare. A recent development in some states is the appointment of a Director of Medical Education in view of the increasing number of medical colleges.

The Director of Health and Family Welfare is assisted by a number of deputies and assistants. The Deputy and Assistant Directors of Health may be of two types—regional and functional. The Regional Directors inspect all the branches of public health within their jurisdiction, irrespective of their speciality. The Functional Directors are usually specialists in a particular branch of public health such as mother and child health, family planning, nutrition, tuberculosis, leprosy, health education, etc.[1]

III – At the District Level

The District

The principal unit of administration in India is the district under a Collector. Within each district again, there are 6 types of administrative areas:

1. Sub-divisions
2. Tehsils (Taluks)
3. Community development blocks
4. Muncipalities and corporations
5. Villages
6. Panchayats

Most districts in India are divided into two or more subdivisions, each in charge of an Assistant Collector or sub-Collector. Each division is again divided into tehsils (taluks), in charge of a Tehsildar. A tehsil usually comprises between 200 and 600 villages. Since the launching of the Community Development Programme in India in 1952, the rural areas of the district have been organized into blocks, known as community development blocks, the area of which may or may not coincide with a tehsil. The block is a unit of rural planning and development, and comprises approximately 100 villages and about 80,000 to 1,20,000 population, in charge of a Block Development Officer. Finally there are the village panchayats, which are institutions of rural local self-government.

The urban areas of the district are organized into the following institutions of local selfgovernment:

1. Town area committees (in areas with population ranging between 5,000 and 10,000)
2. Municipal boards (in areas with population ranging between 10,000 and 2 lakhs)
3. Corporations (with population above 2 lakhs)

The town area committees are like panchayats. They provide sanitary services. A Chairman/President elected usually by the members heads the Municipal Boards. The term of a Municipal Board ranges between 3 and 5

years. The functions of a municipal board are: Construction and maintenance of roads, sanitation and drainage, street lighting, water supply, maintenance of hospitals and dispensaries, education, registration of births and deaths, etc. Mayors head corporations. The councilors are elected from different wards of the city. The executive agency includes the Commissioner, the Secretary, the Engineer and the Health Officer. The activities are similar to those of the municipalities, but on a much wider scale.[1]

Panchayati Raj

The Panchayati Raj is a 3-tier structure of rural local self-government in India, linking the village to the district. The three institutions are:

1. Panchayat—at the village level
2. Panchayat Samiti—at the block level
3. Zila Parishad—at the district level

1. ***Village level*:**

Gram Sabha: It is the assembly of all the adults of the village, which meets at least twice a year. The Gram Sabha considers proposals for taxation, discusses the annual programme and elects members of the Gram Panchayat.

Gram Panchayat: It is the executive organ of the Gram Sabha, and an agency for planning and development at the village level. Its strength varies from 15 to 30, and the population covered also varies widely from 5,000 to 15,000 or more. The members of the panchayat hold office for a period of 3 to 4 years. Every panchayat has an elected President (Sarpanch or Sabhapati or Mukhiya), a Vice-President and a Panchayat Secretary. The powers and functions of the Panchayat Secretary are very wide—they cover the entire field of civic administration, including sanitation and public health; and a social and economic development of the village. [2]

2. ***Block level*:** The block consists of about 100 villages and a population of about 80,000 to 1, 20,000. The Panchayati Raj agency at the block level is the Panchayat Samiti/Janpada Panchayat. The Panchayat Samiti consists of all Sarpanchas (heads) of the village panchayats in the Block; MLAs, MPs residing in the block area; representatives of

women, scheduled castes, scheduled tribes and cooperative societies. The Block Development Officer (BDO) is the ex-officio secretary of the Panchayat Samiti. The prime function of the Panchayat Samiti is the execution of the community development programme in the block. The funds provided by the government for development are channeled through the Panchayat Samiti. The Block Development Officer and his staff give technical assistance and guidance to the village panchayat engaged in development work.

3. ***District level*:** The Zilla Parishad/Zilla Panchayat is the agency of rural local selfgovernment at the district level. The Zilla Parishad is primarily supervisory and coordinating body. The members of the Zila Parishad include all heads of the Panchayat Samiti in the district; MPs, MLs of the district; representatives of scheduled castes, scheduled tribes and women, and 2 persons of experience in administration, public life or rural development. The Collector of the district is a non-voting member. Thus, the membership of the Zilla Parishad is fairly large varying from 40 to 70.

Rural Development

Community development programme

Community development was defined as "a process designed to create conditions of economic and social progress for the whole community with its active participation and the fullest possible reliance upon the community's initiative."[4]

A programme, known as the Community Development Programme, was launched on 2nd October 1952 for all-round development of the rural areas.

The Community Development Programme was envisaged as a multipurpose programme covering the following main activities—improvement of agriculture, improvement of communications, education, health and sanitation (through the establishment of primary health centres and subcentres), improvement of housing through self-help, social welfare and training in rural arts, crafts and industries to local people.

***Integrated Rural Development Programme (IRDP)*:** It was launched in April 1978 to eliminate rural poverty and improve the quality of life of the rural poor. The target families are generally agricultural labourers, small

cultivators, village artisans and craftsmen. They are provided with resources and skills, bank loans and subsidies by the government. The IRDP is being implemented through District Rural Development Agency (DRDA).

The Village Level Worker

The village level worker (Gram Sevak) is the key person responsible for transforming the economic and social life of the people. Each Gram Sevak is in charge of 10 villages and attends to 5 or 6 thousand people. He lives with the people and keeps in close touch with them and their families. He probes into their “felt-needs” and seeks to arouse in them interest in all-round family and village development. In short, he functions as a multipurpose worker and a link between the people and governmental agencies.

NATIONAL HEALTH POLICY

The main objective of this policy is to achieve an acceptable standard of good health amongst the general population of the country. The approach would be to increase access to the decentralized public health system by establishing new infrastructure in deficient areas, and by upgrading the Infrastructure in the existing institutions. Overriding importance would be given to ensuring a more equitable access to health services across the social and geographical expanse of the country. Emphasis will be given to increasing the aggregate public health investment through a substantially increased contribution by the Central Government. It is expected that this initiative will strengthen the capacity of the public health administration at the State level to render effective service delivery. The contribution of the private sector in providing health services would be much enhanced, particularly for the population group which can afford to pay for services.

Primacy will be given to preventive and first-line curative initiatives at the primary health level through increased sectoral share of allocation. Emphasis will be laid on rational use of drugs within the allopathic system. Increased access to tried and tested systems of traditional medicine will be ensured. Within these broad objectives, NHP-2002 will endeavour to achieve the time-bound goals mentioned in Table 6.1

Table 6.1: National Health Policy—2002 goals to be achieved by 2015

Eradicate Polio and Yaws	2005
Eliminate Leprosy	2005
Eliminate Kala-azar	2010
Eliminate Lymphatic Filariasis	2015
Achieve zero level growth of HIV/AIDS	2007
Reduce mortality by 50% on account of TB, Malaria and other vector borne diseases	2010
Reduce prevalence of blindness to 0.5%	2010
Reduce IMR to30/1000 and MMR to100/Lakh	2010
Increase utilization of public health facilities from current level	2010

of <20% to >75%	
Establish an integrated system of surveillance, National Health Accounts and Health statistics	2005
Increase health expenditure by Government as a % of GDP from existing 0.9% to 2.0%	2010
Increase share of central grants to constitute at least 25% of total health spending	2010
Increase state health sector spending from 5.5% to 7% of the budget	2005
Further increase to 8% of the budget	2010

HEALTH CARE SYSTEMS IN INDIA

The health care system is intended to deliver the health care services. In India, it is represented by five major sectors or agencies, which differ from each other by the health technology applied, and by the source of funds for operation. These are:

1. ***Public health sector***
    a. Primary health care
        - Primary health centres
        - Subcentres
    b. Hospitals/health centres
        - Community health centres
        - Rural hospitals
        - District hospitals/health centre
        - Specialist hospitals
        - Teaching hospitals
    c. Health insurance schemes
        - Employees state insurance
        - Central govt. health scheme
    d. Other agencies
        - Defence services
        - Railways
2. ***Private sector***
    a. Private hospitals, polyclinics, nursing homes and dispensaries
    b. General practitioners and clinics
3. ***Indigenous systems of medicine***
    - Ayurveda and Siddha
    - Unani and Tibbi
    - Homeopathy
    - Unregistered practitioners

4. ***Voluntary health agencies***
5. ***National health programmes***

1. PUBLIC HEALTH SECTOR

a. Primary Health Care

***Definition*:** "Primary health care is essential health care made universally accessible to individuals and acceptable to them, through their full participation and at a cost the community and country can afford. "[3a]

Elements of Primary Health Care

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

1. Education concerning prevailing health problems and the 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 major infectious diseases.
6. Prevention and control of locally 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.
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. There must be a continuing effort to secure meaningful involvement of the community in the planning, implementation and maintenance of health services.

3. ***Intersectoral coordination*:** An important element of intersectoral approach is planning—planning with other sectors to avoid unnecessary duplication of activities. To achieve such cooperation, countries may have to review their administrative system, relocate their resources and introduce suitable legislation to ensure that coordination can take place.

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 principles of selfreliance with the resources the community and country can afford."

In 1977, the Govt. of India launched a Rural Health Scheme, based on the principle of "placing people's health in people's hand." Keeping in view the WHO goal of "Health for All" by 2000 AD, the Govt. of India evolved a National Health Policy based on primary health care approach. It was approved by Parliament in 1983. Steps are already under way to implement the National Health Policy objectives towards achieving Health for all by the year 2000 AD.[3b] These are described below:

Village Level

To implement the National Health Policy at the village level, the following schemes are in operation:

a. Village health guide scheme
b. Training of local dais
c. ICDS scheme
d. ASHA scheme

***Village health guide*:** A village health guide is a person with an aptitude for social service and is not a full time govt. functionary. It was introduced on 2nd October 1977 with the idea of securing people's participation in the care of their own health. The guidelines for their selection are:

1. They should be permanent residents of the local community, preferably women.

2. They should be able to read and write, having minimum formal education at least up to the VI standard.
3. They should be acceptable to all sections of the community.
4. They should be able to spare at least 2 to 3 hours everyday for community health work.

They undergo a short training in primary health care at the nearest primary health centre for a duration of 200 hours, spread over a period of 3 months. On completion of training, they receive a working manual and a kit of simple medicines belonging to the modern and traditional systems of medicine in vogue in that part of the country to which they belong. The duties assigned include treatment of simple ailments and activities in first aid, mother and child health including family planning, health education and sanitation. As of date, there are 4.10 lakhs village health guides functioning in the country. The target is to achieve 1 health guide for each village or 1000 rural population.[1]

***Local dais*:** An extensive programme has been undertaken, under the Rural Health Scheme, to train all categories of local *dais* (traditional birth attendants) in the country to improve their knowledge in the elementary concepts of maternal and child health and sterilization, besides obstetric skills. The training is for 30 working days, at the primary health centre for 2 days in a week, and on the remaining 4 days of the week they accompany the health worker (female) to the villages preferably in the dai's own area. After successful completion of training, each dai is provided with a delivery kit and a certificate. The national target is to train one local dai in each village.[1]

***Anganwadi workers*:** Angan means a courtyard. Under the ICDS (Integrated Child Development Services) scheme, there is a Anganwadi worker for a population of 1000. There are about 100 such workers in each ICDS project. The Anganwadi worker is selected from the community she is expected to serve. She undergoes training in various aspects of health, nutrition, and child development for 4 months. The services provided by her include health checkup, immunization, supplementary nutrition, health education, non-formal pre-school education and referral services. The beneficiaries are especially nursing mothers, other women and children below the age of 6 years.

Accredited Social Health Activist (ASHA)

ASHA must be the resident of the village—a woman (married/widow/divorced) preferably in the age group of 25 to 45 years with formal education up to eighth class, having communication skills and leadership qualities. Adequate representation from the disadvantaged population group should be ensured to serve such groups better.

The general norm of selection will be one ASHA for 1000 population. In tribal, hilly and desert areas, the norm could be relaxed to one ASHA per habitation.

Role and responsibility of ASHA

ASHA will be a health activist in the community who will create awareness on health. Her responsibilities will be as follows:

1. ASHA will take steps to create awareness and provide information to the community on determinates of health such as nutrition, basic sanitation and hygienic practices, healthy living and working conditions, information on existing health services, and the need for timely utilization of health and family welfare services.
2. She will counsel women on birth preparedness, importance of safe delivery, breastfeeding and complementary feeding, immunization, contraception and prevention of common infections including reproductive tract infection/sexually transmitted infection and care of the young child.
3. ASHA will mobilize the community and facilitate them in accessing health and health-related services available at the Anganwadi/subcentre/primary health centres, such as immunization, antenatal check-up, postnatal check-up, supplementary nutrition, sanitation and other services being provided by the government.
4. She will work with the village health and sanitation committee of the Gram Panchayat to develop a comprehensive village health plan.
5. She will arrange escort/accompany pregnant women and children requiring treatment/admission to the nearest pre-identified health facility, i.e. primary health centre/community health centre/first referral unit.

6. ASHA will provide primary medical care for minor ailments such as diarrhoea, fevers, and first-aid for minor injuries. She will be a provider of directly observed treatment short-course (DOTS) under revised national tuberculosis control programme.
7. She will also act as a depot holder for essential provisions being made available to every habitation like oral rehydration therapy, iron folic acid tablet, chloroquine, disposable delivery kits, oral pills and condoms, etc. She will inform about the births and deaths in her village and any unusual health problems/disease outbreaks in the community to the subcentre/primary health care.
8. She will promote construction of household toilets under total sanitation campaign.

Subcentre Level

The subcentre is the peripheral outpost of the existing health delivery system in rural areas. They are being established on the basis of one subcentre for every 3000 population in hilly, tribal and backward areas and for every 5000 population in general. One male and one female multipurpose health worker attends each subcentre. The functions of a subcentre are limited to mother and child health care, family planning and immunization.

Primary Health Centre Level

The Bhore Committee on 1946 gave birth to the concept of the primary health centre as the basic health unit, to provide, as close to the people as possible, an integrated curative and a preventive health care to the rural population with emphasis on preventive and promotive aspects of health care. The Bhore Committee aimed at having a health centre to serve a population of 10,000 to 20,000 with 6 medical officers, 6 public health nurses and other supporting staff.[2]

The Central Council of Health in January 1953 had recommended the establishment of the health centres. But these centres were not able to provide adequate health coverage, partly because they were poorly staffed and equipped.

The Mudaliar Committee in 1962 had recommended that the existing primary health centre should be strengthened and the population to be served

by them to be scaled down to 40,000.

The National Health Plan 1983 proposed reorganisation of primary health centres on the basis of one primary health centre for every 30,000 rural population in the plains, and one primary health centre for every 20,000 population in hilly, tribal and backward areas for more effective coverage. As on 30th June 1996, 21, 854 primary health centres have been established in the country against the total requirement of 23,000.

Functions of the primary health centre

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

It is proposed to equip the primary health centres with facilities for selected surgical procedures and for paediatric care.

b. Hospitals/Health Centres

Community Health Centre

The community health centres were established by upgrading the primary health centres, each community health centre covering a population of 80,000 to 1.2 lakhs with 30 beds and specialists in surgery, medicine, obstetrics and gynaecology, and paediatrics with X-ray and laboratory facilities. A new non-medical post called community health officer was created at each health centre. The specialist at the community health centre may refer a patient directly to a state level hospital or the nearest medical college hospital.[1]

Staffing pattern

Manpower	*Sub centre*	*PHC*	*CHC*
Health worker (female)	1	1	
Health worker (male)	1		
Voluntary worker	1 optional		
Medical officer		1	
AYUH practitioner		Nil	
Account manager		Nil	
Pharmacist		1	
Nurse-midwife		1	7 + 2
Health educator		1	
Health asst (M and F)		2	
Clerks		2	
Lab technician		1	
Driver		1	
Class IV		4	
General surgeon			1
Physician			1
Obstetrician/ gynecologist			1
Pediatrician			1
Dresser			1
Radiographer			1
Ophthalmic asst			1
Ward boy			2
Sweeper/chowkidar/OPD attendant			3
DTP/statistical asst/OT attendant/registration clerk			5 (as per req)
Total	**2/3**	**15**	**21/ 22 + 2**

Apart from the primary health centres, the present organisation of health services of the government sector consists of rural hospitals, subdivisional/tehsils/taluka hospitals, district hospitals, speciality hospitals and teaching institutions.

Rural Hospitals

It is now proposed to upgrade the rural dispensaries to primary health centres. At present, a number of primary health centres also have hospitals. There are plans to have an epidemiological wing attached to them.

District Hospitals

There are proposals to convert the district hospitals to district health centres. A hospital differs from a health centre in the following respects:

1. In a hospital, services are provided are mostly curative, while in a health centre services are preventive, promotive and curative.
2. A hospital has no catchment area while a health centre is responsible for a definite area and population.
3. In the hospital, the team consists of only the curative staff while the health team in a health centre is a mix of medical and paramedical workers.

c. Health Insurance Schemes

There is no universal health insurance in India. Health insurance is at present limited to industrial workers and their families.

Employees State Insurance Scheme (ESI Scheme)

The ESI scheme, introduced by an Act of parliament in 1948, is a unique piece of social legislation in India. It has introduced for the first time in India, the principle of contribution by the employer and employee. The Act provides for medical care in cash and kind, benefits in the contingency of sickness, maternity, employment injury, and pension. for dependents as on the death of worker because of employment injury.

Central Government Health Scheme

This scheme was introduced in 1954 in New Delhi for the central government employees to provide comprehensive medical care to the central government employees. It is based on the principle of co-operative effort by the employee and the employer, to the mutual advantage of both.

The facilities under the scheme include:

1. Out-patient care through a network of dispensaries.
2. Supply of necessary drugs.
3. Laboratory and X-ray investigation.
4. Domiciliary visits.
5. Hospitalization facilities at government as well as private hospitals recognised for the purpose.
6. Specialist consultations.
7. Paediatric services including immunization.
8. Antenatal, natal, and postnatal services.
9. Emergency treatment.
10. Supply of optical and dental aids at reasonable rates.
11. Family welfare services.

These two schemes cover two large groups of wage earners in the

country. They are well organized health insurance schemes, and are providing reasonable medical care plus some essential preventive and promotive health services.

d. Other Health Agencies

Defence Medical Services

Defence services have their own organization for medical care to defence personal under the banner “Armed Forces Medical Services.” The services provided are integrated and comprehensive embracing preventive, promotive, and curative services.

Health Care of Railway Employees

The railways provide comprehensive health care services through the agency of railway hospitals, health units and clinics. Health check-up of employees is provided at the time of entry into service, and thereafter at yearly intervals. There are lady medical officers, health visitors and midwives who look after the maternal and child health and school health services. Specialist services are also available at the divisional hospitals.

2. PRIVATE SECTOR

In a mixed economy such as India's, private practice provides a large share of the health services available. The general practitioners constitute 70% of the medical profession and most of them tend to congregate in urban areas, providing mainly curative services to those who can pay. The Medical Council of India and the Indian Medical Association regulates some of the functions and activities of the large body of private registered practitioners.

3. INDIGENOUS SYSTEM OF MEDICINE

The practitioners of indigenous systems of medicine (ayurveda, siddha, homeopathy, etc.) provide the bulk of medical care to the rural people. Studies indicate that nearly 90% of ayurvedic physicians serve the rural areas. In recent years, there has been considerable state patronage to foster these systems of medicine. Many ayurvedic dispensaries are state run. The Government of India is studying the question of how indigenous systems of medicine could best be utilised form or effective or total health coverage.[4]

4. VOLUNTARY HEALTH AGENCIES

The voluntary health agencies occupy an important place in community health programmes. “A voluntary health agency may be defined as an organization that is administered by an autonomous board which holds meetings, collects funds for its support chiefly from private sources and expends money, whether with or without paid workers, in conducting a programme directed primarily to furthering the public health by providing health services or health education, or by advancing research or legislation for health, or by a combination of these activities”.

Functions

a. Supplementing the work of government agencies
b. Pioneering
c. Education
d. Demonstration
e. Guarding the work of government agencies
f. Advancing health legislation

Voluntary Health Agencies in India

1. ***Indian Red Cross Society*:** The Indian Red Cross Society was established in 1920. A network of over 400 branches all over India. Its activities are:
   a. Relief work
   b. Milk and medical supplies
   c. Armed forces
   d. Maternal and child welfare services
   e. Family planning
   f. Blood bank and first aid
2. ***Hind Kusht Nivaran Sangh*:** The Hind Kusht Nivaran Sangh was founded in 1950 with its headquarters in New Delhi. The programme of work of the Sangh included rendering of financial assistance to various leprosy homes and clinics, health education through publications and posters, training of medical workers and physiotherapists, conducting research and field investigations, organizing All-India leprosy workers conferences and publication of 'Leprosy in India', a quarterly journal.[4]
3. ***Indian Council for Child Welfare*:** Indian Council for Child Welfare was established in 1952. The services of ICCW are devoted to secure for India's children those "opportunities and facilities, by law and other means" which are necessary to enable them to develop physically, mentally, morally, spiritually and socially in a health and normal manner and in conditions of freedom and dignity.
4. ***Tuberculosis Association of India*:** The Tuberculosis Association of India was formed in 1939. It has branches in all the states in India. The activities of this association comprise organizing a TB Seal campaign every year to raise funds, training of doctors, health visitors and social workers in antituberculosis work, promotion of health education and promotion of consultations and conferences.
5. ***Bharat Sevak Samaj*:** The Bharat Sevak Samaj which is a non-political and nonofficial organization was formed in 1952. One of the prime objectives of the Bharat Sevak Samaj (BSS) is to help people to

achieve health by their own actions and efforts.[1]

6. ***Central Social Welfare Board*:** The Central Social Welfare Board is an autonomous organization under the general administrative control of ministry of education. The government of India in August 1953 set it up.
7. ***The Kasturba Memorial Funds*:** Created in commemoration of Kasturba Gandhi, after her death in 1944, the fund was raised with the main object of improving the lot of Indian women, especially in the villages, through Gram Sevikas.
8. ***Family Planning Association of India*:** The Family Planning Association was formed in 1949 with its headquarters at Bombay. The association has trained several hundred doctors, health visitors and social workers in propagating family planning in India.[1]
9. ***All India Women's Conference*:** Established in 1926. It is the only women's voluntary welfare organization in the country.
10. ***The All-India Blind Relief Society*:** The All-India Blind Relief Society was established in 1946 with view to coordinate different institutions working for the blind.
11. ***Professional Bodies*:** The Indian Medical Association, All India Licentiates Association, All India Dental Association, The Trained Nurses Association of India are all voluntary agencies of men and women who are qualified in their respective specialities and possess registerable qualifications. These professional bodies conduct annual conferences, publish journals, arrange scientific sessions and exhibitions, foster research, set up standards of professional education and organize relief camps during periods of natural calamities.

5. NATIONAL HEALTH PROGRAMMES

1. National malaria eradication programme
2. National filaria control programme
3. National tuberculosis programme
4. National leprosy eradication programme
5. Diarrhoeal diseases control programme
6. STD control programme
7. National programme for control of blindness
8. Iodine deficiency disorder programme
9. Universal immunisation programme
10. National family welfare programme
11. National water supply and sanitation programme
12. National diabetes control programme
13. National mental health programme
14. National cancer control programme
15. National AIDS control programme
16. Child survival and safe motherhood programme.

INTERNATIONAL HEALTH AGENCIES

World Health Organisation (WHO)

Definitions

It is a specialized, largest, non-political most prominent, self-governing, influential, multilateral health agency of United Nations with head quarters in Geneva. The constitution came into force on 7th April 1948, which is celebrated every year as "World Health Day".[3b]



Memberships

Membership in WHO is open to all countries. Each member state contribute yearly to the budget and each is entitled to the services and aid the organization can provide.

Work of WHO

1. Prevention and control of specific diseases
2. Development of comprehensive health services
3. Family health
4. Environmental health
5. Health statistics
6. Biomedical research
7. Health literature and information
8. Co-operation with other organizations

Structure

1. The world health assembly
2. The executive board
3. The secretariat

The Regions

Table 6.2: Regional organization of WHO[3b]

Region	*Headquarters*
1. South East Asia	New Delhi (India)
2. Africa	Harare (Zimbabwe)
3. The Americas	Washington DC (USA)
4. Europe	Copenhagen (Denmark)
5. Eastern Mediterranean	Alexandria (Egypt)
6. Western Pacific	Manila (Philippines)

Other United Nations Agencies

I. UNICEF

United Nations International Children's Emergency Fund. It is one of the specialized agencies of United Nations. It was established in 1946 by the United Nations General Assembly to deal with rehabilitation of children in war ravaged countries.

Content of services

1. Child health
2. Family and child welfare
3. Education

II. World Banks

World Bank is a specialized agency of the United Nations. It was established with the purpose of helping less developed countries raise their living standards. The powers of the bank are vested in a Board of Governors. The bank gives loans for projects that will lead to economic growth.

Non-Governmental Agencies

I. International Red Cross

Red Cross is a non-political, non-official international humanitarian organization devoted to the service of mankind in peace and war. Henry Dunant founded it in 1859.

II. Rockfeller Foundation

It founded by John. D. Rockfeller in 1913. Its purpose is to promote the wellbeing of mankind throughout the world. It was active chiefly in public health and medical education. Subsequently, its interest was expanded to include the advancement of life sciences, social sciences, the humanities and the agricultural sciences.

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Section

B

Epidemiology

7. Epidemiological Methods

8. Epidemiology of Oral Diseases

CHAPTER

7

Epidemiological Methods

Epidemiology is the basic science of preventive and social medicine. Epidemiology has evolved rapidly during the past three decades. Its ramifications cover not only the study of disease distribution and causation, but also health and health-related events occurring in human populations. By identifying risk factors of chronic disease, evaluating treatment modalities and health services, it has provided new opportunities for prevention, treatment, planning and improving the effectiveness and efficiency of health services. Epidemiology is derived from the word epidemic (epi = among; demos = people; logos = study).[1]

The Greek physician *Hippocrates* has been called the 'Father of Epidemiology'. He is the first person known to have examined the relationships between the occurrence of disease and environmental influences.

Definition

The study of the distribution and determinants of health-related states and events in populations, and the application of this study to control health problems (John Last-1988).

The three components of this definition are:[5]

1. ***Disease frequency*:** Basic measures of disease frequency are ratio or rate. It helps to compare disease frequency in different populations or subgroups in relation to suspected causal factors.
2. ***Distribution of disease*:** The basic tenet of epidemiology is that the distribution of disease occurs in patterns which gives a clue to the causative factors. These distribution patterns are studied in terms of time, place and person.
3. ***Determinants of disease*:** An unique feature of epidemiology is to test aetiological hypothesis and identify the underlying causes of disease. This aspect of epidemiology is known as “analytical epidemiology.”

AIMS

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

Ultimate Aim

To eliminate or reduce health problems or its consequences and promote health and wellbeing.

Principles

1. Exact observation (strict, vigorous, accurate, precise)
2. Correct interpretation (free from error)
3. Rationale explanation (intelligent, sensible, reasonable)
4. Scientific construction (by expert knowledge and technical skill).

Table 7.1: Epidemiology and clinical medicine[5]

Epidemiology	***Clinical medicine***
1. The unit of study is a defined population	1. The unit of study is a case.
2. Study the disease pattern in the entire population	2. Study the disease in the individual patient
3. Identify the source of infection, mode of spread, future trend, and control measures	3. Diagnosis, prognosis, specific treatment
4. The investigator goes into the community	4. The patient comes to the doctor
5. Subject matter is ‘conceptual’	5. Easily perceived

Epidemiological Approach

1. ***Asking questions*:**
    a. *Related to health events*—what is the event, what is its magnitude, where did it occur, when did it occur, who are affected, why did it happen?
    b. *Related to health action*—what can be done to reduce this problem, to prevent it, what action has to be taken by the community, health services, other sectors, where and for whom, what resources are required, how are the activities to be organized, what difficulties will arise and how to overcome them?
2. ***Making comparison*:** The basic approach in epidemiology is to make comparisons and draw inferences. This may be comparison of exposed and not exposed, or those having and not having the disease.

EPIDEMIOLOGIC TRIAD

The epidemiologic triangle (Fig. 7.1) is a model that scientists have developed for studying health problems. It can help us understand infectious diseases and how they spread. The triangle has three corners (called *vertices*):

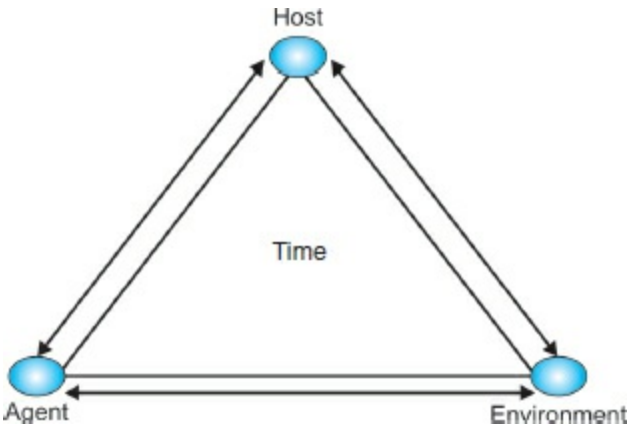


Fig. 7.1: The epidemiologic triangle

- *Agent*, or microbe that causes the disease (the "what" of the triangle)
- *Host*, or organism harboring the disease (the "who" of the triangle)
- *Environment*, or those external factors that cause or allow disease transmission (the "where" of the triangle)

An *outbreak* or an *epidemic* exists when there are more cases of a particular disease than expected in a given area, or among a specific group of people, over a particular period of time. Another term you might come across is *endemic*, when a population has a high level of the disease all the time. For example, giardiasis and even malaria are endemic in parts of the world.

The mission of an epidemiologist is to break at least one of the sides of the triangle, disrupting the connection between the environment, the host, and the agent, and stopping the continuation of disease.

Parts of the Epidemiologic Triangle

***Vertex 1*. The agent—"what"**. The agent is the cause of the disease. When studying the epidemiology of most infectious diseases, the agent is a microbe—an organism too small to be seen with the naked eye. Disease-causing microbes are bacteria, virus, fungi, and protozoa (a type of parasite). They are what most people call "germs."

***Vertex 2*. The host—"who"**. Hosts are organisms, usually humans or animals, which are exposed to and harbor a disease. The host can be the organism that gets sick, as well as any animal carrier (including insects and worms) that may or may not get sick. Although the host may or may not know it has the disease or have any outward signs of illness, the disease does take lodging from the host. The "host" heading also includes symptoms of the disease. Different people may have different reactions to the same agent. For example, adults infected with the virus *varicella* (chickenpox) are more likely than children to develop serious complications.

***Vertex 3*. The environment—"where"**. The environment is the favourable surroundings and conditions *external* to the host that cause or allow the disease to be transmitted. Some diseases live best in dirty water. Others survive in human blood. Still others, like *E. coli*, thrive in warm temperatures but are killed by high heat. Other environment factors include the season of the year (in the US, the peak of the flu season is between November and March, for example).

Time

In the center of the triangle is time. Most infectious diseases have an incubation period—the time between when the host is infected and when disease symptoms occur. Or, time may describe the duration of the illness or the amount of time a person can be sick before death or recovery occurs. Time also describes the period from an infection to the threshold of an epidemic for a population.

Core Epidemiologic Functions

In the mid-1980s, five major tasks of epidemiology in public health practice were identified: **Public health surveillance, field investigation, analytic studies, evaluation, and linkages**. A sixth task, policy development, was recently added. These tasks are described below.

Public Health Surveillance

Public health surveillance is the ongoing, systematic collection, analysis, interpretation, and dissemination of health data to help guide public health decision making and action. Surveillance is equivalent to monitoring the pulse of the community. The purpose of public health surveillance, which is sometimes called “information for action,” is to portray the ongoing patterns of disease occurrence and disease potential so that investigation, control, and prevention measures can be applied efficiently and effectively.

Field Investigation

As noted above, surveillance provides information for action. One of the first actions that results from a surveillance case report or report of a cluster is investigation by the public health department. The investigation may be as limited as a phone call to the healthcare provider to confirm or clarify the circumstances of the reported case, or it may involve a field investigation requiring the coordinated efforts of dozens of people to characterize the extent of an epidemic and to identify its cause.

Analytic Studies

Surveillance and field investigations are usually sufficient to identify causes, modes of transmission, and appropriate control and prevention measures. But sometimes analytic studies employing more rigorous methods are needed. Often the methods are used in combination—with surveillance and field investigations providing clues or hypotheses about causes and modes of transmission, and analytic studies evaluating the credibility of those hypotheses.

Evaluation

Epidemiologists, who are accustomed to using systematic and quantitative approaches, have come to play an important role in evaluation of public health services and other activities. Evaluation is the process of determining, as systematically and objectively as possible, the relevance, effectiveness, efficiency, and impact of activities with respect to established goals.

Linkages

Epidemiologists working in public health settings rarely act in isolation. In fact, field epidemiology is often said to be a "team sport." During an investigation, an epidemiologist usually participates as either a member or the leader of a multidisciplinary team. Other team members may be laboratorians, sanitarians, infection control personnel, nurses or other clinical staff, and increasingly, computer information specialists. Many outbreaks cross geographical and jurisdictional lines, so co-investigators may be from local, state, or federal levels of government, academic institutions, clinical facilities, or the private sector. To promote current and future collaboration, the epidemiologists need to maintain relationships with staff of other agencies and institutions. Mechanisms for sustaining such linkages include official memoranda of understanding, sharing of published or on-line information for public health audiences and outside partners, and informal networking that takes place at professional meetings.

Policy Development

The definition of epidemiology ends with the following phrase: "... and the application of this study to the control of health problems." While some academically minded epidemiologists have stated that epidemiologists should stick to research and not get involved in policy development or even make recommendations, public health epidemiologists do not have this luxury. Indeed, epidemiologists who understand a problem and the population in which it occurs are often in a uniquely qualified position to recommend appropriate interventions. As a result, epidemiologists working in public health regularly provide input, testimony, and recommendations regarding disease control strategies, reportable disease regulations, and healthcare policy.

MEASUREMENTS IN EPIDEMIOLOGY

1. Measurements of mortality
2. Measurements of morbidity
3. Measurements of disability
4. Measurements of natality
5. Measurements of presence, absence or distribution of the characteristics of the disease
6. Measurements of medical needs, health care facilities, utilization of health services and other health-related events
7. Measurements of environmental and other factors suspected of causing the disease

Tools of Measurements

1. ***Rate*:** Measures the occurrence of some particular events in a population during a given time period.

   Death rate

$$= \frac{\text{Number of deaths in one year}}{\text{Mid-year population}} \times 1000$$

2. ***Ratio*:** It expresses a relation in size between two random quantities. Numerator is not a component of the denominator.

$$\frac{\text{No. of children with scabies at a certain time}}{\text{No. of children with malnutrition at a certain time}}$$

3. ***Proportion*:** It is a ratio which indicates the relation in magnitude of a part of the whole. Numerator is included in the denominator. It is usually expressed as percentage.

$$\frac{\text{The number of children with scabies at a certain time}}{\text{The total number of children in the village at the same time}}$$

Concept of Numerator and Denominator

1. ***Numerator*.** Refers to then number of times an event has occurred. In case of rate, the numerator is a component of the denominator.
2. ***Denominator*:** It would be:
    a. Related to the population and would comprise of (i) mid-year population, (ii) population at risk, (iii) person-time, (iv) person distance, (v) subgroup of the population.
    b. Related to the total events and comprise of number of accidents “per 1000 vehicles.”

Measurement of Mortality

Mortality data provide the starting point for many epidemiological studies. The basis of mortality data is the death certificate.

Limitations of Mortality Data

1. Incomplete reporting
2. Lack of accuracy
3. Lack of uniformity
4. Choosing a single cause of death
5. Diseases with low fatality

Use of Mortality Data

1. Explaining trends
2. Indicating priorities for health action
3. Designing intervention programs.

Mortality Rates and Ratios

1. Crude death rate

$$= \frac{\text{Number of deaths during the year}}{\text{Mid-year population}} \times 1000$$

2. Specific death rates: It may be:
   a. Cause or disease specific
   b. Related to specific groups.

   Specific death rates due to tuberculosis

$$= \frac{\text{Number of deaths from tuberculosis during a calendar year}}{\text{Mid-year population}} \times 1000$$

   Specific death rates for males

$$= \frac{\text{Number of deaths among male during a calendar year}}{\text{Mid-year population}} \times 1000$$

3. Case fatality rate

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

4. *Proportional mortality rate*: It expresses the "number of deaths due to a particular cause (or in a specific age group) per 100 (or 1000) total deaths."

$$= \frac{\text{No. of deaths from the specific disease in a year}}{\text{Total deaths from all causes in that year}} \times 100$$

5. *Survival rate*: For example, 5-year survival rate

$$= \frac{\text{Total number of patients alive after five years}}{\text{Total number of patients diagnosed or treated}} \times 100$$

Measurement of Morbidity

Morbidity is defined as any departure, subjective or objective from a state of physiological well-being.[3]

Three aspects of morbidity are commonly measured by morbidity rates or morbidity ratios, namely frequency, duration, and severity. Disease frequency is measured by incidence and prevalence. Measure of the duration of illness is measured as average duration/cases. Case fatality rate may be used as an index of severity (Fig. 7.2).

Uses

1. They describe the extent and nature of disease in the community.
2. They usually provide more accurate and clinically relevant information on patient characteristics.
3. They serve as starting point for aetiological studies and play crucial role in prevention.
4. They are needed for monitoring and evaluation of disease control activities.

Incidence

The number of new cases occurring in a defined population during a specified period of time.

Incidence rate

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

For example, 500/30,000 × 1000

= 16.7/1000/year

***Uses of incidence rate*:** For taking action: (a) to control disease, (b) for research to aetiology and pathogenesis, distribution of diseases, and efficacy of preventive and therapeutic measures.

Prevalence

Prevalence refers specifically to all current cases (old + new) existing at a given point in time, or over a period of time in a given population.

Two types: (1) Point prevalence, (2) Period prevalence

1. *Point prevalence* is defined as the number of all current cases (old + new) of a disease at one point in time in relation to a defined population.

The "point" in point prevalence, may for all practical purposes consist of day, several days, or even a few weeks depending upon the time it takes to examine the population sample.

$$\frac{\text{Number of all current cases of a specified disease existing at a given point in time}}{\text{Estimated population at the same point in time}}$$

2. *Period prevalence* measures the frequency of all current cases existing during a period of time (annual prevalence) expressed in relation to a defined population.

$$\frac{\text{Number of all existing cases of a specified disease during a given period of time interval}}{\text{Estimated mid-interval population at risk}}$$

Uses of prevalence

1. Helps to estimate the magnitude of health/disease problems in the community and identify high-risk populations.
2. Useful for administrative and planning purposes.

Relationship between prevalence (P) and incidence (I)

$P = I \times D$

$I = P/D$

$D = P/I$

I = 10 cases/1000 population/year

D = 5 years

$P = 10 \times 5 = 50/1000$ population

Longer the duration of the disease, greater its prevalence, e.g. tuberculosis.

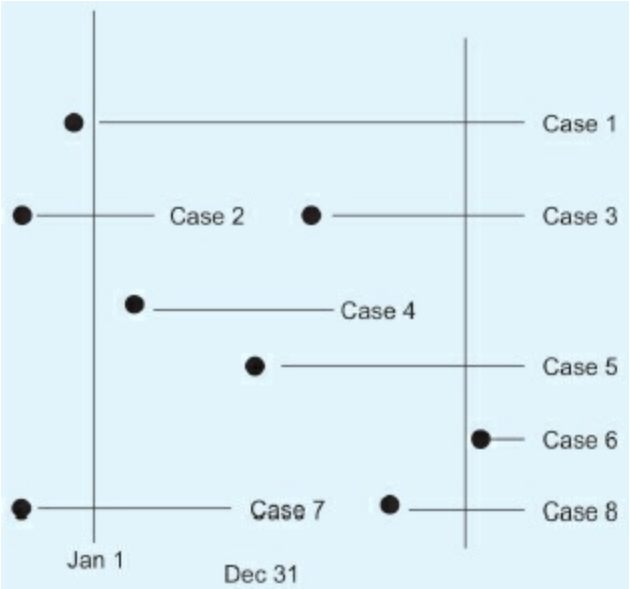


Fig. 7.2: Number of cases of a disease beginning, developing and ending during a period of time[5]

• Start of illness

—Duration of illness

Incidence: Cases 3, 4, 5 and 8

Point prevalence (Jan 1): Cases 1, 2 and 7

Point prevalence (Dec 31): Cases 1, 3, 5 and 8

Period prevalence (Jan-Dec): Cases 1, 2, 3, 4, 5, 7, 8.

Measurement of Disability

Disabilities are an umbrella term, covering impairments, activity limitations, and participation restrictions. Disability is thus not just a health problem. It is a complex phenomenon, reflecting the interaction between features of a person's body and features of the society in which he or she lives. Overcoming the difficulties faced by people with disabilities requires interventions to remove environmental and social barriers.

Measures of Disability

1. Barthel's index of activities of daily living
2. WHO quality of life brief scale
3. Environment impact scale
4. Disability adjusted life years
5. International classification of functioning

Disability and Health

Measurements of Natality

Natality measures are population-based measures of birth. These measures are used primarily by persons working in the field of maternal and child health.

Measure	*Numerator*	*Denominator*	*10^n*
Crude birth rate	Number of live births during a specified time interval	Mid-interval population	1,000
Crude fertility rate	Number of live births during a specified time interval	Number of women ages 15–44 years at mid-interval	1,000
Crude rate of natural increase	Number of live births minus number of deaths during a specified time interval	Mid-interval population	1,000
Low-birth weight ratio	Number of live births < 2,500 grams during a specified time interval	Number of live births during the same time interval	100

EPIDEMIOLOGIC METHODS

I. Descriptive epidemiology.
II. Analytical epidemiology.
III. Experimental epidemiology.

I. DESCRIPTIVE EPIDEMIOLOGY

Descriptive studies are usually the 1st phase of epidemiological investigation. These studies are concerned with the distribution of diseases or health-related characteristics in human populations and identifying the characteristics with which the disease in question seems to be associated. The study describes the disease in terms of time, place and person. Procedures in descriptive studies are:

1. Defining the population to be studied
2. Defining the disease under study
3. Describing the disease by—time, place, and person
4. Measurement of disease
5. Comparing with known indices
6. Formulation of an aetiological hypothesis

1. Defining the Population to be Studied

First step is to define the population base not only in terms of the total number but also in terms of age, sex, occupation, cultural characters and similar information needed for the study.[6] “Defined population” can be the whole population in a geographic area, or specifically selected group such as age and sex group, occupational groups, school children—wherever a group of people can be fairly accurately counted and should be stable without migration. The defined population provides a denominator for calculating rates.

2. Defining the Disease Under Study

Epidemiologist needs a definition that is both precise and valid to enable him to identify those who have the disease from those who do not. He looks out for an “operational definition” that is a definition by which the disease condition can be identified and measured in the defined population.[6]

3. Describing the Disease

Describing the disease by:

a. Time

b. Place

c. Person

Time Distribution

Patterns of disease may be described by the time of its occurrence that is by week, month, year, day of the week, etc.

Epidemiologist has identified 3 kinds of time trends in disease occurrence. They are:

1. ***Short-term fluctuations***, e.g. epidemic.

A. *Common source epidemics*.

1. Single exposure or point source epidemics, e.g. food poisoning.
2. Continuous or multiple exposure, e.g. water from a contaminated well.

B. *Propagated epidemics*: It is most often of infectious origin and results from person to person transmission of an infectious agent. For example, epidemics of hepatitis A and polio.

2. ***Periodic fluctuations*:**

A. *Seasonal trend*: It is well known for many communicable diseases, e.g. measles and varicella.

B. *Cyclic trend*: Some disease occur in cycles spread over short periods of time which may be days, weeks, months, years. Measles in the pre-vaccination era appeared in cycles with major peaks every 2 to 3 years and rubella every 6 to 9 years.

3. ***Long-term or secular trends*:** The term secular trend implies changes in the occurrence of disease (progressive increase or decrease) over a long period of time, generally several years or decades.

For example, coronary heart disease, lung cancer and diabetes have shown a consistent upward trend in the past 50 years or so, followed by

a decline of such diseases as tuberculosis, typhoid, diphtheria and polio.[5]

Interpretation of time trends helps in seeking emerging health problems and effectiveness of measures to control old ones.

Place Distribution

1. International variations
2. National variations
3. Rural-urban differences
4. Local distributions

1. ***International variation*:** International comparisons may examine mortality and morbidity in relation to socioeconomic factors, dietary differences and the differences in culture and behaviour. For example, cancer of stomach is very common in Japan and unusual in USA. Cancers of oral cavity and uterine cervix are exceedingly common in India as compared to industrialized countries.

2. ***National variation*:** Distributions of endemic goitre, fluorosis, leprosy, malaria have shown variations in their distribution in India. Such information is needed to demarcate the affected areas and for providing appropriate health care services.

3. ***Rural-urban differences*:** Chronic bronchitis, lung cancer, cardiovascular diseases are usually more common in urban than in rural areas. Infant mortality rate, maternal mortality rate are higher in rural than urban areas. Variations are due to differences in medical care, social class levels of sanitation, educational and environmental factors.

4. ***Local distributions*:** Inner and outer city variations in disease frequency are well known. These variations 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.

Geographic distribution may provide evidence of the source of disease

and its mode of spread. By relating these variations to agent, host and environmental factors the epidemiologist tries to derive clues to the source of disease and its mode of spread to formulate and test aetiological hypothesis.[5]

***Migration studies*:** They provide a unique opportunity to evaluate the role of the possible genetic and environmental factors in the occurrence of disease in the population.

a. Comparison of disease and death rates for migrants with those of their kin who have stayed at home. This permits study of genetically similar groups but living under different environment. If the disease and death rates in migrants are similar to the country of adoption, the likely explanation could be change in the environment.

b. Comparison of migrants with local population of the host country provides information on genetically different groups living in similar environment. If migration rates of disease and death are similar to the country of origin, the likely explanation could be the genetic factors.[1]

Person Distribution

In descriptive studies, the disease is further characterized by defining the persons who developed the disease by:

A. ***Age*:** It is related to disease than any other single host factor. Certain diseases are more frequent in certain age groups than in others. For example, measles in childhood, cancer in middle age and artheroscelerosis in old age.

B. ***Sex*:** Chronic diseases such as diabetes, hypothyroidism, obesity are common in females, whereas lung cancer and coronary heart disease are more common in males. The differences may be due to biological differences between the sexes and also due to cultural and behavioural differences.

C. ***Ethnicity*:** Differences in disease occurrence have been noted in population subgroups of different racial and ethnic origin, e.g. tuberculosis, cancer, sickle cell anaemia. These differences whether they are related to genetic or environmental factors, have been a stimulus to further study.

D. ***Marital status*:** Married persons are generally more secure and

protected and this contributes to lower mortality rates among married persons.

E. ***Occupation*****:** Occupation may alter the habit pattern of employees like sleep, alcohol, smoking. Persons working in particular occupation are exposed to particular types of risks. For example, coal miners are likely to suffer from silicosis, those in sedentary occupation face the risk of heart disease.

F. ***Social class*****:** Individuals in upper social classes have a longer life expectancy and better health and nutritional status than those in lower social classes. Certain diseases like cardiovascular diseases, hypertension and diabetes have shown a higher prevalence in upper classes compared to lower classes.

G. ***Behaviour*****:** Behaviuor is looked upon as a risk factor in modern day diseases such as cancer, obesity, cardiovascular diseases, etc. For example, cigarette smoking, sedentary life, over eating and drug abuse.

H. ***Stress*****:** Stress has shown to affect a variety of variables related to patient response, e.g. susceptibility to disease.

I. ***Migration*****:** In India, diseases like leprosy, filaria and malaria are considered to be rural problems. However, because of the movement of the people from rural to urban areas, these diseases have created a serious problem in urban areas also.

4. Measurement of Disease

This information should be available in terms of mortality, morbidity, disability and so on; and should preferably be available for different subgroups of the population. Measurement of morbidity has 2 aspects—incidence and prevalence. Incidence can be obtained from "longitudinal" studies and prevalence from "cross-sectional studies."

***Cross-sectional studies*:** It is the simplest form of observational study. It is based on a single examination of a cross-section of population at one point of time—the results of which can be projected on the whole population provided the sampling has been done correctly. This study is also known as "prevalence study". These studies are more usually for chronic than short-lived diseases. These studies are useful to:

- Know the distribution of a disease rather than aetiology.
- Suggest causal hypothesis, which can be tested by analytical study.

***Disadvantage*:**

- Time sequence cannot be deduced.
- Little information about the natural history of the disease and rate of incidence.

***Longitudinal studies*:** In case of longitudinal studies, observations are repeated in the same population over a prolonged period of time by means of follow-up examinations. These studies are useful to:

1. Study natural history of disease and its future outcome.
2. Identifying risk factors of the disease.
3. For finding out incidence rate.

Disadvantage: Difficult to organize and more time consuming.

5. Comparing with Known Indices

By making comparisons between different populations, and subgroups of same population, it is possible to arrive at clues to disease aetiology and also identify groups who are at increased risk for certain diseases.

6. Formulation of a Hypothesis

By studying the distribution of disease and utilizing the techniques of descriptive epidemiology, it is possible to formulate hypothesis relating to disease aetiology. A hypothesis can be accepted or rejected, using the techniques of analytical epidemiology.

An epidemiological hypothesis should specify—the population, specific cause, expected outcome, dose-response relationship, and time-response relationship.

For example, the smoking of 30–40 cigarettes/day causes lung cancer in 10% of smokers after 20 years of exposure.

Uses of descriptive epidemiology

1. Provide data regarding the magnitude of disease and type of disease in the community.
2. Provide clues to disease aetiology.
3. Provide data for planning, organizing, evaluating preventive and curative services.
4. Contribute to research.

II. ANALYTICAL EPIDEMIOLOGY

The objective of analytical epidemiology is to test the aetiological hypothesis.[3]

Analytical epidemiology consists of 2 distinct types of observational studies: (1) Case control study, (2) Cohort study.

From each of these study designs, one can determine whether or not as statistical association exists between a disease and a suspected factor and the strength of the association.

1. Case-Control Study

Often called “retrospective study” is the first approach to test causal hypothesis. This study has 3 distinct features:

1. Both exposure and disease occurred before the start of the study.
2. The study proceeds from effect to cause.
3. It uses a control group to support or refute an inference.

Frequency of smoking in (1) cases = a/(a + c), (2) controls = b/(b + d).

If the frequency of smoking a/(a + c) is higher in cases than in controls b/(b + d), an association is said to exist between smoking and lung cancer.

Table 7.2: A case control study of smoking and lung cancer[3]

Risk factor (smoking)	***Cases (with lung cancer)***	***Control (without lung cancer)***
Present	a	b
Absent	c	d
	(a + c)	(b + d)

Basic Steps in Case-Control Study

I. Selection of Cases and Controls

1. ***Definition of a case*:**
   a. *Diagnostic criteria of the disease*: The diagnostic criteria of the disease and stage, if any, to be included in the study must be specified before the study is undertaken and should not be altered or changed until the study is over.
   b. *Eligibility criteria*: Only newly diagnosed cases within a specified period of time are eligible than old cases or cases in advanced stages of disease.
2. ***Source of cases*:** Cases may be drawn from:
   a. ***Hospitals*:** Often it is convenient to select from hospital admitted during a specified period of time.
   b. ***General population*:** 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.
3. ***Selection of controls*:** Controls must be free from the disease under study. Similar to the cases, except for the absence of disease. Controls should comprise of persons who have not been exposed to the disease or some other factor whose influence is being studied.

Sources of controls

1. ***Hospital controls*:** Controls may be selected from the same hospital as the cases, but with different illnesses other than the study disease.
2. ***Relatives*:** Sibling controls are unsuitable where genetic conditions are under study
3. ***Neighbourhood controls*:** Controls may be people living in same locality as cases, persons working in the same factory, children attending same school.
4. ***General population*:** Population controls can be obtained from defined

geographic areas, by taking a random sample of individuals free of the study disease.[5]

Failure to select comparable controls can introduce “bias” into results of case control studies and decrease the confidence one can place in the findings.

II. Matching

Matching is defined as the process by which we select controls in such a way that they are similar to cases with regards to certain pertinent selection variables (e.g. sex, age) which is known to influence the outcome of disease and which, if not adequately matched for comparability, could distort or confound the results.

A ‘confounding factors’ is defined as one, which is associated both with exposure and disease, and is distributed unequally in study and control groups. For example, role of alcohol in the aetiology of oesophageal cancer, smoking is a confounding factor because: (1) It is associated with the consumption of alcohol and (2) it is an independent risk factor for oesophageal cancer. The effects of alcohol consumption can be determined only if the influence of smoking is neutralized by matching.

While matching it should be borne in mind that the suspected aetiological factor or variable we wish to measure should not be matched, because by matching, its aetiological role is eliminated in that study. There are several kinds of matching procedures.[2]

1. ***Group matching*:** This may be done by assigning cases to subcategories 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.
2. ***By pairs*:** 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 disease as a control. Thus one can obtain pairs of patients and controls of the same sex, age, duration and severity of illness, etc.

III. Measurement of Exposure

Information about exposure should be obtained in precisely the same manner for both cases and controls. This may be obtained by: (1) Interviews, (2) Questionnaires, (3) Past records (cases and controls).

IV. Analysis and Interpretation

a. Exposure rates in (1) cases = a/(a + c), (2) controls = b/(b + d) (Table 7.2).

b. The estimation of disease risk

1. Relative risk

$$= \frac{\text{Incidence among exposed}}{\text{Incidence among non-exposed}}$$

= a/(a + b)/c/(c + d) (Table 7.2)

2. Odds ratio is a measure of the strength of the association between risk factor and outcome = ad/bc

Bias in Case Control Study

Bias is any systematic error in the determination of the association between the exposure and the disease. Some of these are:

1. ***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.
2. ***Selection bias*:** The cases and controls may not be representative of cases and controls in the general population. There may be systematic differences in characteristics between cases and controls. The selection bias can be best controlled by prevention.
3. ***Interviewer's 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. This type of bias can be eliminated by double-blinding.
4. ***Bias due to confounding*:** Confounding is an important source of bias. This bias can be removed by matching in case control studies.
5. ***Berkesonian bias*:** This bias arises because of the different rates of admission to hospitals for people with different diseases. It is termed after Dr. Joseph Berkesonian who recognized this problem.

Case Control Study-Advantages

1. Easy to carry out
2. Rapid and inexpensive
3. Few subjects are required
4. Rare disease can be studied
5. No risk to subjects
6. Allows study of several aetiological factor
7. Risk factors can be identified
8. No attrition problems
9. Ethical problems are minimal

Disadvantages

1. Problems of bias
2. Selection of appropriate control group
3. Incidence cannot be measured
4. Not distinguished between causes and associated factors
5. Not suited to the evaluation of therapy
6. Concern is representativeness of cases and controls, e.g. (1) thalidomide tragedy, (2) maternal smoking and congenital malformations.

2. Cohort Study

Cohort study is known by a number of names:

Prospective study, longitudinal study, incidence study, forward-looking study.

'Cohort' is defined as a group of people who share a common characteristic or experience within a defined time period, e.g. age, sex, occupation, exposure to drug or vaccine.

Distinguishing Features

1. The cohorts are identified prior to the appearance of the disease under investigation.
2. The study groups are observed over a period of time to determine the frequency of the disease among them.
3. The study proceeds forward from cause to effect.

Indications for Cohort Study

1. When there is good evidence of an association between exposure and disease, supported by descriptive and case control studies.
2. When exposure is rare, but the incidence of disease is high among the exposed.
3. When attrition of study population can be minimized.
4. When ample funds are available.

If the incidence of the disease in the exposed group = a/(a + b) is significantly higher than in the non-exposed group = c/(c + d), it would suggest that the disease and cause suspected are associated (Table 7.3).

Table 7.3: Framework of a cohortstudy

Controls	*Disease*		*Total*
	Yes	No	
Exposed	a	b	(a + b)
Non-exposed	c	d	(c + d)

Types of Cohort Studies

1. ***Prospective cohort study*:** In this study, the outcome (disease) has not yet occurred at the time the investigation begins. These studies begin in the present and continue into the future.
2. ***Retrospective cohort study*:** In this study, the outcomes have all occurred before he start of the investigation. It is known by a variety of names like 'historical' cohort study, prospective study in retrospect and non-concurrent prospective study.
3. ***Combination of retrospective and prospective cohort study*:** 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.[3]

Elements of a Cohort Study

I. ***Selection of study subjects*:** Study subjects may be selected from (a) the general population—when exposure or cause of death is fairly frequent in the population, (b) special groups like select groups (professional groups) or exposure group (radiologist exposed to X-rays).

II. ***Obtaining data on exposure*:** Information about exposure may be obtained through, survey, interviews, questionnaires, medical records, or environmental surveys. Information about exposure allow classification of cohort members:

   1. Whether or not they have been exposed to the suspected factor.
   2. According to level or degree of exposure, at least in broad classes, in the case of special exposure group.

III. ***Selection of comparison group*:** There are many ways of assembling comparison groups:

   1. ***Internal comparisons*:** In some cohort studies, no outside comparison group is required. That is single cohort enters the study, and its members may, on the basis of information obtained, be classified into several comparison groups according to the degrees or levels of exposure to risk (e.g. smoking—1 packet per day, 2 packets per day, etc. blood pressure) before the

development of the diseases in question. The groups, so defined, are compared in terms of their subsequent morbidity and mortality rates.

2. ***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 nonsmokers, radiologists and ophthalmologists, etc. The study and control cohorts should be similar in demographic and possibly important variables other than those under study.

3. ***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. For example, comparison of frequency of lung cancer among uranium mine workers with lung cancer mortality in the general population where the miners resided.[2]

IV. ***Follow-up*:** Regular follow-up is required which comprise of periodic medical examination, reviewing hospital records, surveillance of death records, mailed questionnaires, telephone calls, periodic home visits—preferably on an annual basis. The safest course recommended is to achieve as close as 95 % follow-up as possible.

V. ***Analysis*:** The data are analyzed in terms of:

1. Incidence rates of outcome among exposed = a/a + b and and non-exposed = c/c + d (Table 7.3)
2. Estimation of risk
   a. Relative risk

$$= \frac{\text{Incidence of disease among exposed}}{\text{Incidence of disease among non-exposed}}$$

For example, RR = 10. Smokers are 10 times at greater risk of developing lung cancer compared to non-smokers. Greater the relative risk, greater the association.

a. Attributable risk = 90%, means 90% of lung cancer among smokers was due to their smoking.

b. Population attributable risk = 86%. If risk factor of cigarettes were avoided 86% of deaths from lung cancer could be avoided.

Advantages of Cohort Study

1. Incidence can be calculated.
2. Several possible outcome can be studied simultaneously.
3. Direct estimate of relative risk is possible.
4. Dose-response ratios can be calculated.
5. Bias can be minimized since comparison groups are formed before disease develops.

Disadvantages

1. Involves large number of study subjects.
2. Longer time needed to complete the study.
3. Extensive record keeping needed.
4. Attrition problem among study population.
5. Selection of groups is a limiting factor.
6. Diagnostic criteria can change over prolonged follow-up.
7. Study is expensive.

Differences between case control study and cohort study are described in Table 7.4.

Table 7.4: Differences between case control study and cohort study

Case control study	*Cohort study*
1. Proceeds from "effect to cause"	1. Proceeds from "cause to effect"
2. Starts with the disease	2. Starts with people exposed to the risk factor or suspected cause
3. Tests whether the suspected cause occurs more frequently in those with the disease than among those without the disease	3. Tests whether disease occurs more frequently in those exposed, than in those not similarly exposed

4.	Usually the first approach to the testing of a hypothesis, but also useful for exploratory studies	4.	Reserved for testing of precisely formulated hypothesis
5.	Involves fewer numbers of subjects	5.	Involves larger number of subjects
6.	Yields relatively quick results	6.	Long follow-up period often needed involving delayed results
7.	Suitable for study of rare diseases	7.	Inappropriate when the disease or exposure under investigation is rare
8.	Generally yields only estimate of RR (odds ratio)	8.	Yields incidence rates, RR as well as AR attributable risk
9.	Cannot yield information about diseases other than that selected for study	9.	Can yield information about more than one disease outcome
10.	Relatively inexpensive	10.	Expensive

III. EXPERIMENTAL EPIDEMIOLOGY

Experimental epidemiology is often equated with randomized controlled trials. The conditions in which study is carried out are under the direct control of the investigator. Thus it involves some action, intervention or manipulation such as deliberate application or withdrawal of the 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 or withdrawal of the suspected cause.[6]

Aims

1. To provide “scientific proof” of aetiological factors
2. 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 are of two types*:**

a. Randomized control trials (i.e. those involving a process of random allocation).

b. Non-randomized or non-experimental trials (i.e. those departing from strict randomization for practical purposes).

Steps in Randomized Controlled Trial

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

One of the essential features of a randomized controlled trial is that the study is conducted under a strict protocol. The protocol specifies the aims and objectives of the study, questions to be answered, criteria for the selection of the study and the control groups, size of the sample, the procedures for allocation of subjects into study and control groups, treatments to be applied —when and where and how to what kind of patients, standardization of working procedures and schedules as well as responsibilities of the parties involved in the trial, up to the stage of evaluation of outcome of the study. The protocol aims that preventing bias and to reduce the sources of error in 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, are expected to be applicable. Thus the reference population may comprise the population of a whole city, or a population of school children, industrial workers, and so on according to the nature of the study.

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.[5]

The participants or volunteers must fulfill the following three criteria:

a. They must give “informed consent”.

b. They should be representative of the population to which they belong.

c. They should be qualified or eligible for the trial.

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, manoeuvre or intervention. Randomization is an attempt to eliminate “bias” and allow for comparability. Theoretically, it is possible to assure comparability by matching. But when one matches, one can only match those factors, which are, known to be important. Randomization ensures that the investigator has no control over allocation of participants to either study or control group, thus eliminating what is known as “selection bias”.

In randomization, every individual gets an equal chance of being allocated into either group or any of the trial groups. Randomization is best done by using a table of random numbers.

4. Manipulation

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

5. Follow-up

This implies the examination of the experimental and the control group subjects at defined intervals of time, in a standard manner, with equal intensity, under the same given circumstances, in the same time frame till the final assessment of outcome. Thus the follow-up may be short or may require many years depending upon the study undertaken. It may be mentioned that some losses to follow-up are inevitable due to factors, such as death, migration and loss of interest. This is known as attrition. Every effort should be made to minimize the losses to follow-up.

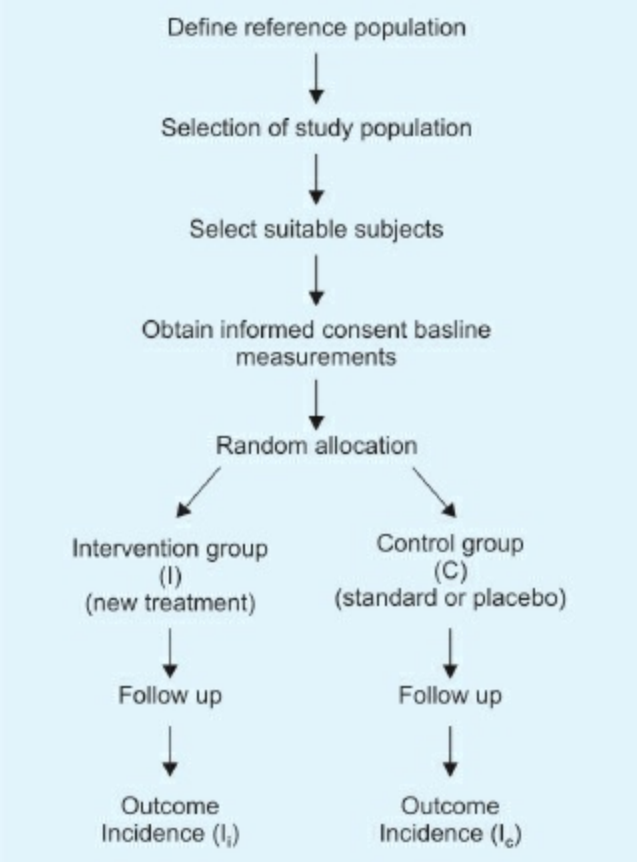


Fig. 7.3: Design of a randomized controlled trial[5]

6. Assessment

The final step is the assessment of the outcome of the trial in terms of positive results/negative results. The incidence of positive and negative results is rigorously compared in both the groups, and the differences, if any, are tested for statistical significance.

Blinding Technique

Bias may arise from errors of assessment of the outcome due to human element. These may be bias on the part of the participants, may be observer bias, and may be bias in evaluation. Randomization cannot guard against these sorts of bias, or the size of the sample. In order to reduce these problems, a technique known as "blinding" is adopted, which will ensure that the outcome is assessed objectively. Blinding can be done in three ways:

1. ***Single blind trial*:** The trial is so planned that the participant is not aware whether he belongs to the study group or control group.
2. ***Double blind trial*:** The trial is so planned that neither the doctor nor the participant is aware of the group allocation and the treatment received.
3. ***Triple blind trial*:** This goes one step further. The participant, the investigator and the person analyzing the data are all "blind". Ideally, of course, triple-blinding should be used; but the double-blinding is the most frequently used method when a blind trial is conducted.

Types of Randomized Controlled Trials

1. Clinical trials
2. Preventive trials
3. Risk factor trials
4. Cessation experiments
5. Trial of aetiological agents
6. Evaluation of health services.

***Clinical trials*:** When a new treatment has been developed it is important to provide answers to 2 questions: (1) Does it work? (2) Is it better than the existing treatment?

To answer these, clinical trials must be carried out. The first stage is to conduct an experimental clinical trial in which the effectiveness of the treatment is measured under ideal conditions. A fissure sealant, for example, may be tested in older children using premolar teeth and the clinical operation performed by the researcher. However, even if the results of an experimental

clinical trial are encouraging, the results are only applicable under these ideal conditions. Under normal conditions, the fissure sealant would often be applied to the molars of younger children and the technique performed by a variety of clinicians. It is, therefore, necessary to carry out a community clinical trial or field trial, which is designed to measure the efficacy of the agent under real life conditions. This enables the investigator to decide whether the new form of treatment is a more efficient use of resources than the existing treatment.[2]

Study Designs of Controlled Trials

1. Concurrent parallel study designs
2. Cross-over type of study designs.

Non-Randomized Trials

1. Uncontrolled trials
2. Natural experiments
3. Before and after comparison studies with control and without control

Uses of Epidemiology[4]

1. Study historically the rise and fall of disease in the population.
2. Community diagnosis.
3. Planning and evaluation.
4. Evaluation of individual's risks and chances.
5. Syndrome identification.
6. Completing the natural history of disease.
7. Searching for causes and risk factors.

Water fluoridation is an excellent example of an epidemiological investigation

1. Mapping the occurrence of mottled enamel, correlating the findings with fluoride content of water and finally with the occurrence of dental caries—descriptive epidemiology.
2. 1PPM of fluoride would provide safe and acceptable caries control—formulation of the aetiological hypothesis.
3. Studies of the caries—fluorine hypothesis in areas of natural fluoride water—analytical epidemiology.
4. Field trails of water fluoridation, devising of better mechanical means for both fluoridation and de-fluoridation of water—experimental epidemiology.

Association

Association may be defined as the concurrence of 2 variables more after than would be expect by chance.

1. ***Spurious (false) association*****:** The association between a disease and

suspected factor may not be real.

2. ***Indirect association*****:** The indirect association is a statistical association between a characteristic or variable of interest and a disease due to the presence of another factor, known or unknown, that is common to both the characteristic and the disease.

3. ***Direct (causal) association***

   a. ***One-to-one causal relationship*****:** Suggests that when the factor A is present, the disease B must result. Conversely, when the disease is present, the factor must also be present.

   b. ***Multifactorial causation*****:** Here the causal factors act cumulatively to produce the disease. For example, smoking, air pollution, exposure to asbestos cause lung cancer.

THE EPIDEMIOLOGIST

If epidemiology is taken in its broadest sense, any researcher into the occurrence of disease or disability in groups of people is in fact an epidemiologist. Only large health departments, however, can usually afford specialists in this field.

According to Smillie, an epidemiologist should have the five 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 familiar with the history of medicine, particularly that portion of it that relates to epidemics of disease.
4. He should have a good knowledge of bacteriology, and immunology and a thorough understanding of physiology, particularly in relation to the various environmental factors that may influence the health of individuals.
5. He must develop a point of view, which will interrelate disease processes as they affect the community as a unit, rather than the individual. Thus he must have a real knowledge of the principles of preventive medicine.

The epidemiologist is essentially a planner. Data come to him from many sources and his recommendations may be carried out by a great variety of different personnel, such as physicians, sanitarians, dentists, school nurses, government regulatory bodies, and the like. The epidemiologist, however, must keep close supervision over the collection of data and also serve as consultant to those in the field of public health administration. It is he who must determine when an epidemic of disease starts and when it has ceased to exist. He may not be able to do very much about the actual control of the epidemic once it has started, but if not, it is he who should apply the lessons learned to the design of measures which will prevent future epidemics.

TERMINOLOGIES IN EPIDEMIOLOGY

***Communicable disease*:** An illness due to a specific infectious agent or its toxic products capable of being directly or indirectly transmitted from man to man, animal to animal, or from the environment to man and animal.

Epidemic: The unusual occurrence is a community or region of disease, specific health-related behaviour (e.g. smoking), or other health-related events (e.g. traffic accidents) clearly in excess of "expected occurrence".

Endemic: It refers to the constant presence of a disease or infectious agent within a given geographic area or population group, without importation from outside.

Sporadic: The word sporadic means scattered about. The cases occur irregularly, haphazardly from time to time, and generally infrequently.

Infection: The entry and development or multiplication of an infectious agent in the body of man or animal.

Contamination: The presence of an infectious agent on a body surface, also on or in clothes, beddings, toys, surgical instruments or dressings, or other inanimate articles or substances including water, milk and food.

***Infectious disease*:** A clinically manifest disease of man or animals resulting from an infection.

***Contagious disease*:** A disease that is transmitted through contact, e.g. scabies, trachoma, STD and leprosy.

Pandemic: An epidemic usually affecting a large proportion of the population, occurring over a wide geographic area such as a section of a nation, the entire nation, a continent or the world, e.g. influenza pandemics of 1918 and 1957.

***Nosocomial infection*:** Nosocomial infection is an infection originating in a patient while in a hospital or other health care facility.

***Opportunistic infection*:** This is infection by an organism that takes the opportunity provided by a defect in host defence to infect the host and hence cause disease.

***Iatrogenic disease*:** Any untoward or adverse consequence of a preventive, diagnostic or therapeutic regimen or procedure, that causes impairment, handicap, disability or death resulting from a physician's professional activity or from the professional activity of other health professionals.

***Investigation of epidemic*:** The "**unusual**" occurrence in a community or region of disease, specific health-related behaviour (e.g. smoking) or other health-related events (e.g. traffic accidents) clearly in excess of "**expected occurrence**".

The amount of disease occurring in the past, in the absence of an epidemic is called **expected frequency**.

Outbreak is term used for a small usually localized epidemic in the interest of minimizing public alarm, unless the number of cases is indeed very large.

***Characteristics of epidemic*:**

- Epidemic includes any kind of disease.
- There is no universally applicable number. of cases which constitute an epidemic.
- There is no specification of geographic extent.
- It may encompass any time period.

***Objective of an epidemic investigation*:**

a. To define the magnitude of the epidemic outbreak or involvement in terms of time, place and person.

b. To determine the particular conditions and factors responsible for the occurrence of the epidemic.

c. To identify the cause, source of infection and modes of transmission to determine measures necessary to control the epidemic.

d. To make recommendations to prevent recurrence.

STEPS IN INVESTIGATION OF AN EPIDEMIC

Frequently, epidemic investigations are called for after the peak of the epidemic has occurred; in such cases, the investigation is mainly retrospective. No step by step approach applicable in all situations can be described like a “cook-book”.

However, in investigating an epidemic, it is desired to have an orderly procedure or practical guidelines.

1. Verification of diagnosis
2. Confirmation of the existence of an epidemic
3. Defining the population at risk
4. Rapid search for all cases and their characteristics
5. Data analysis
6. Formulation of hypotheses
7. Testing of hypotheses
8. Evaluation of ecological factors
9. Further investigation of population at risk
10. Writing the report

1. ***Verification of diagnosis*****:** It is the first step in an epidemic investigation, as it may happen sometimes that the report may be spurious, and arise from misinterpretation of signs and symptoms by the lay public. It is, therefore, necessary to have the verification of diagnosis on the spot as quickly as possible. It is not necessary to examine all the cases to arrive at the diagnosis. A clinical examination of a sample of cases may well suffice. Laboratory investigations, wherever applicable, are most useful to confirm the diagnosis but the epidemiological investigations should not be delayed until the laboratory results are available.

2. ***Confirmation of the existence of an epidemic*****:** The next step is to confirm, if epidemic exists. This is done by comparing the disease frequencies during the same period of previous years. An epidemic is said to exist when the number of cases (observed frequencies) is in excess of the expected frequency for that population based on the past

experience. An arbitrary limit of two standard errors from an endemic occurrence is used to define the epidemic threshold for common diseases such as influenza. Often the existence of an epidemic is obvious needing no such comparison as in the case of common source epidemics of cholera, food poisoning and hepatitis A. These epidemics are easily recognized. In contrast, the existence of modern epidemics (e.g. cancer, cardiovascular diseases) is not easily recognized unless comparison is made with previous experience.

3. *Defining the population at risk*:

a. *Obtaining a map of the area*: Before beginning the investigation, it is necessary to have a detailed and current map of the area. If this is not available, it may be necessary to prepare such a map. It should contain information concerning natural landmarks, roads and the location of all dwelling units along each road or in isolated areas. The area may be divided into segments, using natural landmarks as boundaries. This may again be divided into smaller sections. Within each section, the dwelling units (houses) may be designated by numbers.

b. *Counting the population*: The denominator may be related to the entire population or subgroups of a population. It may also be related to total events. For example, if the denominator is the entire population on a complete census of the population by age and sex should be carried out in the defined area by house to house visits. For this purpose, lay health workers in sufficient numbers may be employed. Using this technique, it is possible to establish the size of the population. The population census will help in computing the much-needed attack rates in various groups and subgroups of the population later on. Without an appropriate denominator of "population at risk" attack rates cannot be calculated.

4. *Rapid search for all cases and their characteristics*:

a. *Medical survey*: Concurrently, a medical survey should be carried out in the defined area to identify all cases including those who have not sought medical care, and those possibly exposed to risk. Ideally, the complete survey (screening each question) will pick up all affected individuals with symptoms or

signs of the disorder. Lay health workers may be trained to administer the ‘epidemiological case sheet’ or questionnaire to collect data.

b. *Epidemiological case sheet*: The epidemiologist should be armed with an ‘epidemiological case sheet’ for collecting data from cases and from persons apparently exposed but unaffected. The epidemiological case sheet or ‘case interview form’ should be carefully designed (based on the findings of a rapid preliminary inquiry) to collect relevant information. This includes: name, age, sex, occupation, social class, travel, history of previous exposure, time of onset of disease, signs and symptoms of illness, personal contact at home, work, school and other places; special events such as parties attended, food eaten and exposure to common vehicles such as water, food and milk; visits out of the community, history of receiving injections or blood products, attendance at large gathering, etc. the information collected should be relevant to the disease under study. For example, if the disease is food-borne, detailed food histories are necessary. A case review form will ensure completeness and consistency of data collection.

   If the outbreak is large, it may not be possible to interview all the cases (e.g. influenza). In such cases, a random sample should be examined and data collected.

c. *Searching for more cases*: The patient may be asked, if he knew of other cases in the home, family, neighbourhood, school, work place having an onset within the incubation of the index case. Cases admitted to the local hospitals should also be taken into consideration. This may reveal not only additional cases but also person to person spread.

5. ***Data analysis*****:** The data should be analyzed on ongoing basis, using the classical epidemiological parameters—time, place and person.

a. ***Time*****:** Epidemic curve—chronological distribution of dates of onset and construct. Look for time clustering of cases.

b. ***Place*****:** Prepare a spot map (geographic distribution) of cases and if possible, their relation to possible source of infection

c. ***Person*****:** Analyze the data by age, sex, occupation, and other possible risk factors. Determine the attack rates/cases, fatality rates, for those exposed and those not exposed and according to host factors.

6. ***Formulation of hypotheses*****:** A hypothesis is an educated "guess" about the source of the outbreak. Generating hypotheses enable the investigators to test these hypotheses in an analytic study. The success of the investigation depends upon the quality of the hypotheses. On the basis of time, place and person distribution or the agent-host-environment model, formulate hypotheses to explain the epidemic in terms of:

a. Possible source

b. Causative agent

c. Possible modes of spread

d. The environmental factors which enabled it to occur

Formulation of a tentative hypothesis should guide further investigation.

7. ***Testing of hypotheses: Intensive follow-up*****:**

- Evaluate in more details clinical, pathological, microbiological toxicological data
- Same for previously collected data *Further epidemiological studies*
- Retrospective cohort study
- Case-control study

Environmental sampling

- Collect appropriate samples
- Allow epidemiological data to guide testing
- If analytic study results are conclusive, don't wait for positive samples before implementing prevention.

8. ***Evaluation of ecological factors*****:** An investigation of the circumstances involved should be carried out to undertake appropriate measures to prevent further transmission of disease.

9. ***Further investigation of population at risk*****:** A study of the population

at risk or a sample of it may be needed to obtain additional information. This may involve medical examination, screening tests, examination of suspected food, faeces or blood samples, biochemical studies, assessment of immunity status, etc. This will permit classification of all members as to:

a. Exposure to specific potential vehicles

b. Whether ill or not

10. ***Writing the report*****:** The report should be complete and convincing. It is important for the concerned officials to make appropriate and timely reports to higher authorities.

This has two main uses:

1. It keep the authorities at the higher level informed so that they can make the appropriate decisions.
2. It helps to review the outbreak and response, identify system failures and take corrective measures so that similar events are not repeated.

   Thus reports are an important learning tool and should not be seen as a mindless chore. But for this to happen, the authorities at the appropriate level should read the reports and take the necessary action.

Information to be included in the final report on an endemic

1. *Background*
   - Geographical location
   - Climatic conditions
   - Demographic status (population pyramid)
   - Socioeconomic situation
   - Organization of health services
   - Surveillance and early warning systems
   - Normal disease prevalence.
2. *Historical data*
   - Previous occurrence of epidemics:
     – Of the same disease

  - Locally or elsewhere
- Occurrence of related diseases, if any:
  - In the same area
  - In other areas
- Discovery of the first cases of the present outbreak.

3. *Methodology of investigations*
   - Case definition
   - Questionnaire used in epidemiological investigation
   - Survey teams
     - Household survey
     - Retrospective study
     - Prospective surveillance
     - Collection of laboratory specimens
     - Laboratory techniques.
4. *Analysis of data*
   - Clinical data
     - Frequency of signs and symptoms
     - Course of disease
     - Differential diagnosis
     - Death or sequelae rates
   - Epidemiological data
     - Mode of occurrence
     - In time
     - By place
     - By population groups
   - Modes of transmission
     - Sources of infection
     - Routes of excretion or portal of entry
     - Factors influencing transmission

- Laboratory data
  - Isolation of agents
  - Serological confirmation
  - Significance of results
- Interpretation of data
  - Comprehensive pictures of the outbreak
  - Hypotheses as to cause
  - Formulation and testing of hypotheses by statistical analysis.

5. *Control measures*: Definition of strategies and methodology of implementation
   - Constraints
   - Results Evaluation
   - Significance of results
   - Cost or effectiveness
     - Preventive measures.

Methods of control

- Eliminate reservoir of infection
  - Isolation of patients
  - Quarantine
  - The zoonoses
  - Non-living reservoir such as soil
- Interrupt the pathways of transmission
- Protect the susceptible hosts
  - Active or passive immunization
  - Chemoprophylaxis
  - Mass campaigns.

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CHAPTER

8

Epidemiology of Oral Diseases

EPIDEMIOLOGY, AETIOLOGY AND PREVENTION OF DENTAL CARIES

Dental caries is an infectious microbial disease that results in localized dissolution and destruction of calcified tissues of the teeth. The enzymes produced by the bacteria act upon the fermentable carbohydrates to produce acids. These acids react with the enamel leading to dental caries as a result of demineralization.

Epidemiology

Dental caries may be considered a disease of modern civilization. Studies revealed that the skulls of men from pre-neolithic period (12,000 BC) did not exhibit dental caries but skulls from Neolithic period (12,000 to 3000 BC) contained carious teeth. Dental caries was also found in the skulls of Neanderthal age (3000 BC – 750 BC). Evidence of caries was found in about one-half of the 24 skulls of the prehistoric race, which lived in Central Europe about 15,000 years ago.[1]

Aetiology of Dental Caries—Theories

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 obtained from the Mesopotamian areas which dates to about 5000 BC. The early history of India, Egypt and the writing of Homer also makes reference to the worm as the cause of toothache. Chinese and Egyptians used fumigation devices for treatment of dental caries.[1]

Endogenous Theories

1. ***Humoral theory*:** The four humours 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 internal action of acid and corroding humors". Hippocrates, the father of medicine, while favouring the concept of humoural 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.[2]
2. ***Vital theory*:** Proposed during the 18th century. According to this theory, it is postulated that tooth decay originated like bone gangrene, from within the tooth itself.

Exogenous Theories

1. ***Chemical (acid) theory*:** In the 17th and 18th centuries there emerged the concept that teeth were destroyed by acids formed in the oral cavity by fermentation of food particles around teeth.
2. ***Parasitic (septic) theory*:** Indicated that microorganisms were associated with the carious process.
3. ***Miller's chemicoparasitic theory (acido-genic theory)*:** This theory was proposed by WD Miller in 1890. The microorganisms found in the oral cavity produce enzymes that act upon the fermentable carbohydrates to produce acids (like lactic acid, butyric acid, formic acid, succinic acid). These acids act upon the enamel of the tooth

resulting in its demineralization leading to dental caries.[1]

4. ***Proteolysis theory*:** Proposed by Gottileb in 1934. According to this theory, the organic matrix would be attacked, before the mineral phase of the enamel. The proteolytic enzymes liberated by the oral bacteria destroy the organic matrix of enamel, loosening the apatite crystals, so they are eventually lost and tissue collapses.[2]
5. ***Proteolysis chelation theory*:** Originated by Schatz and Martin in 1955. It proposes that some of the products of bacterial action on enamel, dentin and salivary constituents can form chelates with calcium. Since chelates can be formed at neutral or alkaline pH, the theory suggested that demineralization of the enamel could arise without acid formation.

Epidemiological Triad

I. Host Factors

1. ***Tooth*****:** *Composition*: The enamel consists of 96% inorganic matter and 4% water and organic matter. The dentin consists of 35% of organic matter and water and 65% of inorganic matter. The cementum consists of 45 to 50% of inorganic matter and 50 to 55% of organic matter and water.

   Morphology: Presence of deep, narrow, occlusal fissures or buccal and lingual pits tends to trap food, bacteria and debris. 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. 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.[3]

2. ***Saliva*****:** It helps in removal of bacteria and food debris by its flushing action. The quantities of inorganic and organic constituents of saliva vary from person to person.

   Calcium and phosphorus: The quantity of calcium and phosphorus is inversely related to the rate of flow. Its quantity is less in case of caries active individuals.

   Ammonia: As the quantity of ammonia decreases, caries activity increases, because ammonia retards plaque formation and neutralizes acid.

   Urea: Urea gets hydrolyzed to ammonium carbonate by urease which has a neutralizing effect.

   Ptyalin and amylase: Help in the degradation of starches.

   pH of saliva: The pH of saliva depends on its bicarbonate content. As the flow rate of saliva increases, the pH also increases. 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. Quantity of saliva secreted normally is 700 to 800 ml/day. As the viscosity of saliva increases, the

caries activity also increases. The saliva also contains a number of antibacterial substances or enzymes like lactoperoxidase, lysozyme, lactoferrin, and IgA.[3]

3. ***Sex*:** Most of the studies have shown that dental caries is more common in females.
4. ***Race*:** Dental caries is more in whites compared to the blacks.
5. ***Age*:** Though dental caries is considered to the disease with universal prevalence, it is more commonly seen in childhood. Over 60 years of age, root caries is seen which is mainly due to gingival recession and deterioration of oral clearance ability.
6. ***Familial heredity*:** Inheritance of a characteristic tooth structure has lesser influence than environmental factors.
7. ***Developmental disturbances*:** The presence of deep pits and fissures, enamel hypoplasia and enamel defects make the tooth more prone to dental caries.
8. ***Economic status*:** In young primary school children, dental caries decreases with increase in income. Among adults, as income decreases, there is decrease in dental caries.
9. ***Concomitant disease*:** Dental caries is found to be less in controlled diabetes.
10. ***Oral hygiene habits*:** Dental caries is found to be less among those who maintain good oral hygiene.

II. Agent Factors

Consists of dental plaque forming streptococci (*Streptococcus mutans*).[3]

Role of Microoganisms in Caries

1. They are a prerequisite for caries initiation.
2. A single type of microorganism is capable of inducing caries.
3. Acid production is a prerequisite for caries, but not all acidogenic organisms are cario-genic.
4. *Streptococcus* strains produce extracellular dextrans or levans.
5. Organisms vary greatly in their capacity to induce caries.

Properties of Cariogenic Plaque

1. The rate of sucrose consumption was higher.
2. Synthesize more intracellular polysaccharides.
3. More lactic acid is formed.
4. Twice as much as extracellular polysaccharide is produced.
5. Higher levels of *Streptococcus mutans*.
6. Lower levels of *Streptococcus sanguis* and *Actinomyces*.

III. Environmental Factor

1. Diet

Diet is defined as the types and amounts of food eaten daily by an individual. Difference in caries incidence was noted among populations with dissimilar diets. Some dietary studies are given below.

A. *Vipeholm study*: It was conducted by Gustafsson et al in 1954. It was a five-year investigation of 436 adult inmates in a mental institution at the Vipeholm hospital, Sweden. The institutional diet was nutritious, but contained little sugar, with no provisions for between meal snacks. The dental caries rate in the inmates was relatively low. The experimental design divided the inmates into seven groups that is a control group, a sucrose group, a bread group, a chocolate group, a caramel group, an 8 toffee group, a 24 toffee group.[3]

***Conclusions of the study were*:**

1. Increase in carbohydrate increased the level of dental caries.
2. The risk of caries is greater, if food was in a form that will be retained on the tooth surfaces.
3. The risk of caries was greater, if sugar is consumed between meals.
4. The increase in caries activity varies between individuals.
5. Increased caries activity rapidly disappears upon withdrawal of sugar rich foods.
6. A high concentration of sugar in solution and its prolonged retention on tooth surfaces leads to increased caries activity.
7. The clearance time of the sugar correlates closely with caries activity. Physical form and frequency of intake is important in cariogenicity than total amount ingested.

B. *Hopewood house study*: This study was conducted by Sullivan in 1958. The dental status of children between 3 and 14 years of age residing at Hopewood House, New South Wales was studied longitudinally for 10 years. The absence of meat and a rigid restriction of refined carbohydrate were the two principal features of the Hopewood House diet. It was found that 53% of

the children at the Hope-wood House were caries-free whereas only 0.4% of the 13 years old, state school children were free from caries. The children, oral hygiene was poor and gingivitis was prevalent in 75% of them. This work shows that, in institutionalized children, at least, dental caries can be reduced by diet, without the beneficial effects of fluoride and in the presence of unfavourable oral hygiene.[2]

C. *Turku sugar study*: This study was conducted by Scheinin, Makinen *et al* in 1975. In a 2-year feeding study, 125 young adults, divided into three groups, consumed the entire dietary intake using these sugars exclusively: Sucrose group 35 people, fructose group 38 people and xylitol group 52 people. A dramatic reduction in the incidence of dental caries was found after 2 years of xylitol consumption. Fructose was as cariogenic as sucrose for the first 12 months but became less so at the end of 24 months. It was also found that frequent between meal chewing of a xylitol gum produced an anticariogenic effect.[2]

D. *Seventh-day adventist children study*: The seven day adventist had certain restrictions in their diet which included the limitation of:

1. Sugar sticky elements
2. Highly refined starches
3. Between meal snacking

All the studies showed that the level of dental caries was much lower in the Seven Day Adventist group compared to the other children.

E. *Hereditary fructose intolerence*: Persons affected with this rare metabolic disorder had learned to avoid any food that contains fructose or sucrose, because the ingestion of these foods causes symptoms of nausea, vomiting, tremor, etc. It was noted that the level of dental caries was lower in this group compared to others.[1]

Vitamins like A, D, K, B complex (B_6), and calcium and phosphorus, fluoride, amino acid like lysine and fats have an inhibitory effect on dental caries.

2. Geographic Variations

Decayed, missing and filled teeth (DMFT) is found to be decreasing in developed countries, and increasing in developing countries. The use of

fluorides, oral hygiene practice and diet play a major role as a cause for this difference.

3. Soil

Population depend largely on locally grown food products it is logical to look to differences in soil consumption to help differences in caries experience.

Trace elements and dental caries

- *Caries promoting elements*: Se, Mg, Cd, Pt, Pb and Si.
- ***Mildly cariostatic elements*:** Vd, St, Ca, Bo, Li, Au.
- *Doubtful effect on caries*: Be, Co, Mn, Zn, Br and I.
- ***Caries inert elements*:** Ba, Al, Ni, Fe, Pd and Ti.
- ***Strongly cariostatic elements*:** F, phosphorus.

4. Urbanization

Dental caries is said to increase with urbanization.

5. Climate

Sunlight is said to decrease caries, UV light from sun is known to promote vitamin D productions thus tend to reduce dental caries, whereas rainfall is said to increase dental caries.

6. Social Factors

Good economic status and social pressure in the direction of good health appearance are both strong factors in creating demand for dental treatment. Effect of social pressure can be seen on an international basis by comparing dentist-population ratios among civilised countries as well able to afford as many dentists as may be considered important. A good economic status carries with it a lower caries rate.

7. Industrial Hazards

Carbohydrate dust and acid fumes are both known to be deleterious to the teeth, the one promoting caries and the other chemical erosion.

Dental Caries in India

Dental caries is a public health problem in India with a prevalence as high as 60–80% in Indian children, a figure far more than asthma. Apart from this, about 30% of children suffer from malaligned teeth and jaws affecting proper functioning of the dentofacial apparatus. Lack of awareness about dental diseases has resulted in gross neglect of oral health. There is no component of oral health in the present health care system. The grass-root level health workers and doctors do not have adequate knowledge about oral hygiene and prevention of orodental problems. All the above factors have resulted in poor orodental health of our population.

Mandal KP et al. Prevalence and severity of dental caries and treatment needs among population in Eastern states of India. JISPPD 2001:19(3):85–91. 2067 individuals were examined in age group 5–6, 15–16 and 30–35 years belonging to urban and rural areas. Results showed that DMFT was high in urban than in rural areas, the decayed component contributed maximum to the DMFT or deft, followed by the missing component.

Saravanan S et al. Prevalence of dental caries and treatment needs among school going children of Pondicherry, India. JISPPD 2003: 21(1):1–12. 2022 school children and the prevalence of dental caries was 44.4% in 5-year age group and 22.3% in the children of 12-year age group.

David J et al. Dental caries and associated factors in 12-year-old school children in Thiru-vananthapuram, Kerala, India. Prevalence of dental caries in permanent dentition was 27%.

H. Grewal et al. Prevalence of dental caries and treatment needs in the rural child population of Nainital district, Uttranchal. JISPPD 2009:27(4):224–226. 722 children in the age group of 7–12 years were examined and the prevalence of dental caries was 77.7%.

V Dhar et al. Prevalence of dental caries and treatment needs in the school-going children of rural areas of Udaipur district. JISPPD 2007:25(3):119–121. 1587 government school children constituted the study population. Dental caries was found in 46.75% children and 76.87% children require

some kind of treatment.

Binod Kumar Patro et al. Prevalence of dental caries among adults and elderly in an urban resettlement colony in New Delhi. Indian Journal of dental research 2008:19(2):95–98. A total of 452 participants were enrolled in the study, the prevalence of dental caries in 35–44 years age group was 82.4% and it was 91.9% in those above > 60 years.

Joyson Moses et al. Prevalence of dental caries, socio-economic status and treatment needs among 5 to 15 years old school going children of Chidambaram. Journal of Clinical and Diagnostic Research 2011:5(1):148–151. 2362 children were examined and the prevalence of dental caries was 63.83%.

Abdul Arif Khan et al. Prevalence of dental caries among the population of Gwalior in relation of different associated factors. European Journal of Dentistry 2008:2:81–85. Incidence of dental caries was high among females and 21–30 year age group was found to be most infected with dental caries.

Jagan Kumar Baskar Doss et al. Prevalence of dental fluorosis and associated risk factors in 11–15 years old school children of Kanyakumari district, Tamil Nadu, India: A cross-sectional survey. Indian Journal of Dental Research 2008:19(4):297–305.

Nanak Chand Rao et al. Dentition status and treatment needs of 12-year-old rural school children of Panchkula district, Haryana, India. Journal of Indian Dental Association 2010: 4(9):303–305. 440 school children were examined and the prevalence of dental caries was 42.3% in permanent dentition. Dental fluorosis was present among 10% of the study population.

Prevention of Dental Caries

Primary Prevention

Health promotion

i. Diet counselling with specific instructions on limiting frequency of sugar intake.
ii. Dental health education programmes for children giving them instructions about aetiology and prevention.
iii. Plaque control programmes to ensure proper maintenance of good oral hygiene.
iv. Community water fluoridation in areas with deficient fluoride levels in drinking water.

Specific protection

i. Appropriate use of topical fluoride.
ii. Use of fluoridated tooth paste.
iii. School based fluoride mouth rinse programme.
iv. Preventive resin restoration.
v. Topical fluoride supplements.

Secondary Prevention

i. Periodic screening and referral
ii. Simple restorative dental procedures.

Tertiary Prevention

i. Utilization of dental services
ii. Complex restorative treatment and RCT
iii. Removable and fixed prosthodontics.

Prevention and Control of Dental Caries

1. Increase the Resistance of the Teeth

Systemic use of fluoride

i. Fluoridation of water, milk and salt;

ii. Fluoride supplementation in the form of tablets and lozenges; and

iii. Consuming a fluoride-rich diet such as tea, fish, etc.

Topical

- Use of fluoridated toothpaste and mouthwash;
- Use of fluoride varnishes (in-office application, longer duration of action, high fluoride content);
- Use of casein phosphopeptide-amorphous calcium phosphate (CPP-ACP), which is available as tooth mousse, helps to remineralize the soft initial carious, demineralized areas of the teeth.

2. Combat the Microbial Plaque by Physical and Chemical Methods

i. ***Physical methods*:**

- The correct method and frequency of brushing should be followed—in the morning and before going to bed and preferably after every major meal.
- Tongue cleaning and the use of indigenous agents such as the bark of neem or mango (where toothbrush and paste are unaffordable) should be encouraged. The use of coarse toothpowder and tobacco-containing dentifrices should be avoided.
- The use of various interdental cleaning aids such as dental floss, interdental brush, water pik, etc. supplements the cleansing effect of a toothbrush. Use of an electronic toothbrush in children and persons with decreased manual dexterity is recommended.

ii. ***Chemical methods*:** These include the use of a fluoride-containing toothpaste, mouthrinses and 0.2% chlorhexidine and povidine-iodine mouthwash. These should be used on prescription of a dental surgeon.

3. Modify the Diet

Reduce the intake and frequency of refined carbohydrates. Avoid sticky foods and replace refined with unrefined natural food. Increase the intake of fibrous food to stimulate salivary flow, which is protective against caries. Consume caries-protective foods such as cheese, nuts, raw vegetables, fruits, etc. Stimulate salivary flow with sugarfree chewing gum. Xylitol (a sugar substitute)-containing chewing gum, if chewed between meals, produces an anticaries effect by stimulating salivary flow.

Preventive Interventions

The use of pit and fissure sealants and application of fluoride varnish help in slowing down the development of caries. Preventive restorations should be carried out and atraumatic restorative treatment (ART) should be used as a community-based approach for the treatment and prevention of dental caries.

Miscellaneous Measures

These include the following:

- Prevention of malocclusion (especially crowding of the teeth)
- Prevention of premature loss of deciduous teeth
- Restoration of missing permanent teeth by prostheses (dentures)
- Making sugar-free chewing gum freely available and affordable in the country
- Using sugar substitutes such as saccharine, xylitol, mannitol, aspartame, etc. in paediatric medicinal syrups, bakery products, jams, marmalade, etc.
- Making toothbrushes and fluoridated toothpaste available to the masses at low cost. Regular use of fluoridated toothpaste is proven to reduce the incidence of dental caries by 30%.

Table 8.1: Caries prevalence in India

S.no.	Year	Investigators	Index used	Age	Place	Number	Point prevalence %	Mean DMFT	Mean DMFS
1.	1992	Sarkar and Chowdhary	WHO (1971)	4 yrs	West Bengal	50	25.5	—	—
2.	1993	Chawla et al	WHO (1987)	5–6 yrs	Chandigarh	—	—	2.6	—
3.	1993	Hari Prakash et al	WHO	12 yrs	New Delhi	—	87.0	0.86	1.46
4.	1993	Damle and Ghonomodi	WHO (1983)	15 yrs	Nagpur	—	82.6	4.0	5.0
5.	1994	Mandal et al	WHO (1983)	< 5 yrs	West Bengal (U)	124	52.42	1.86	3.84
6.	1994	Mandal et al	WHO (1987)	15–16 yrs	West Bengal (U)	119	21.0	0.35	0.66
					West Bengal (R)	118	15.2	0.3	0.64
7.	1994	Mandal et al	WHO (1987)	30–35 yrs	West Bengal (U)	118	19.49	0.47	1.30
					Sikkim (U)	107	29.91	0.62	1.71
					West Bengal (R)	120	18.18	0.40	1.04
					Sikkim (R)	106	24.53	0.60	1.72
8.	1995	Chopra et al	WHO (1987)	30–35 yrs	Delhi (U)	388	24.5	0.5	0.99
9.	1998	Rudrigues and Damle	WHO (1997)	12 yrs	Mumbai (U)	358	63.4	1.23	—
10.	1998	Rodrigues and Damle	WHO (1997)	15 yrs	Mumbai (U)	334	70.4	1.99	—
11.	1999	Kuriarose S and Joseph E	WHO	< 5 yrs	Trivandrum – Kerala	600	57	2.28	4.103
12.	1999	Tewari S	WHO (1987)	5– 6 yrs	Haryana				
				5 yrs		113	36.3	0.87	—
				6 yrs		157	38.2	0.91	—
13.	1999	Gopinath, Bharathi VKP, Kannon A	WHO (1987)	3– 6 yrs	Tamil Nadu	97	36.0	MI-36 FI-17	—
14.	1999	Singh A. A et al	WHO (1987)	12 yrs	Haryana (R)	233	33.1	0.79	—
15.	1999	Gopinath et al	WHO (1987)	12 yrs	Tamil Nadu	232	61.2	MO-32 FO-37	—
16.	1999	Singh A. A et al	WHO (1987)	15 yrs	Haryana (R)	207	42.5	1.29	—
17.	1999	Menon and Indushekhar	WHO (1987)	15 yrs	Calicut (R)	92	45.65	0.91	1.35
					Dharwad	106	55.7	1.09	—
18.	2000	Retnakumari N	WHO (1997)	< 5 yrs	Varkala (R)	80	67.5	2.425	—
19.	2000	Goel. P, Sequeira S.P, Peter. S	WHO (1987)	< 5 yrs	Puttur	224	81.25	4.86	—
20.	2000	Retnakumari N	WHO (1997)	12 yrs	Varkala (R)	119	67.2	2.067	—
21.	2000	Goel P, Sequeria S.P, Peter S.	WHO (1987)	12 yrs	Puttur	203	59.60	1.87	—
22.	2001	Gautam R. et al	WHO (1997)	< 5 yrs	NCT (U) Delhi	2366	35.12	1.18	2.95

EPIDEMIOLOGY, AETIOLOGY AND PREVENTION OF ORAL CANCER

Cancer may be regarded as a group of diseases characterized by:

1. Abnormal growth of cells.
2. Ability to invade adjacent tissues and even distant organs.
3. The eventual death of the affected patient, if the tumour has progressed beyond the stage when it can be successfully removed.

Types of cancers

1. Carcinomas
2. Sarcomas
3. Lymphomas
4. Leukaemias

Oral Cancer

Oral cancer is one of the ten leading cancers in the world. In India, it is one of the common cancers and is an important public health problem. Oral cancer is classically described as an indurated, ulcerated lump or sore that may or may not be painful and is often associated with cervical lymph adenopathy.

90 to 95% of all oral cancers are squamous cell carcinomas.

Epidemiology

***India*:** 10% of 6,44,600 new cancers occurring all over the body is oral cancer. On the basis of annual age-adjusted incidence rates, oral cancer ranks from 1st to 6th among all cancers in different regions of India. The total number of cancers at any time, however, is about 2.5 to 3 times the number (6,44,600) estimated from the incidence rates. Annually almost 7% of all cancer deaths in males and 4% in females have been reported to be due to oral cancer.

In India, data is obtained from registries, which were set at Mumbai, Bengaluru, Chennai, Delhi, Bhopal, Pune, Chandigarh, and Trivandrum.

Mumbai	⟶	16.7	⟶	9.0
Poona	⟶	14.9	⟶	9.4
Chennai	⟶	13.0	⟶	12.6
Bengaluru	⟶	10.2	⟶	17.2

World: In highly industrialized countries, it accounts for only 3–5% of all cancers whereas in some developing countries, it is up to 40%.

***Gender*:** Males are more prone than females. In South East Asia, oral cancer is the leading cancer in males and the 3rd leading in females. In developing countries, for males it is 2.5 times as many as industrialized countries, and for females it is about 4 times.

Age: Commonly seen in the 6th decade of life.

***Sites*:** The site of occurrence of oral cancer is related to the customs and social habits. In south and eastern India, cancer of the buccal mucosa has been found to be more. The lateral border and undersurface of the tongue, labial commissure and buccal mucosa are sites particularly associated with

betel-tobacco chewers. In Mumbai, the most common site reported was the tongue, whereas in Chennai it was the buccal mucosa.

Epidemiological Triad

I. Host Factors

1. ***Age*:** Older age shows increase incidence in carcinoma whereas the younger age shows increase in sarcoma.
2. ***Race*:** Whites develop lip melanoma more frequently than the blacks. Certain odontogenic tumours are more common in black races.
3. ***Sex*:** Cancer of lip is more common in women than in men. Malignant melanoma is more common in women. Cancers of tongue and buccal mucosa are more common in males.
4. ***Genetic factors*:** Discovery of oncogenes introduced an era in which it is possible to identify genetic elements involved in the initiation and progression of malignant disease.
5. ***Occupation*:** Textile workers show an increase in oral cancer. Male leather workers show an increase in cancer of buccal cavity, larynx and pharynx.
6. ***Immunity*:** Kaposi sarcoma is more common in AIDS patients.
7. ***Social class*:** There is a definite relationship between socioeconomic status and frequency of cancer. Low-income groups show increase in cancer of oral cavity.
8. ***Customs and habits*:** Smoking (bidi) increases the incidence of cancer. Reverse smoking increases the rate of cancer of palate. Tobacco chewing, pan chewing, spicy food increase the rate of cancer of floor of mouth and buccal mucosa. Alcohol consumption also increases the chance for cancer.

II. Agent Factors

1. ***Biological*:** (a) Virus (HIV, HSV), (b) Fungus (Candida).
2. ***Chemical*:** Arsenic, dyes, nickel, aromatic amines, chromium.
3. ***Mechanical*:** Sharp tooth, any other source of chronic irritation like ill fitting dentures, chronic sores from jagged teeth, etc.
4. ***Nutritional agents*:** Precarcinogens in food (saccharin, aflatoxin), increased consumption of fat, deficiency of folic acid, protein

deficiency, increased consumption of red chilly powder, decrease in copper, zinc, vegetables, vitamins E and C.

III. Environmental Factors

1. ***Water contaminants*:** It includes some organic pollutants like chloroform.
2. ***Air pollution*:** Air pollution caused by the release of a number of gases from the automobiles and factories, e.g. carbon dioxide.
3. ***Geographic variations*:** In Netherlands, buccal mucosa is most commonly affected and is more often seen in males. In Switzerland, lip, tongues are the sites most affected and is often seen in males. In Canadian Eskimos, cancer of salivary gland is more common. In Srikakulam, and Visakapatnam, palatal cancer is most common.
4. ***Solar heat*:** Prolonged exposure to sunlight causes melanoma.
5. ***Industrialization*:** The release of various toxins by the industries contaminates water and air, which may lead to cancer.

Tobacco

According to WHO, 90% of cancer in South East Asia is due to the use of tobacco. In India, about 200 million people use tobacco in some form or the other. Among them, 70% smoke bidis, 10% smoke cigarettes and 20% use smokeless tobacco.

Smoking form of Tobacco

1. ***Bidi*:** It is the most popular form of tobacco in India. About 0.2 to 0.3 gm of sundried tobacco flakes are hand-rolled in a rectangular piece of temburni or tendu leaf and tied with a thread (Fig. 8.1). It is available in lengths of about 60 mm and 80 mm. The nicotine content has been estimated to be 1.7 to 3 mg.



Fig. 8.1: Rolling of bidi

2. ***Chillum*:** It is a straight 10–14 cm long conical clay pipe used for smoking tobacco. It is held vertically. It is filled with coarsely cut tobacco pieces and a glowing charcoal is kept on top of tobacco (Fig. 8.2).



Fig. 8.2: Chillum

3. ***Chutta*:** Cured tobacco wrapped in dried tobacco leaf. It is also called as cigar and is a popular form of tobacco in certain parts of India. Cigars are made of air cured, fermented tobacco usually in modern factories (Fig. 8.3). Chutta are small cigars made of heavily bodied tobacco.

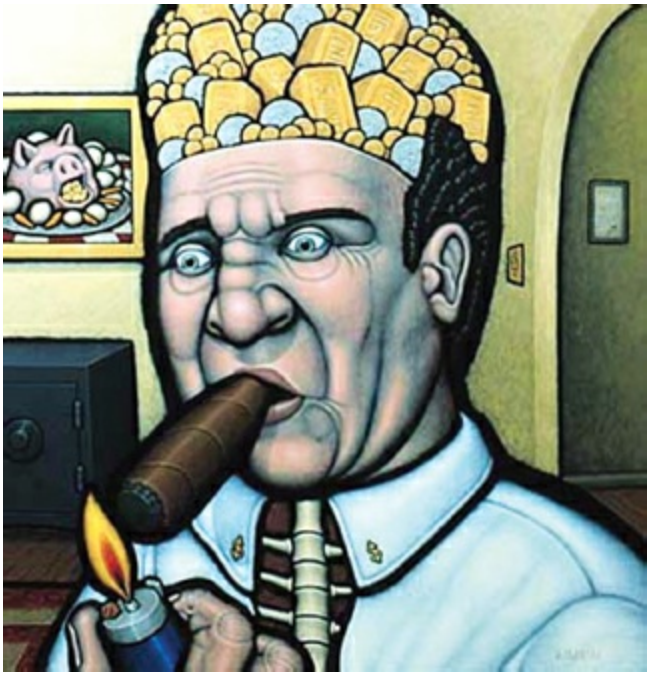


Fig. 8.3: Cigar

4. ***Cigarettes*:** About 1 gm of tobacco cured in the sun or artificial heat is

covered by paper. The tobacco is generally treated with variety of sugars, flavouring and aromatic ingredients. They contain 1–1.4 mg of nicotine. Only about 51% are filter tipped. The filters of Indian made cigarettes comparatively trap less nicotine. Cigarette smoking is more common in urban areas than in the rural areas (Fig. 8.4).



Fig. 8.4: Cigarette smoking

5. ***Dhumti*:** Rolled leaf tobacco is used inside a leaf of jackfruit tree. Sometimes dried leaf of the banana plant is used. This form of tobacco is occasionally used for reverse smoking especially among women. Commonly seen in Goa.
6. ***Hookah*:** It is also called water pipe or hubble-bubble. It is purely of Indian origin. The tobacco smoke is drawn through the water in the base of the hookah, which cools and filters the smoke (Fig. 8.5).



Fig. 8.5: Hookah

7. ***Hookli*:** It is a clay pipe of rather short stem varying from about 7–10 cm with a mouthpiece and bowl (Fig. 8.6). It is commonly used in Bhavnagar district of Gujarat.



Fig. 8.6: Pipe used in smoking

Smokeless Tobacco (Fig. 87)

1. ***Khaini*:** It is a powdered sun-dried tobacco, slaked lime (calcium hydroxide) paste mixture occasionally used with areca nut. It is simply placed in the mouth or chewed. This form of smokeless tobacco is widespread in use in Maharastra.
2. ***Mainpuri tobacco*:** Ingredients are tobacco, slaked lime, finely cut arecanut, camphor, and cloves. About 7% of villages in parts of Uttar Pradesh use this product.
3. ***Mawa*:** It is a preparation containing thin shavings of arecanut with the addition of some tobacco and slaked lime. It is usually sold wrapped in

cellophane papers 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 it is transferred to the mandibular groove.



Fig. 8.7: Smokeless forms of tobacco

4. ***Mishri*:** It is prepared by roasting tobacco on a hot metal plate until it is uniformly black. It is then powdered. It is used primarily to clean teeth.
5. ***Pan*:** Pan chewing is the most common habit of smokeless tobacco usage in India, which has its origin dating back to more than 2000 years. It refers to the betel leaf itself and often to the quid. The quid contains arecanut, lime and according to local customs may also include aniseed, cardamom, cinnamon, coconut, cloves, sugar and tobacco wrapped in betel leaf.
6. ***Snuff*:** It consists of 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. Polycyclic aromatic hydrocarbon, nicotine, phenol, benzopyrene, carbon

monoxide, oxides of nitrogen and nitrosamine are some of the important constituents in tobacco responsible for cancer.

Studies on Prevalence of Oral Cancer in India

***Deepak Ganjewala (2009)*:** Prevalence of tongue cancer (ICD-141) in some parts of Uttar Pradesh and Madhya Pradesh 4.65%. Academic Journal of Cancer Research 2 (1): 12–18, 2009.

***Preeti Sharma (2010)*:** Trends in the epidemiology of oral squamous cell carcinoma in Western UP showed Buccal mucosa was commonly affected and males aged between 36–45 years were frequently affected mainly due to the presence of smokeless tobacco usage habits.

***Ravi Mehrothra (2010)*:** Prevalence of soft tissue lesions in Vidisha. 42% of the population were smokeless tobacco users and oral mucosal lesions were high among smokeless tobacco users with 2% of the population diagnosed as squamous cell carcinoma. BMC Research Notes 2010: 3; 23.

Strategies for Cancer Prevention in India

Prevention means eliminating or minimizing exposure to the causes of cancer, and includes reducing individual susceptibility to the effect of such causes. This approach offers the greatest public health potential and the most cost-effective long-term method of cancer control.

Tobacco is the single leading cause of cancer worldwide and in the fight against cancer every country should give highest priority to tobacco control.

Educating people regarding the disease will help to drive away the fears and stigma associated with the disease. It is important to involve all levels of the population in the educational process. The following educational strategies practiced by the Tata Memorial Hospital have produced very good results and can be easily replicated by other cancer centres and also by institutions and NGOs engaged in cancer control work.

1. Involvement of school children.
2. Involvement of youth and NSS students from university colleges.
3. Involvement of NGOs, particularly those working in the area of women's health.
4. Involvement of the municipal, district and state health administration.
5. Involvement of medical colleges, particularly departments of preventive and social medicine.
6. Involvement of mass media. There are a variety of methods that can be employed for educating people. Some of the useful ones that have produced good results are:
    1. *Conducting drawing and essay competitions*: School children.
    2. *Debates, discussions, seminars and street play competitions*: Youth and university students.
    3. *Participatory workshops and training sessions*: NGO groups, municipal, district and state health administration.
    4. *Structured training and field activities*: Medical colleges.
    5. *Participatory programmes on radio and television*: Mass media.
    6. *Descriptive articles in newspapers and magazines*: Mass media.
    7. *Exhibitions and public lectures*: General population.

Well-illustrated audiovisual educational materials are extremely useful in literate as well as illiterate populations. While health education is an interesting method of communication, it should be clearly understood that education is a process, which goes through the modalities of changes in knowledge, attitudes and practices over a period of time and it takes a long time before the impact of education becomes evident. On the other hand sometimes even simple fact finding surveys can result in increased knowledge leading to a reduction in morbidity and mortality. An interesting example is a health education study conducted in two tehsils of Solapur district in Maharashtra by the Tata Memorial Hospital Rural Cancer Registry at Barshi. This study showed a reduction in mortality due to cervix cancer by 40% in a short span of 5 years.

EPIDEMIOLOGY, AETIOLOGY AND PREVENTION OF PERIODONTAL DISEASES

Periodontal disease is a term, which includes all pathological conditions of the periodontium (gingiva, alveolar bone, cementum and periodontal ligament).

Traditionally, periodontal diseases were classified into gingival and periodontal diseases.

Epidemiology of Periodontal Disease

Progress was slower in the field of periodontal diseases compared to dental caries because unlike dental caries, periodontal disease does not lend itself easily to objective measurement.

Changing Perceptions of Periodontal Diseases

In 1961, the expert committee of WHO said that gingivitis invariably developed to periodontits. Research by 1990s showed that:[4]

1. Severe periodontitis was seen only in a small proportion of the population, whereas mild, and mild to moderate gingivitis were more common.
2. Gingivitis and periodontitis are associated with bacterial flora that have some similarities but also some differences. Gingivitis precedes periodontitis. Fraction of sites and not all sites with gingivitis later develop periodontitis.
3. Though periodontal disease is usually related to age, it is not a natural consequence of aging.
4. Periodontal disease is not a major cause of tooth loss in adults.

Epidemiologic Indices

One of the most valuable techniques employed in study of the epidemiology of periodontal diseases is the use of indices. Some of the indices used are:

1. Periodontal index
2. Periodontal disease index
3. Papillary-marginal attachment index
4. Gingival index
5. OHI-S
6. CPITN

Epidemiological Studies on Prevalence and Incidence of Periodontal Diseases (India)

Many studies look at the prevalence of "advanced *periodontitis*", but have differing definitions of this term. Generally though, severe forms of periodontitis do not seem to affect more than 15% of the population of *industrialized* countries. The proportion of such subjects increases with age and seems to peak between 50 and 60 years. A later decline in prevalence may be due to *tooth loss*.

Periodontal disease in India is still one of the major causes of tooth loss. There are a number of studies done on the prevalence of periodontal disease by many professionals in India.

I. School going children

II. Handicapped children

III. Pregnant women

IV. Adults

I. Among School Going Children

1. Nagaraj Rao et al (1980) conducted a study among 500 school children of 5–10 years of age in Udupi and reported that oral hygiene status was poor in all children. 28% of study population had marginal gingivitis and 72% had chronic generalized gingivitis. Poor oral hygiene was found to be the major factor for the increase in prevalence of gingivitis.
2. Nagaraj Rao (1985) studied oral hygiene status of school going children of 4–14 years in Mysore. Results showed that oral hygiene was better in girls than boys.
3. Pandit K et al (1986) examined 480 boys and girls of Delhi, aged 8–18 years using papillary marginal attachment index and found prevalence of periodontal disease to be 41.7%. In the age group of 8–10 years, the prevalence was found to be 42.2%, while in the age group of 11–13 years, it was 44.2% and above 14 years 54.6%. This study showed an increase in prevalence with age.
4. Srivastava RP (1989) examined 690 subjects aged 6–17 years in Jhansi and reported that 6–8 years age group had a prevalence of 42% and 15–

17 years age group had a prevalence of 94.02% indicating an increase in prevalence with age.

5. Borle RM et al (1990) examined 1240 tribal students in Wardha district of Madhya Pradesh and found that raw food decreased the prevalence of periodontal disease.

II. Among Handicapped Children

1. Mehrotra AK et al (1982) examined 61 physically handicapped and 66 mentally retarded individuals using Russell's Index. Among physically handicapped children, the prevalence of periodontal disease was 88.5% as compared to 100% in mentally retarded subjects. They reported that the greater prevalence was due to lack of awareness of oral hygiene.
2. In 1991, a total of 466 children 11–14 years of age in Mumbai consisting of mentally subnormal, physically handicapped, juvenile delinquents and normal children were examined and periodontal disease was found 100% in mentally subnormal, 95.95% in juvenile delinquents and 97.38% among physically handicapped. The periodontal status of mentally abnormal children revealed that 7.45% had pockets of 4–5 mm deep requiring surgical intervention. 60% of the children had calculus deposits requiring oral prophylaxis.

III. Among Pregnant Women

1. Dixit J et al (1980) studied the occurrence and severity of gingivitis in 80 pregnant and 40 non-pregnant women in the age group of 20–40 years in Lucknow. They found a significantly higher severity of gingivitis in pregnant subject as compared to nonpregnant. They also noted increase in severity in second trimester.

IV. Among Adults

1. Ramachandra et al (1973) surveyed 6,647 rural and 1,536 urban population of Tamil Nadu and found that periodontal disease in both the populations was high (95.3% and 95.5% respectively). Periodontal index score was found to increase with age.
2. In 1990, Anil S, Hari S and Vijay Kumar T assessed the periodontal conditions of 2756 subjects aged 15–44 years from urban and rural

areas of Trivandrum using CPITN Index. They reported that 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 in 33% in age group of 35–44 years.

3. Maily AK, Banarjee KL, and Pal TL (1994) examined 5960 subjects aged 15–65 years in a rural population in West Bengal using CPITN Index. The subjects selected were mostly poor farmers. Remarkable finding was that there was relatively low percentage of people with deep periodontal pockets. They found CPITN score 4 in only 2–3 subjects. On the other hand, calculus was wide spread.

Epidemiological Triad

I. Host Factors

1. ***Age*:** Chronic destructive periodontal disease has been associated with older age groups (>40 years).
2. ***Sex*:** It is more common in males than in females.
3. ***Race*:** Blacks are more affected than the whites.
4. ***Intraoral variations*:** Gingivitis is more seen on the interproximal areas than the buccal and lingual areas. The upper arch shows more gingivitis compared to the lower arch (except lingual). On the facial aspect, upper 1st and 2nd molars are more prone to gingivitis followed by the lower anteriors and least is the lower 2nd premolar. On the lingual aspect, lower 1st and 2nd molars are the most prone to gingivitis, followed by lower premolar and the least are the upper anteriors. Gingivitis is more often seen on the right arch than on the left arch.[4]

   Severity of bone loss: Incisor and molar areas are more severely involved than canine and premolar areas. Maxillary teeth experience more bone loss compared to the mandible (except anterior). Inter-proximally bone loss is higher than the facial and lingual. Severely affected are lower centrals and laterals and upper molars.
5. ***Endocrine changes*:** Puberty, menstruation and pregnancy, hyperthyroidism, hyperparathyroidism increase the chances of gingivitis.
6. ***Traumatic occlusion*:** Sharp cusp acts as 'plungers' and lead to periodontitis.
7. ***Food impaction*:** Food impaction causes chronic gingivitis which if let to continue lead to periodontal disease.
8. ***Tooth position*:** Irregular alignment makes it difficult to keep these areas clean. Sometimes the roots approach each other too closely. This may allow for insufficient intervening alveolar support resulting in early pocket formation.
9. ***Occupational habits*:** Occupational habits like thread biting, holding nails between teeth, etc. can have traumatic effects on the

periodontium.

10. ***Neuroses*:** Bruxism, lip, cheek and nail biting also have traumatic effects on the periodontium.
11. ***Use of tobacco*:** The components present in tobacco lower the tissue resistance and increase susceptibility to gingivitis and periodontal diseases.
12. ***Misuse of toothbrush*:** Improper use of toothbrush may not only cause abrasion or recession of the gingival tissues but may also irritate already inflamed tissues.
13. ***Concomitant disease*:** There is a tendency towards alveolar bone destruction in patients with uncontrolled diabetes. Heavy metal poisoning may accentuate gingivitis. Acute monocytic leukaemia, pernicious anaemia cause gingivitis.
14. ***Income*:** Periodontal disease increases with decrease in income.
15. ***Education*:** Severity of periodontal disease and level of education are inversely related.

II. Agent Factors

1. Plaque
2. Calculus

***Dental plaque*:** It is the primary aetiologic factor for periodontal disease. It is defined as soft deposits that form the biofilm adhering to the tooth surface or other hard surfaces in the oral cavity, including removable and fixed restorations. Disruption of balance between plaque bacteria and host results in periodontal disease.

Dental plaque is divided into supragingival and subgingival plaques.

Marginal plaque is responsible for gingivitis whereas supragingival and tooth associated subgingival plaque is responsible for calculus and root caries.

Tissue associated subgingival plaque is responsible for periodontitis. 1 gram of plaque contains 2×10^{11} bacteria. It also contains epithelial cells and macrophages embedded in an organic and inorganic matrix.

Organic and inorganic materials are derived from saliva, crevicular fluid

and bacterial products.

Accumulation of plaque is found to be more on gingival one-third of the tooth surface, cracks, pits and fissures, overhanging restorations and around malaligned teeth. The rate of formation and location vary according to the oral hygiene practices, diet, salivary composition and rate of flow.

Calculus: Calculus is an adherent calcified mass that forms on the surface of natural teeth and dental prosthesis. It consists of mineralized plaque.

Calculus would be divided into:

1. *Supragingival calculus*: It is white or whitish yellow in colour. It is found to be maximum in the upper 1st molars, followed by the lower central and laterals and least in the upper anteriors. It can be easily detached.
2. *Subgingival calculus*: It is dark brown or greenish black in colour. It is found to be maximum in lower central and laterals followed by upper 1st molar, upper anteriors, and upper 2nd molars. It is found to be least in lower 1st and 2nd premolars, and lower 3rd molar.

Calculus provides a fixed nidus for the continued accumulation of plaque.

III. Environmental Factors

1. ***Geographic variations*:** Periodontal diseases are found to be high in Chile, Jordan, India, Malaysia, Ceylon. It is found to be intermediate in US (blacks), Columbia, Ethiopia, and Ecuador and low in US (whites), primitive Eskimos of Alaska. Underdeveloped and dentist deprived areas have increased scores for periodontal diseases.
2. ***Nutrition*:** Avitaminosis C, niacin deficiency show higher prevalence for periodontal diseases. ICNND (International Committee on Nutrition for National Defence) said that there is no consistent association between periodontal disease and nutrition items. Trend towards a higher prevalence and severity of periodontal were found in areas with protein malnutrition and vitamin A deficiency. Nutrition is a secondary factor.
3. ***Degree of urbanization*:** Rural population seems to suffer more from periodontal diseases compared to urban population.

4. ***Stress*:** Stress is said to predispose to acute necrotising ulcerative gingivitis and is often seen in military groups and in exam going students.

Table 8.2: Prevalence of periodontal disease in India

Year	*Reference*	*Age (in years)*	*Sample size*	*Clinical parameters*	*Results/findings*
2009	Kumar TS, Dagli RJ et al[7] Oral health status and practices of dentate Bhil adult tribes in Southern Rajasthan	15–54 yrs	1590 male subjects	• OHI-S-CPITN	• Debria, calculus and OHI-S increased with age • Shallow pockets were prevalent (40%) in 35–44 years age • Deep pockets were common (11%) in older individuals
2009	Parmar G, Sangwan P et al[8] Oral hygiene status of arecanut and tobacco chewers and nonchewers	Mean age 32.5±0.7 years (chwewers) 30.4±0.8 years (nonchewers)	365 subjects (168 chewers and 197 nonchewers)	• CHI-S • Clinical examination for ulcers and burns, etc.	• Periodontal pockets and gingival lesion and gum recession was significantly higher in chewers
2009	Das UM, Beena JP et al[9] Oral health status of 6 and 12 years old school going children in Bengaluru	6 years and 12 years	430 subjects (229—6 years old, 201—12 years old)	• Periodontal condition by CPITN • Malocclusion by WHO criteria • Caries by dentition status and treatment need	• Highly significant difference with respective periodontal disease • No significant difference for dental caries
2009	Jain M, Mathur A et al[10] Oral health status of mentally disabled subjects in India	12–30 years	225 mentally retarded subjects	• OHI-S • CPITN • DMFT	• Oral health status of mentally retarded population was poor and influenced by cause of disability, IQ level and parents education
2009	Kumar S, Sharma J et al[11] Determinants for oral hygiene and periodontal status among mentally disturbed children and adolescents	—	171 mentally retarded subjects	• OHI-S • CPITN • DMFT	• Oral health status of mentally retarded population was poor and influenced by causes of disability, IQ level and parents education
2009	Doshi D, Ramapuram J et al[12] Periodontal status of HIV positive patients	—	52 HIV positive 52 controls	• OHI-S • Plaque index	• CHI-S was significantly different in HIV positive • Plaque index was not significantly different in HIV positive

2009	Acharya S, Bhat PV[13] Oral health-related quality of life during pregnancy	Pregnant – 26±5 years; non-pregnant – 27.8 ± 6.9 years	259 pregnant, 237 non-pregnant	• CPITN	• CPITN score 2 and 3 and gingival index score were significantly high among pregnant than non-pregnant women
2008	S Nagarajan, Puspanjali K[14] Self-assessed and clinically diagnosed periodontal health status among patients visiting dental hospital, Bengaluru	20–14 years	216 patients	• Self-administered questionnaire • Periodontal examination • Loe and Silness gingival index • CPITN • Mobility	• Perceived periodontal health status was low and the discrepancy was more between subjective and objective assessment of disease • The awareness increased with increasing severity of the disease
2008	Kumar S, Dagl RJ et al[15] Periodontal status of green marble mine labours, Rajasthan	18–25 years 26–34 years 35–44 years 45 and above	513 male subjects	• WHO oral health assessment form • Clincal examination by method suggested by WHO oral health survey	• Prevalence was 98.2% • Prevalence increased with increasing age • Maximum disease was present in 35–44 years of age • On an average 0.4% sextant having deep probing depth
2008	Sumanth S, Bhat KM et al[16] Periodontal status of pan chewers with or without tobacco	—	300 subjects (150 tobacco chewers, 150 non-tobacco chewers)	• CHI-S • CPITN	• Deep pockets were more (30%) in pan chewers with tobacco than (7.3%) in pan chewers without tobacco, approx 4 times more • Pan with tobacco chewers were found to have 7 times more risk of loss of attachment
2007	Vandana KL, Sesha Reddy M[17] Periodontal status of a population residing in high fluoride area of Davangere district	15–74 years	1029 subjects	• CPITN • CHI-S • Jackson's fluorosis index	• With increasing age, gingivitis reduced from 85 to 42.9% and periodontitis increased from 18.0 to 57.1% • With increased severity of fluorosis severity of gingivitis reduced 89.4 to 64% and periodontitis increased from 8.5 to 35.8%
2007	Dhar V, Jan A et al[18] Prevalence of gingival disease, melocclusion and fluorosis in school going children of rural areas in Udaipur distt.	—	1587 government school children	—	• Gingivitis was found in 84.37% of children, malocclusion in 36.42% and fluorosis in 36.36%
2007	Nasim VS, Sheety YR et al[19] Dental health status in children with acute lymphoblastic leukaemia	—	104 children with acute lymphoblastic leukaemia	• Questionnaire • Clinical examination	• Moderate gingival inflammation irrespective of treatment • Tender TM joint and oral mucositis • High DMFT and history of haltosis
2007	Shashi Khan ND, Reddy W et al[20] Effect of asthmatic medication on dental disease	6–14 years	105 asthmatic children	—	• Anti-asthmatic medication has its effect on periodontal disease and dental caries • Asthmatic patients on medication should take more precaution for oral hygiene practice
2007	Ranganathan K, Magesh KT et al[21] Greater severity and extent of periodontal breakdown in HIV positive patients	—	136 HIV positive individuals and 136 controls from the same background	• CPITN	• Periodontal breakdown more in HIV positive patients
2006	Kumar M, Chandu GN et al[22] Oral health status and treatment needs in institutionalized psychiatric patients in India	—	220 psychiatric patients	• CPITN • OHI-S • DMFT	• Low prevalence of cartes with poor oral hygiene and extensive need for dental treatment

EPIDEMIOLOGY, CLASSIFICATION OF AETIOLOGY AND PREVENTION OF MALOCCLUSION

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 aesthetics, function and for overall preservation or restoration of dental health.

Sequelae of Malocclusion

- Poor facial appearance
- Risk of caries
- Predisposition to periodontal diseases
- Psychological disturbances
- Risk of trauma
- Abnormalities of function
- Temporomandibular joint problems

Epidemiology of Malocclusion

Prevalence of malocclusion is estimated to be higher in developed countries as compared to developing and underdeveloped countries.

Distoclusion in India is very low in contrast to USA (34% in whites and 15% in blacks) and in Europe 29%. However, Indians have more tendencies for class II relationship than Africans (4.26% in Nigeria). Class III malocclusion is also much less prevalent in India compared to USA, Netherlands and Kenya.

Malocclusion percentage is relatively low in deciduous dentition. Incidence of normal occlusion in deciduous dentition is 51%; mixed 40% and permanent dentition about 30%.

Aetiology of Malocclusion

Graber's Classification

General factors

1. Heredity
2. Congenital
3. Environment
    a. Prenatal (trauma, maternal diet, German measles, maternal metabolism, etc.)
    b. Postnatal (birth injury, cerebral palsy, TMJ injury)
4. Predisposing metabolic climate and disease
    a. Endocrine imbalance
    b. Metabolic disturbances
    c. Infectious disease
5. Dietary problems (nutritional deficiency)
6. Abnormal pressure habits and functional aberrations
    a. Abnormal sucking
    b. Thumb and finger sucking
    c. Tongue thrust and tongue sucking
    d. Lip and nail biting
    e. Abnormal swallowing habits (improper deglutition)
    f. Speech defects
    g. Respiratory abnormalities (mouth breathing, etc.)
    h. Tonsils and adenoids
    i. Psychogenitics and bruxism
7. Posture
8. Trauma and accidents

Local factors

1. Anomalies of number

- Supernumerary teeth
- Missing teeth (congenital absence or loss due to accidents, caries, etc.)

2. Anomalies of tooth size
3. Anomalies of tooth shape
4. Abnormal labial frenum
5. Premature loss
6. Prolonged retention
7. Delayed eruption of permanent teeth
8. Abnormal eruptive path
9. Ankylosis
10. Dental caries
11. Improper dental restorations.

The measurement of malocclusion as a public health problem is extremely difficult since most orthodontic treatment is undertaken for aesthetic reasons and it is very difficult to estimate the extent to which malposed teeth or dentofacial anomalies constitute a psychological hazard.

Prevention and Treatment

The prevention and treatment of dentofacial anomalies can be undertaken at three levels (Table 8.3).

- *Primary prevention*—preventive orthodontics
- *Secondary prevention*—interceptive orthodontics
- *Tertiary prevention*—corrective orthodontic treatment by removable and fixed appliances, and surgical orthodontics.

Primary Prevention

This includes control of harmful oral habits, and preservation and restoration of primary and permanent dentition.

Secondary Prevention

Habit-breaking appliances should be used. Serial extractions, space maintainers/regainers, and functional appliances to correct jaw relations are other modalities. Frenectomies and simple appliances can be used to correct anterior crossbites.

Table 8.3: Strategies for the prevention and treatment of dentofacial anomalies and malocclusion

Medical interventions	***Non-medical interventions***
• Habit-breaking appliances • Serial extractions • Space-maintainers and-regainers • Functional appliances in developing malocclusion to correct jaw relations • Frenectomies and simple appliances • Removable and fixed appliances • Orthogenic and plastic surgery • Speech therapy	• Control harmful oral habits • Prenatal and perinatal care • Genetic counselling

Regular dental check-up for
- early intervention
- Counselling
- Preservation and restoration of primary and permanent teeth

Tertiary Prevention

Corrective orthodontic treatment includes the use of fixed and removal appliances and surgical orthodontics in cases of severe malocclusion.

Prevalence of Malocclusion in India (Table 8.4)

- **Ashok Khandelwal et al.** Incidence of malocclusion in males of Indore, Malwa. JIDA 2010:4:10:357–358. 922 school children were examined and 53.49% children had malocclusion according to WHO criteria.
- **Sreedhar Reddy et al.** Normative and perceived orthodontic needs among 12 years old school children in Chennai, India – A comparative study. Applied Technologies and Innovations. 2010:3(3):40–47. 613, 12 years old school children were examined and 25.8% subjects had definite malocclusion.
- **Mahesh Kumar P et al.** Oral health status of 5 years and 12 years school going children in Chennai city—an epidemiological study. JISPPD 2005:17–22. 1200 school children were examined and prevalence of malocclusion was found to be high among 12 years old children, also there was an increased severity of dental caries among these children.

Table 8.4: Prevalence studies of malocclusion in India

Study by	*Year*	*Sample age*	*Region*	*Prevalence*
Shourie	1942	13–16	Punjab	50%
Shaikh	1960	6–13	Mumbai	68%
Miglani	1963	15–25	Chennai	19.6%
Shaik and Desai	1966	7–21	Mumbai	72.9%
Sidhu	1968	6–30	Delhi	90%
Jacob	1969	12–15	Trivandrum	44.97%
Prasad and Savadi	1971	5–15	Bengaluru	85.7%
Arya	1976	5–28	Nagpur	96.5%
Nagaraja Rao	1980	5–15	Udupi	28.8%
Gardiner JH	1989	10–12	South Kanara	42%
Jalili	1989	6–14	Mandu Distt.	14.4%
Kharbanda	1991	5–13	Delhi	10–18%

- **KM Shivakumar et al.** Prevalence of malocclusion and orthodontic treatment needs among middle and high school children of Davangere city, India by using Dental Aesthetic Index. JISPPD 2009:27(4): 211–

218. Results showed 43.56% of malocclusion among the study subjects.

- **Goel P et al.** Prevalence of dental disease amongst 5–6 and 12–13 year old school children of Puttur municipality, Karnataka state – India. JISPPD 2000:11–18. 427 children were examined and the prevalence of malocclusion among 5–6 old and 12–13 year old children was 1.79% and 36.95% according to WHO criteria.

EPIDEMIOLOGY AND PREVENTION OF DENTAL FLUOROSIS

Enamel fluorosis is a subsurface enamel hypo-mineralization or porosity that occurs when a child ingests above optimum amounts of fluoride while enamel formation is occurring. Clinically, the appearance of enamel fluorosis can vary from faint white flecks in its mildest presentation, to more noticeable snow flaking or mottling of enamel, sometimes with accompanying brown staining of enamel. A number of indices have been developed to measure dental fluorosis the most commonly employed is the Dean's fluorosis index, commonly used in epidemiological surveys to assess the prevalence of dental fluorosis, also Community Fluorosis Index given by Dean in 1935 was used to assess the degree of enamel mottling in the community.

The other commonly used indices in measurement of dental fluorosis are Thylstrup and Fejereskov Index, Tooth Surface Index for Fluorosis, Fluorosis Risk Index to assess the risk of developing dental dental fluorosis, Murray and Shaw's Index and Young's Index.

Prevalence of Enamel Fluorosis

Contribution of fluoride had reduced the prevalence of dental caries, paralleling this decline there has been an observed increase in the prevalence of enamel fluorosis, Circa in a study found that in an optimally fluoridated area, the prevalence of dental fluorosis is 16% especially in mild forms.

EPIDEMIOLOGICAL STUDIES AROUND WORLD

Kathrin Buchel et al. Prevalence of enamel fluorosis in 12 years old in two Swiss cantons. Schwieiz Monatsschr Zahmed. 2011: 121:652657. 373 school children were examined and the prevalence of dental fluorosis was found to be 31.9%.

Irene Ramires et al. Prevalence of dental fluorosis in Bauru, Sao Paulo, Brazil. Journal of Applied Oral Sciences 2007: 15(2): 140–143. 1318, 12 to 15 years old children were examined and the prevalence of dental fluorosis was found to be 36%.

EAM Vuhahula et al. Dental fluorosis in Tanzania Great Rift Valley in relation to fluoride levels in water and and 'Magadi'. Desalination 2010(252) 193–198. 2912 school children aged between 12 and 18 years were examined and the prevalence of dental fluorosis was found to be 96.3%.

Danilo Bonadia Catani et al. Relationship between fluoride levels in public water supply and dental fluorosis. Rev Saude Publica 2007: 41(5):1–7. 386 seven-year-old school children were examined and the prevalence of dental fluorosis was found to be 79.9%.

Ch. Berndt et al. Fluorosis, caries and oral hygiene in school children on the Ombili Foundation in Namibia. Oral Health and Preventive Dentistry 2010: 8: 269–275. 120, 12 years old children were examined and the prevalence of dental fluorosis was found to be 65.8%.

SR Grobler et al. Dental fluorosis and caries experience in relation to three different drinking water fluoride levels in South Africa. International Journal of Paediatric dentistry 2001:11:372–379. 282, 10–15 years old children were examined and the prevalence of dental fluorosis was found to be 50%.

Wond Wossen et al. The relationship between dental caries and dental fluorosis in areas with moderate- and high-fluoride drinking water in Ethiopia. Community Dentistry and Oral Epidemiology 2004:32: 337–344.

DENTAL FLUOROSIS IN INDIA

Shortt in 1937 conducted a study and found that four states, Tamil Nadu, Andhra Pradesh, Uttar Pradesh and Punjab, are affected by fluorosis.

1986 additional 9 states were identified to be affected by fluorosis by 'Water Mission'.

1990–1992—Kerala and Jammu and Kashmir were added to the list leading to the total of 15 states.

At present more than 22 states are affected with dental fluorosis in India. Out of 6 lakh villages in India, at least 50% of the villages have fluoride level in water exceeding 1.0 ppm.

They are further divided by the prevalence of districts affected in each state

***Category I*:** < 30% of the districts affected with fluorosis. The states are Jammu and Kashmir, Delhi, Kerala and Orissa.

***Category II*:** > 30% of the districts were affected, the affected states are Punjab, Haryana, Madhya Pradesh, Maharashtra, Karnataka and Bihar.

***Category III*:** > 50% of the districts is affected, the states affected are Tamil Nadu, Andhra Pradesh, Uttar Pradesh, Gujarat and Rajasthan.

Prevalence Studies in India (Fig. 8.8)

Apurva K Srivatsava et al. Endemic dental and skeletal fluorosis: Effects of high ground water fluoride in some North Indian villages. International Journal of Oral and Maxillofacial Pathology 2011:2(2): 7–12. Out of 5024 people studied 43% had fluorosis. And dental fluorosis was high among 13–15 years old children and boys were commonly affected than girls.

Padma K Bhat et al. Prevalence and severity of dental fluorosis in an endemically affected district of Karnataka, South India. International Journal of Contemporary Dentistry 2011:2(2): 96–101. 588 individuals were examined in a house to house survey and 89.6% of the total population studied were affected with fluorosis.

Sudhir KM et al. Prevalence and severity of dental fluorosis among 13 to 15 years old school children of an area known for endemic fluorosis: Nalgonda district of Andhra Pradesh. JISPPD 2009:27(4):190–196. 1000 school children were examined and the prevalence of fluorosis was 100%.

Dhar V et al. Prevalence of gingival diseases, malocclusion and fluorosis in school going children of rural areas of Udaipur district. JISPPD. 2007:103–105. 1,587 government school children were examined in Udaipur district and prevalence of fluorosis was 36.36%.

Gopalan Viswanathan et al. Mapping of fluoride endemic areas and assessment of fluoride exposure. Dindigul district in Tamil Nadu was analysed and about 88% of the villages in this block had fluoride levels in water above normal. Science of the Total Environment 2009:407:579–587.

Bhupen Kumar Baruah et al. Fluoride aion in drinking water and prevalence of dental fluorosis in some tea garden belt villages in Golaght district of Assam, India. Archives of Applied Science Research 2011:3(1):175–179. The study showed prevalence of dental fluorosis was 25.67% among females and 74.33% among males in the study area.

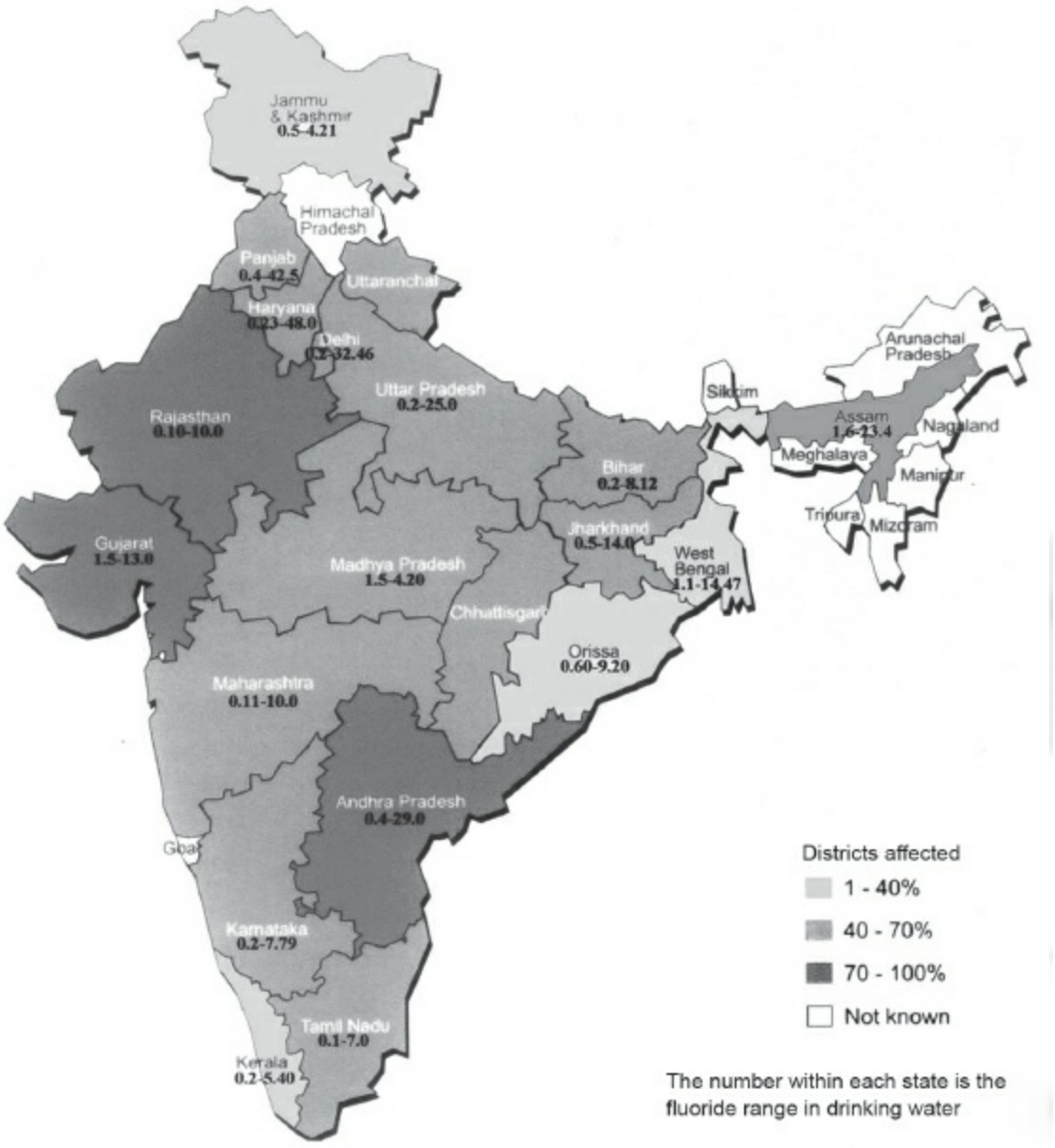


Fig. 8.8: Fluorosis prevalent states

(**Source of information:** 1. UNICEF State of Art Report, 1999, 2. FR and RDF data bank)

Risk Factors for Enamel Fluorosis

Enamel is at risk of developing fluorosis only during its formation. Therefore, only the ingestion of fluoride during the first 6 to 8 years of life can be a risk factor for enamel fluorosis. Studies by Pendrys D and Mascerandes A has demonstrated an association between the use of fluoride tooth paste by preschool children and enamel fluorosis. This was due to the fact that preschool children swallow much of dentrifices they put into their mouth.

Prevention of Dental Fluorosis (Table 8.5)

- ***Individual level:***
  - Avoid using fluoridated tooth paste in fluoride endemic areas.
  - Children should be taught proper brushing technique.
  - Children are encouraged to spit rather than swallow tooth paste while brushing.
  - Parents are encouraged to guide children during brushing.
- ***Community level*:** Defluoridation of the community water supplies.

Table 8.5: Prevention of dental fluorosis

Primary prevention	*Secondary prevention*	*Tertiary prevention*
• Specific guidelines on the use and appropriate dose levels of fluoride supplements, and use of fluoride toothpaste for young children • In high fluoride areas – Provide an alternate supply of drinking water – Employ defluoridation techniques at the community or individual level	• Improve the nutritional status, especially of expecting mothers, newborns and children up to the age of 12 years • Treat other causes of fluoride toxicity such as kidney and thyroid diseases, etc.	Treat the discoloured/disfigured dentition by appropriate aesthetic treatment such as bleaching, microabrasion, laminate veneers, etc.

Treatment for Dental Fluorosis

Dental fluorosis of moderate or severe degree is of aesthetic concern for the people. So, conservative aesthetic procedures like bleaching and veneering are carried out. Dental caries is also found to increase in patients with increased severity of dental fluorosis.

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Section

C

Infection Control

9. Infection Control and Sterilization

CHAPTER

9

Infection Control and Sterilization

In utero the oral cavity is sterile but after birth within a few hours to 1 day a simple oral flora develops. As the infant grows, there is continuing introduction of microorganisms normal for an adult oral cavity.

Most of the salivary bacteria come from the dorsum of the tongue, but some are from other mucous membranes. Much higher counts of microorganisms are found in bacterial plaque, periodontal pockets and carious lesions than in saliva.

The intact mucous membrane of the oral cavity protects against infection to a degree. However, when the gingival tissues are inflamed and are manipulated during instrumentation, microorganisms can be introduced into the underlying tissues by way of the gingival sulcus or periodontal pocket.[1]

***The infectious process*:** A chain of events is required for the spread of an infectious agent. These are:

I. Essential features for disease transmission[2]

a. An infectious agent, the invading organisms (bacterium, virus, fungus, rickettsia, or protozoa). Each organism has its own specific reaction in an infected host.

b. A reservoir where the invading organism live and multiply. The infectious agent has its own essential environment, which may be an inanimate matter, an insect, or human cells or blood. For example, soil is the reservoir for tetanus, and humans are the reservoir for herpetic infections.

c. A mode of escape, the port of exit from the reservoir. Organisms exit through various body systems, such as the respiratory tract, or through skin lesions. Escape from the bloodstream may be through skin abrasions, hypodermic needles, or dental instruments.

d. A mode of transmission, which may be direct, person to person, or indirect by way of an intermediate vehicle, such as contaminated hands or hypodermic needle. Transmission by a droplet may be direct from the respiratory tract of one person to the oral cavity of the receiving host. Droplets also may pass indirectly to hands or inanimate object to be transferred indirectly to the susceptible host.

e. A mode of entry, the port of entry of the infectious agent into the new host. Modes of entry may be similar to modes of escape, such as the respiratory tract, mucous membranes, or a break in the skin.

f. A susceptible host that does not have immunity to the invading infectious agent.

II. Factors that influence the development of infection

The presence of an infectious agent does not lead inevitably to infection or disease. Factors involved include, but are not limited to, the following:

A. Number of organisms and duration of exposure.

B. Virulence of the organisms: Their ability to survive interim exposure.

C. Immune status of the host; antibody response; defense cell reaction.

D. General physical health and the nutritional status of the host. In health, disease is resisted, whereas in deprived state, the body can be susceptible to infection.

III. Factors that alter normal defenses

The patient's complete medical and dental history must be reviewed to identify specific problems and take necessary precautions. Examples of situations that alter the normal defenses are included under the following topics.

a. ***Abnormal physical conditions*****:** A heart valve may be defective as a result of a congenital or acquired condition. Such a valve may be susceptible to infective endocarditis resulting from a bacteraemia

created during dental or dental hygiene instrumentation.

b. ***Systemic diseases*****:** Examples of systemic conditions in which susceptibility to infection is increased are diabetes mellitus, alcoholism, leukaemia, glomerulonephritis, acquired immunodeficiency syndrome and all causes of immunosuppression.

c. ***Drug therapy*****:** Certain drugs used in the treatment of systemic disease alter the body's defenses. Examples are steroids and chemotherapeutic agents that are immunosuppressive. Special precautions, such a prophylactic antibiotics, may be indicated to prevent infection.

d. ***Prostheses and transplants*****:** A patient with, for example, a joint replacement, cardiac prosthesis ventriculoatrial shunt for hydrocephalus or an organ transplant may require antibiotic premedication.

AIRBORNE INFECTION[1]

I. Dust-Borne Organisms

Clostridium tetani (tetanus bacillus, *Staphylococcus aureus*, and enteric bacteria are among the organisms that may travel in the dust brought in from outside and that moves in and about dental treatment areas. When doors are opened and closed and people pass in and out, dust in set into motion that can settle on instruments, other objects or people.

Infectious microorganisms also reach dust from the oral cavities of patients by way of large airborne particles. Dust-borne organisms can be sources of contamination for dental instruments and the hands of dental personnel.

II. Aerosol Production

Airborne particles are usually classified by size as either aerosols or spatter.

a. ***Aerosols*:** A particle of a true aerosol is less than 50 mm in diameter, and nearly all are less than 5 mm. Aerosols are biologic contaminants that occur in solid or liquid form, are invisible, and remain suspended in air for long periods.

b. ***Spatter*:** Heavier large particles may remain airborne a relatively short time because of their own size and weight. They drop or spatter on objects, people and the floor. The spatter is composed of particles greater than 50 mm in diameter.

c. ***Origin*:** Aerosols and spatter are created during breathing, speaking, coughing and sneezing. They are produced during all intraoral procedures, including examination and manual scaling. When produced by air spray, air-water spray, handpiece activity or ultrasonic scaling, the number of aerosols increases to tremendous proportions.

d. ***Contents*:**

1. *Microorganisms*: An aerosol may contain a single organism or a dump of microorganisms adhered to a dust or debris particle. The organisms may be contained within a liquid droplet.
2. *Particles from cavity preparation*: Tooth fragments; microorganisms from saliva, plaque, and/or oropharynx/nasopharynx; oil from a handpiece; and water from the cooling equipment may be in aerosols following cavity preparation.
3. *Ultrasonic scaling*: Microorganisms found in the aerosols from ultrasonic scalers include *Staphylococcus aureus, S. albus* and *S. pyogenes, Streptococcus viridans*, lactobacilli, actinomyces, pneumococci and diphtheroids viruses which may be spread by ultrasonic instruments.

e. ***Concentration*:** Bacteria-laden aerosols and spatter are in greater concentration close to the scene of instrumentation. The quantity decreases with distance. The aerosols travel with air currents and, therefore, move from room to room.

III. Prevention of Transmission

The control of airborne infection depends on elimination or limitation of the organisms at their source, interruption of transmission, and protection of the potentially susceptible recipient.

a. ***Pre-procedural oral hygiene measures*:** Toothbrushing and using an antiseptic mouthrinse reduce the numbers of bacteria contained in aerosols.

b. ***Interruption of transmission*:**

1. Use rubber dam, high-volume evacuation, and manual instrumentation as much as possible.
2. Install air-control methods to supply adequate ventilation, filtration, and relative humidity.
3. Employ vacuum cleaning to remove dirt and microorganisms rather than dust-arousing housekeeping methods. The cleaner must have a filter to prevent the escape of organisms after they are suctioned.

c. ***Clean water*:** Run water through all tubings to handpieces, ultrasonic scalers, and air-water spray for at least 2 minutes at the start of the day and at least 30 seconds after each appointment during the day. Contamination by spatter and aerosols is reduced by this method.

d. ***Protection of the clinician*:** The use of masks and protective eyewear can prevent direct contact of spatter and aerosols with the faces of the dental team.

INFECTION CONTROL: CLINICAL PROCEDURES[3]

The success of a planned system for control of disease transmission depends on the cooperative effort of each member of the dental health team. The aim is to provide the highest level of infection control possible and practical that will ensure a safe environment for both patient and clinician.

Objectives of Infection Control

The following are necessary to prevent the transmission of infectious agents and eliminate cross-contamination.

a. Reduction of available pathogenic microorganisms to a level at which the normal resistance mechanisms of the body may prevent infection.

b. Elimination of cross-contamination by breaking the chain of infection.

c. Application of universal precautions by treating each patient as if all human blood and body fluids are known to be infectious for HIV, HBV and other blood-borne pathogens.

Treatment Room Features

The design of many treatment rooms may not be conducive to ideal planning for infection control. Changes can be made in routines so that updated, preferred systems can be adapted. When renovations or a new dental officer or clinic are anticipated, plans must reflect the most advanced knowledge available relative to safety and disease control.

The objective is to have materials, shapes, and surface textures that facilitate the effective use of infection control measures.

1. Unit

- Designed for easy cleaning and disinfection, with smooth, uncluttered surfaces.
- Removable hoses that can be cleaned and disinfected.
- Hoses that are not mechanically retractable, but are straight, not coiled, with round smooth outer surfaces.
- Syringes with autoclavable tips or fitted with disposable tips.
- Handpieces with antiretraction valves.
- Handpieces that can be autoclaved.

2. Dental chair

- Control all foot-operated. If manually operated, need disposable barrier cover for buttons (switches).
- Surfaces and seamless finish of easily cleaned plastic material that withstand chemical disinfection without damage or discolouring; cloth upholstery to be avoided.

3. Light

- Foot-activated switches.
- Removable handle for sterilization or disposable barrier cover.

4. Clinician's stool

- Smooth, plastic material that is easily disinfected and has a minimum of seams and creases.

- Foot-operated controls. If manually operated, must have a barrier cover for the control.

5. Floor

- Carpeting should be avoided.
- Floor covering should be smooth, easily cleaned, non-absorbent.

6. Sink

- Smooth material (stainless steel).
- Wide and deep enough for effective handwashing without splashing.
- Water faucets and soap dispensers with electronic, knee, or foot-operated controls.
- Separate room or an area for contaminated instrument care.

7. Supplies

- All sterilizable or disposable.

8. Waste

- Receptacle with opening large enough to prevent contact with sides when material is dropped in; heavy-duty plastic bag liner to be sealed tightly for disposal.

***Sharps disposal*:** Small biohazard receptacle near treatment area to receive contaminated sponges and other waste, for disposal in large waste container clearly marked for contaminated waste.

Occupational Safety and Health Administration (OSHA)

OSHA's role is to assure the safety and health of America's workers by setting and enforcing standards; providing training, outreach and education; establishing partnerships; and encouraging continual improvement in workplace safety and health.[3]

Bloodborne Pathogens Standard

This is the most frequently requested and referenced OSHA standard affecting medical and dental offices. Some basic requirements of the OSHA Bloodborne Pathogens standard include:

1. A written exposure control plan, to be updated annually.
2. Use of universal precautions.
3. Consideration, implementation and use of safer engineered needles and sharps.
4. Use of engineering and work practice controls and appropriate personal protective equipment (gloves, face and eye protection, gowns).
5. Hepatitis B vaccine provided to exposed employees at no cost.
6. Medical follow-up in the event of an “exposure incident.”
7. Use of labels or colour-coding for items such as sharps disposal boxes and containers for regulated waste, contaminated laundry and certain specimens.
8. Employee training.
9. Proper containment of all regulated waste.

Hazard Communication Standard

The hazard communication standard is sometimes called the “employee right-to-know” standard. It requires employee access to hazard information. The basic requirements include:

1. A written hazard communication programme.
2. A list of hazardous chemicals (such as alcohol, disinfectants, anaesthetic agents, sterilants and mercury) used or stored in the office.
3. A copy of the material safety data sheet (MSDS) for each chemical (obtained from the manufacturer) used or stored in the office.
4. Employee training.

Ionizing Radiation Standard

This standard applies to facilities that have an X-ray machine and requires the following:

1. A survey of the types of radiation used in the facility, including X-rays.
2. Restricted areas to limit employee exposures.
3. Employees working in restricted areas must wear personal radiation monitors such as film badges or pocket dosimeters.
4. Rooms and equipment may need to be labelled and equipped with caution signs.

STERILIZATION

Sterilization is the process by which all forms of life are destroyed. All materials and items cannot be treated by the same system of sterilization. The various approved methods of sterilization are:[2]

1. Moist heat: Stream under pressure
2. Dry heat
3. Chemical vapor
4. Ethylene oxide

The method for sterilization that is selected must provide complete destruction of all microorganisms, viruses, and spores and yet must not damage the instruments and other materials. The tests for sterilization requires the use of selected test microorganisms that are put through a regular cycle of sterilization and then are cultured. When no growth occurs, the sterilizer has performed with maximum efficiency. At least weekly testing is recommended.

Moist Heat: Steam Under Pressure

Destruction of microorganisms by heat takes place as a result of inactivation of essential cellular proteins or enzymes. Moist heat causes coagulation of protein.

Principles of Action

1. Sterilization is achieved by action of heat and moisture; pressure serves only to attain high temperature.
2. Sterilization depends on the penetrating ability of steam. Air must be excluded, otherwise steam penetration and heat transfer are prevented. Space between objects is essential to ensure access for the steam. Materials must be thoroughly cleaned and air-dried. Air discharge occurs in a downward direction; load must be arranged for free passage of steam towards the bottom of autoclave.
3. The temperature must remain at 121°C at 15 pounds pressure for 15 minutes after the meters show that proper pressure and temperature have been reached. Use 30 minutes for heavy loads to ensure penetration.

Advantages

1. All microorganisms, spores and viruses are destroyed quickly and efficiently.
2. Most economical method of sterilization.

Disadvantages

1. May corrode carbon steel instruments, if precautions are not taken.
2. Unsuitable for oils or powders that are impervious to heat.

Dry Heat

The action of dry heat is oxidation.

Principles of Action

1. Sterilization is achieved by heat that is conducted from the exterior surface to the interior of the object; the time required to penetrate varies among materials.
2. Sterilization can result when the whole material is treated for a sufficient length of time at the required temperature; therefore, timing for sterilization must start when the entire contents of the sterilizer have reached the peak temperature needed for that load.
3. A temperature of 160°C (320°F) maintained for 2 hours; 170°C for 1 hour. Timing must start after the desired temperature has been reached. Care must be taken not to overheat because certain materials can be affected. Temperatures over 160°C (320°F) may destroy the sharp edges of cutting instruments.

Advantages

1. Useful for materials that cannot be subjected to steam under pressure.
2. When maintained at correct temperature it is well suited for sharp instruments.
3. No corrosion as compared with steam under pressure.

Disadvantages

1. Long exposure time required; penetration slow and uneven.
2. High temperature is critical to certain materials.

Chemical Vapour Sterilizer[2]

A complication of alcohols, formaldehyde, ketone, water + acetone heated under pressure produces a gas that is effective as a strigling agent. Microbial and viral destruction results from the permeation of the heated formaldehyde and alcohol. Heavy, tightly wrapped or sealed packages would not permit the penetration of the vapours. Minimum of 20 minutes with temperature from 127°C to 132°C with 20 to 40 pounds pressure in accord with manufacturer's directions.

Advantages

1. Corrosion—rust-free operation for carbon steel instruments.
2. Ability to sterilize in a relatively short total cycle.
3. Use of operation and care of the equipment.

Disadvantages

1. Cannot be used for materials or objects that can be altered by the chemicals that make the vapour or that cannot withstand the high temperature.
2. Adequate ventilation is needed; cannot use in a small room.
3. Slight odour, which is rarely objectionable.

BARRIERS FOR PATIENT AND CLINICIAN (PERSONAL PROTECTION OF THE DENTAL TEAM)[3]

Screening for possible contagious disease is needed prior to an oral examination of any clinical procedure.

The continuing health and productivity of dental personnel depend to a large degree on the control of cross-contamination. Loss of work-time, personal suffering, long-term systemic effects, and even exclusion from continued practice are possible results from communicable diseases. The only safe procedure is to practice defensively at all times, with specific precautions for personal protection.

I. Immunization

A. Basic Schedule

The immunization schedule for infants and children may include protection against poliomyelitis, diphtheria, tetanus, pertussis (whooping cough), measles, mumps and rubella (German measles).

B. Booster and Reimmunization

Each agent requires booster or reimmunization on a specific plan, which may range from 1 to 10 years, or reimmunization only upon intimate contact or exposure.

For tetanus boosters, intervals of 10 years are indicated. If an injury occurs, however, a booster should be given on the day of the injury.

II. Management Programme

A. Recommended Tests

1. Annual tuberculin test (mantoux) chest radiograph as indicated.
2. Periodic throat culture for possible haemolytic Streptococcus carrier.
3. Serologic test for herpes simplex virus I (HSV I) antibodies to determine susceptibility to primary HSV.

B. Obtaining Tests

Obtaining tests when exposed to infectious diseases and seek immunization.

C. Written Records

Keep written records of immunization, reimmunization, and boosters; plan for regular follow-up.

Clinical Attire[2]

The wearing apparel of clinicians and their assistants is vulnerable to contamination from splash, splatter, aerosols and patient contact. The gown or uniform should be designed and cared for in a manner that will minimize crosscontamination.

Sterile-clean Procedures

When a sterile-clean technique is followed in routine practice, personal hygiene and cleanliness do not differ from that in the strict aseptic technique.

a. ***Gown, uniform or scrubsuit*:** Gowns, uniforms or scrubsuits are expected to be clean and maintained as free as possible from contamination. Wearing clinic coats over street clothes, cannot be recommended because of the exposure of the street clothes to infectious material.

Solid, closed front: The garment should be closed at the neck. The fabric should be able to be washed commercially and withstand washing with bleach.

No pockets: Pockets are too readily available for placing contaminated objects such as writing implements or keys. Gloved hands, prepared for patient treatment, must be kept from touching objects or being placed in pockets.

Long sleeves: Hand, wrist, and forearm washing and scrubbing are necessary in preparation for gloving. Long sleeves with fitted cuffs permit protective gloves to extend over the cuffs.

b. ***Hair and head covering*:** Hair must be worn off the shoulders and back. When longer, it must be held within a head cover. Because the hair is exposed to much contamination, an appropriate head cover is advised when using handpieces, ultrasonic or abrasive instruments.

c. ***Protection of uniform*:** A plastic, washable or a disposable apron may be used when clinical services are performed that usually involve blood, splatter or aerosols.

d. ***Outside wear*:** Clinic uniforms and shoes should not be worn outside the clinic practice setting. When clinic clothing is worn outside, it

carries contamination from, and brings contamination into, the treatment area. Another problem is that contamination is taken into the home when uniforms are worn to and from the work area. When laundered at home, the items from a dental office or clinic should be kept separate and treated with household bleach for disinfection.

Use of Face Mask

In attempt to prevent airborne infections, it has been a common practice to wear a mask when either the patient or the operator is known to have an acute respiratory infection. Such a practice has its own value, but does not take into account the fact that many diseases are transmissible during the incubation period, when no clinical signs are apparent.

Dispersion of particles of debris, polishing agents, calculus and water, all of which are contaminated by the patient's oral flora, occurs regularly during all instrumentation. The greatest aerosols are created following the use of a handpiece, prophylaxis angle, or ultrasonic scaler. Evidence of the spread of particles appears on the splashed face, glasses and uniform, and on the cover placed over the patient for protection from the spray.

The shape, material, and degree of absorption will influence the efficiency of a mask. A scientifically efficient mask will,

- Prevent inward and outward passage of microorganisms.
- Filter particles produced during dental and dental hygiene procedures.
- Have minimal marginal leakage.

Various materials have been used for masks, including gauze and other cloth, plastic foam, fibre glass, synthetic fibre mat, and paper. Glass fibre and synthetic fibre mat were shown to be the most effective.

Use of a Mask

a. Tie on the mask before a scrub or hand wash.

b. Use a fresh mask for each patient. When a mask becomes wet, it should be changed, because a wet mask is not longer an effective barrier.

c. Keep the mask on after completing a procedure, while still in the presence of aerosols. Particles under 5 micrometres remain suspended longer (up to 24 hours) than larger particles and can be inhaled directly into terminal lung alveoli. Removal of the mask in the treatment room immediately following the use of aerosol-producing procedures, permits direct exposure to airborne organisms.

Use of Protective Eye Glasses

a. ***Dental team members*****:** Eye protection during dental and dental hygiene appointments for the dental team members and patients is necessary to prevent physical injuries and infections of the eyes. Glasses should be worn at all times. For dental personnel who do not require corrective lens for vision, protective glasses with clear lens should become a routine parts of the clinical dress.

b. ***Patients*****:** Protective eye coverage is recommended for each patient at each appointment. The patient's medical history should reflect types of eye surgery, implants, or other special concerns. Contact lens should be removed.

Protective Glasses

Shielding on all sides of the glasses may give the best protection, provided they fit closely around the edges.

Goggle-style coverage is specially necessary for protection during laboratory work.

A side-shield can provide added protection. For the member of the dental team, it may be possible to wear this type over regular prescription glasses.

When the sides of the glasses are curved back, they may provide adequate protection, similar to those with side-shields.

Care of Protective Glasses

- Run glasses under water stream to remove abrasive particles. Rubbing an abrasive agent over the plastic lens will create scratches.
- Immerse in 2% alkaline glutaraldehyde for disinfection.
- Rinse thoroughly after immersion because glutaraldehyde is irritating to eyes and skin.
- Check periodically for scratches on the lens, and replace appropriately.

Hand Care

Hands, through direct contact with a patient's saliva, become contaminated and, therefore, are sources for cross-infection. Cross-infection can be at least partially controlled by making a conscious effort to keep the gloved hands from touching objects other than the instruments and disinfected parts of equipment prepared for the immediate patient.

I. Bacteriology of the Skin

a. ***Resident bacteria*:** Large numbers of relatively stable bacteria inhabit the surface epithelium or deeper areas in the ducts of skin glands or depths of hair follicles; they are ultimately shed with the exfoliated surface cells, or with excretions of the skin glands. They may be altered by newly introduced pathogens, or reduced by washing. They tend to be less susceptible to destruction by the disinfection procedures.

b. ***Transient bacteria*:** These reflect continuous contamination by routine contacts: some bacteria are pathogens and may act temporarily as residents, may be washed away, or in the event that a skin break exists, may cause an autogenous infection. Most transients can be removed with soap and water by washing for 5 to 10 minutes.

II. Handwashing Principles[1]

a. ***Rationale*:** Effective and frequent handwashing can reduce the overall bacterial flora of the skin and prevent the organisms acquired from a patient from becoming skin residents. It is impossible to sterilize the skin, but every attempt must be made to reduce the bacterial flora to a minimum.

b. ***Purposes*:** The objective of all scrub procedures is to reduce the bacterial flora of the hands to an absolute minimum.

An effective scrub procedure can be expected to accomplish the following:

1. Remove surface dirt and transient bacteria.
2. Dissolve the normal greasy film on the skin.
3. Rinse and remove all loosened debris and microorganisms
4. With a long-acting antiseptic, provide disinfection.

Caring of the Hands

1. Maintain clean, smoothly trimmed, short finger nails with well-cared cuticles to prevent breaks where microorganisms can enter.
2. Remove hand and wrist jewellery at the beginning of day. Microorganisms can become lodged in revices of rings, watch bands and watches where scrubing is impossible.
3. After handwashing, don gloves. Never expose open skin lesion or abrasions to a patient's oral tissues and fluids.
4. Keep gloved hands away from face, hair, clothing (pockets), dental chain, operating stool (manipulate by foot action), telephone, patients records and other objects, that cannot be sterilized or disinfected.

III. Facilities[1]

a. ***Sink***

1. Use a sink with a foot pedal for water flow control to avoid contamination from faucet handles.
2. Adaptation for regular sink: Turn on water at the beginning and leave on through the entire procedure. Turn faucets off with the dowel after drying hands.
3. Use a sink of sufficient size so that contact with the inside of the wash basin can be avoided easily. A sink cannot be sterilized and is highly contaminated.
4. Prevent contamination of uniform by not leaning against the sink.
5. Use a separate area and sink reserved for instruments washing, contaminated instruments should be removed from the treatment room prior to preparation for the next patient.

b. ***Soap***

1. Use a liquid surgical scrub containing an antimicrobial agent. Povidone-iodine (iodohore) has a broad-spectrum of action. Chlorhexidine preparations are used extensively to provide rapid disinfection and a cumulative persistent (residual) action.
2. Apply from a foot- or knee-activated dispenser to avoid contamination to and from a hand-operated dispenser or cake soap.
3. Do not substitute the use of foam hand preparation, alcohol wipes, or other substitutes for handwashing, because many pathogenic microorganisms cannot be destroyed by disinfecting preparations. Rinsing is a very important part of handwashing procedure.

c. ***Scrub brushes***

1. Clean brushes with a detergent, and sterilize after each use.
2. Avoid over-vigorous use of a brush, to minimize skin abrasion. Skin irritation and abrasion can leave openings for additional

cross-contamination.

3. Disposable sponges are available commercially and may be preferred when a scrub brush is traumatic to the skin.
4. Identify brushes by label or colour code for handwashing to prevent mixing with instruments scrub brushes; however, both types will be sterilized. Handwashing and hand instruments cleaning should be accomplished at separate sinks.

D. Towels

1. Obtain towel from a dispenser that requires no contact except with the towel itself which hangs down from the container.
2. When a cloth towel is used, it must be used for only one patient.

IV. Methods of Handwashing[1]

The three methods that will be described here are the short scrub, short standard handwash, and the surgical scrub.

Handwashing techniques are usually defined by numbers of lathering and rinsing, whereas scrub techniques are completed in time periods or by specific numbers of scrub, brush strokes.

The two commonly used systems for scrub techniques are the “stroke-count” method and the “time” method. In the stroke-count method, a specific number of brush strokes is applied to each surface and each finger and part of the hand is considered to have a 4 surfaces. In the time method, each surface is scrubed for a certain number of seconds. When learning to perform a scrub, it is helpful to combine the stroke-count and the time methods to assume complete coverage and to develop a sequence of performance that can be completed in the minimum of time.

A. Short Scrub

The short scrub is recommended for the beginning of the day just prior to the first patient appointment and just prior to the first appointment of second half of the day. It is also used following an appointment for a patient with known communicable disease and following any major interruption that may have caused unusual contamination.

When the time method is used, a short scrub may vary from a minimum of 3–5 mins. Approximately, one-half of the time is used for scrubbing each hand for 3 mins scrub, the time may be divided as follows:

- Nails and finger tips—U min (15 sec each hand)
- Finger and hands—1 U mins (45 secs each hand)
- Wrist and forearm—1 min (30 secs each hand)

The procedure outlined below may be expected to take 3 mins when with stroke-counts are applied to each surface.

i. Don eye glasses and masks and fire hair security back, remove watch and all jewellery.

ii. Wash hands and arms briefly, using surgical scrub soap. Leave water

running at a moderate speed, that will not allow splashing from base and sides of the sinks.

iii. Clean under finger nails with orange wood stick from sterile package. Orange wood stick and scrub brush may be packaged together for sterilization.

iv. Rinse from finger tips to hands, wrists to elbows. Keep hands higher than elbows through the entire procedure.

v. Lather hands and arms again. Leave the soap, lather on the hands and arms during the scrub to increase exposure time to the antimicrobial ingredient of the scrub soap.

vi. Remove scrub brush from the previously opened sterile package; apply several measures of soap. Note the time and start scrubing in an orderly sequence without returning to the areas already scrubed.

vii. First hand

   a. Brush back with forth across nails and finger tips five times.

   b. Begins with the thumb, use small circular strokes (five strokes each area) on each side of thumb and each finger. Then palm and back of hand, extend fingers to gain access to each crevice and line.

   c. Scrub wrist on all sides and move to forearm.

   d. When completed rinse well, from finger tips on up the arm; let water run off at the elbow.

viii. Revise the brush with transfer to the other hand, repeat entire procedure.

ix. Rinse brush and drop it into the sink.

x. Rinse the hand and arm generously and thoroughly to wash away all transient microorganisms.

xi. Dry hand

   a. Take care not to recontaminate hands while drying them.

   b. Use a separate paper towel for each hand.

   c. ***Cloth towel*****:** The one end of a large towel, for one hand and other end for other hand, taking care not to drag the tower over unwashed parts or clothing. Two small towels may be used, one

for each hand.

xii. Don gloves.

B. Short Standard Handwash

Handwashing is done after the first glove removal and before and after each succeeding glove application. It is the general procedure for all times except those indicated under the short scrub technique.

Handwashing is considered the most important single procedure for the prevention of contamination and is a basic requirement before and after hospital patient care.

1. Don eye glasses and mask and fix hair securely. Remove watch and all jewelleries.
2. Use comfortable warm water and surgical scrub soap.
3. Lather hands, wrist and forearms quickly, rubbing all surfaces vigorously. Interface fingers and rub back and forth with pressure.
4. Rinse thoroughly, running the water from fingertips down the hands.
5. Repeat 2 more times. One lathering for 3 minutes is less effective than 3 short latherings and rinsing 3 times in 30 seconds. The lathering serves to loosen, the debris and microorganisms and washes them away.
6. Use paper towels for drying, taking care not to recontaminate.

C. Surgical Hand Scrub

Each hospital or oral surgery clinic will have rules with regulations for scrub procedures.

A surgical scrub performed as the initial scrub a day should be 10 minutes with subsequent scrubs may be 3–5 minutes. Following a contagious and isolated patient, the scrub should be done for at least by 5 minutes.

The outline for a long scrub presented below is similar to the short scrub described previously. The major differences are in the number of strokes, when the stroke-count method is used and the longer time spent.

1. Don eye glasses, mask and hair coverings. Make sure hair is completely covered. Remove watch and jewellery.

2. Open sterile brush package to have ready.
3. Wash hands, arms over the elbows, using surgical soap to remove gross surface dirt before using the scrub brush. Lather vigorously with strong rubbing motions, 10 on each side of hands, wrists, arms. Interlace the fingers, thumbs to clean the proximal surfaces.
4. Rise thoroughly from fingertips across hands and wrists. Hold hands higher than elbows throughout the procedure. Leave water running.
5. Use orange woodstick or file from the sterile package to clean nails.
6. Lather the hands, arms, leave the lather on during the scrub to increase the exposure time to the antimicrobial ingredient.
7. Apply surgical soap, begin the brush procedure. Note the time and scrub in an orderly sequence without returning to areas previously scrubbed.
8. First hands and arms.
    a. Brush back and forth across nails, finger tips, passing the brush under the nails (30 seconds).
    b. For fingers and hands use small circular strokes on all sides of the thumb, each finger, overlapping strokes for complete coverage (2 ½ minutes).
    c. Continue to wrist. Apply more soap to maintain a good lather (2 minutes for wrist and forearm).
    d. When arm is completed over the elbow, leave later on.
9. Repeat on other arm. Some systems require the use of a second sterile brush for the second hand. When this is so, discard the first brush into the proper container and obtain the second brush.
10. At one-half of the scrub time, rinse hands and arms thoroughly. First one, then other starting at the fingertips, letting water pass over the arm.
11. Lather and repeat to, but not over, the elbows.
12. At end of time (or counts), rinse thoroughly, each arm separately from fingertips. When a sterile towel is available for drying apply towel from fingertips to elbow without reapplying to hand area.
13. Hold hands up and clasp together. Proceed to dressing area for

gowning and grooving.

V Gloves[3]

The wearing of gloves is part of the total plan for control of cross-contamination and protection of the clinician. Unseen blood from a patient can be impacted, retained under the fingernails for five or more nails after exposure during an appointment. Hepatitis virus is known to be resistant to drying, might be retained under a fingernail with bloodsaliva. Even scrubbing cannot remove all microorganisms from under nails.

Tiny cuts and abrasions cannot be seen or felt. Protective gloves are needed at all times.

A. Type of Gloves

1. ***General use gloves*:**
    a. *Material*: Latex vinyl non-sterile gloves are available. Latex gloves may be of single or double thickness.
    b. *Surface*: Gloves are available as powdered or unpowdered. Powdered gloves have either cornstarch or an antimicrobial agent.
    c. *Sizes*: Ambidexterous gloves are made in small, medium, large or extra-large in boxes of 100.
    d. The general uses of gloves are commonly referred to as ‘examination’ gloves, but they are suitable for procedures that do not require a strict sterile regimen. Wearing two pairs or double gloving is useful in high-risk evaluations.
2. ***Sterile individually paired gloves*:** Packaged and sealed in sterile pairs by hand size. They are prepared for procedures requiring a sterile technique. They have commonly been referred to as “surgeons gloves” but they also have special case where high-risk patients are being treated.
3. ***Utility gloves*:** Non-used heavy utility gloves are indicated for all instrument handling during clean up and preparation for sterilization, as well as unit preparation, surface disinfection.

B. Procedures for Use of Gloves

1. ***Hand scrub before donning gloves*:** Because gloves are susceptible to tears, pinholes from instrument sticks, pricks can cause infection to be introduced inadvertently. In addition, bacteria can multiply profusely under gloves, where a warm damp medium is provided. Long finger nails under gloves are a potential course of breaks in the gloves.
2. ***Torn, cut or punctured glove*:** Remove immediately, wash hands thoroughly and don new gloves.
3. ***Handwash before glove removal*:** Before removing gloves, lather and rinse thoroughly to:
    a. Reduce possible contamination to hands during removal and disposal.
    b. Reduce contamination in the waste, particularly following a patient known to have a communicable diseases.

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Section

D

Dental Public Health

10. Introduction to Dental Public Health
11. Examination Procedures
12. Indices for Oral Diseases
13. Planning, Survey and Evaluation
14. Dental Auxiliaries
15. School Dental Health
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CHAPTER

10

Introduction to Dental Public Health

Dental diseases have afflicted the human race since the earliest days. Egyptian manuscripts refer to dental problems as early as 3700 BC. Dentistry, however, existed as a vocation only in recent years and it was not until modern times that the care of oral diseases developed any sort of scientific basis.[2]

Evolution of Dental Profession

***1728*:** A two-volume book published by Pierre Fauchard—Le Chirurgien Dentiste, on Traite Desdents—remained an authoritative document in dentistry for over 100 years. Pierre Fauchard is looked upon as a seminal figure in the evolution of dental profession.

***19th century*:** Aspiring dentist of the time served as apprentice. GV Black's formal training also did not exceed 20 months. His introduction to dentistry with Dr Speers was not more than a few weeks whose dental library consisted only of one book.[2]

1840: The first dental school was established in Baltimore

Course	:	16 weeks
Enrolment	:	5
Graduate	:	2

During the same time, The American Journal of Dental Science and The First National Professional Organization were established.

***20th century*:** Gies recommended that dental profession would progress only when dental education became university based.

***1930–1940*:** The economic depression followed by World War II was a hard time for dental education. The teaching in clinical sciences was emphasized on restorative and prosthetic dentistry while radiology, diagnosis, endodontics, periodontics were neglected.

1948: National institute of dental research was established.

1957: Post-war expansion was rapid and dentistry entered a new era with technological growth. The arrival of high-speed engine revolutionized dental practice.

1961: The survey of dentistry was published which led to improvements in education and practice.

1963: Health Professions Educational Assistance Act was passed which provided federal funds for construction and student aid. Semistagnant schools were revitalized.

***1960–1970*:** This era saw an increasing interest in comprehensive care, growth in the use of auxiliaries, prepaid dental insurance and the development of a community outlook in dentistry. Growth in the number of dentists and dental business was sharp.

1980s: The down turn following the post Vietnam war saw a drop in enrollment in dental schools. Five dental schools announced their closing.

***1990s*:** Dentistry is on the brink of new types of practice. The last 80 years have seen dentistry's growth, differentiation and maturation. Enormous advances have been made in restorative and prosthetic techniques.

The demand for dental care will continue to rise, and the public attitudes towards and expectation of dental care will take a dramatic changes in the years to come.

Dental Public Health

Dentistry exists to serve the public. Dental public health is a relatively new specialty subject, wherein the specialists have broad knowledge and skills in public health administration, research methods, the prevention and control of oral diseases, the provision and financing of oral health care and the study and development of resources.

Definition (Winslow)

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 education of the public with applied dental research and with the administration of group dental care programme as well as the prevention and control of dental diseases on a community basis.[4]

PERSONAL VERSUS COMMUNITY HEALTH CARE

A student’s most common aim is to become a successful practitioner. Success in practice is related to the number of people in the community who have confidence in the dental practitioner’s abilities. That confidence is not limited to technical dental services but over a broad-spectrum of community affairs like advise on community proposals for health improvement.[2]

Dental practitioners in solo practice need to know about public health, to properly fulfill their community obligations. The partnership between public and private resources is the only way that everyone’s dental needs can be taken care of.

The Similarities

A. Examination/Survey

When patients first come to a dental office, the dental professional carries out a careful examination. The examination ordinarily starts with a health and personal history, and then goes on to a clinical assessment. An understanding of the patient's general health and personal background also forms a necessary context for determining the dental treatment plan.

The first step in public health practice parallels that used by the clinician. Only here, it is the community that must be examined. It is called a survey instead of an examination and the parallel to the general health history taking is a situation analysis. In dental public health, the word survey without further clarification, usually means clinical assessments of the extent and severity of disease in a population.

B. Diagnosis/Analysis

Following the examination of a patient, the next step is diagnosis. The same approach is used in public health, where the diagnosis comes from analysis of the survey data. A professional statistician may have to be employed to process and analyze the survey data, but special purpose computer software for both recording data in the field and analyzing it in the office are letting dental public health practitioners become more self-reliant. Computers have made survey analysis much less taxing and more efficient.[1]

C. Treatment Planning/Programme Planning

Treatment planning is often complex because of the many factors that have to be balanced. In addition to the dentist's professional judgement of what is required, there is the patient's interest in his oral health, the cost of treatment, the patients reluctance to undergo certain types of treatment. Alternative methods of treatment need to be considered. Final outcome be it acceptance or total rejection vary from patient to patient.

The public health professional like the clinician would like to have the ideal program plan accepted with enthusiasm. The community's reaction to such a plan, may be to reject it or adopt it like the patient in the chair. It is the

community that makes the ultimate decision.

D. Treatment/Programme Operation

When a treatment plan has been accepted, the clinician arranges a schedule to carry out the treatments.

Similarly when a specific community public health programme has been adopted, a public health team with varied disciplines may be called on for programme operation.

E. Payment/Programme Funding

Mutually agreed methods of payment for dental services are arranged between the patient and dentist.

Programme funding is often a complicated mix of local, state and federal funds, which the dental public health professional must first know how to secure, and then to manage. Management may demand extensive reporting requirements. Grant proposals for dental programmes, submitted to local service clubs and local foundations, have proved successful in many cases.

F. Evaluation/Programme Appraisal

The dentist's or hygienist's evaluation of progress begins during the course of treatment and is repeated at each visit. Observations made during the initial examination, such as extent of plaque and calculus deposits, are evaluated from time to time on recall. Evaluation can be objective only if careful examination records of initial conditions were made and are available for study and comparison with later observations.

Similarly, data collected in the initial survey serve as the base line against which a programme appraisal can be made to assess the effectiveness of the public health programme. Public health workers are accountable to the community for a periodic appraisal of their performance just as dental clinicians are accountable to their patients.

Procedural Pattern

Knutson summarized the procedures employed by clinician and public health worker as follows (Tables 10.1 and 10.2).

Table 10.1: The similarities between personal and community health care

Patient	*Community*
1. Examination	1. Survey
2. Diagnosis	2. Analysis
3. Treatment planning	3. Programme planning
4. Treatment	4. Programme operation
5. Payment for service	5. Finance
6. Evaluation	6. Appraisal

Table 10.2: Differences between personal and community health worker

Personal	*Community health worker*
1. Deal with one patient at a time	Deals with groups of people
2. Higher take home pay with less fringe benefits	Salaried employee with fringe benefits like pension plan, sick leave, paid leave, etc.
3. Goals are coincidentally related	Goals are socially determined
4. The patient comes to the dental practitioner	The public health worker goes to the community.
5. Ones own decision	Decision made over a considerable period of time and with several groups
6. Independent health care provider	Their work is visible and publicly accountable

TRADITIONAL DENTAL PUBLIC HEALTH PROGRAMMES

Special Population Groups

Traditionally, dental public health programmes have consisted of a number of projects designed for special subgroups in the population. Certain groups, because of their occupation, position or location, do not have access to private practitioners and must be cared for in special clinics. Thus military populations, inhabitants of Indian reservations, prisoners, institutionalized people, veterans administration hospital patients, the handicapped, nursing home residents, geriatric populations, and the indigent have traditionally received care in clinics supported by public or private funds. The provision of restorative and preventive care to many of these groups requires special training and particular skills. The needs of these subgroups on the average are significantly more severe than the average for the total population because of lack of past treatment, often poor education, and neglect of oral hygiene practices.[2]

Dentists and auxiliaries, trained in the use of mobile dental equipment and management of the disabled patient, are necessary in providing care delivery to the homebound. Removal of the barrier to care and the improved oral health result in an effective dental public health programme. Projects in this category may include a caries bottle-mouth syndrome education programme for young mothers, an oral cancer-screening programme for older adults, a mouthguard fabrication programme for high school football players, a denture-adequacy assessment programme for a geriatric population, a fluoride-therapy programme for cancer patients undergoing head and neck radiation, or implementation of a screening programme for the Head Start children in the community.[2]

Oral Cancer Screening Programme

Probably the programme in which most health professionals participate as a public service is the oral cancer screening programme. Oral cancer is found more frequently in persons over 50 years of age, in heavy smokers, or in alcoholics. To begin the process of the programme planning, the first step is to look at the population served to discern their need for an oral cancer-screening programme.

Once the answers to these basic questions like,

> *What is the age makeup of the population? What are the mortality, morbidity, incidence, and prevalence of oral cancer in this population? Who will sponsor the program, and how will it be staffed and funded?*
>
> *What existing resources are available?*

Having determined these answers, communications with the target population and with health professional peers should begin. It is important that lay individuals should be interviewed to discern their knowledge of oral cancer, as well as their receptivity to such a cancer screening programme. Professional societies and organizations with the prime interest in the programme should be consulted.

Arrangements need to be made for establishing the screening sites. Their locations should be as convenient as possible for the adult population, especially the geriatric groups. Neighbourhood health centres, family clinics and nursing homes are ideal settings for such programmes. If possible, the cancer screening should be arranged as part of a health fair, at which other screening activities are simultaneously being conducted. Such scheduling greatly increases participation.

Arrangements need to be made with appropriate private, public health, or hospital-based histopathology laboratories for processing cytology smears or biopsies arising from the programme. The programme should be funded properly and supported. The short-range goal is to induce as many people as possible to enter the programme, the longer term goal is to reduce the number of deaths resulting from undetected oral cancer.

Once the screening phase is completed, it is then necessary to ensure that all referred persons are sent for a definitive diagnosis and that confirmed

neoplastic lesions are treated.

Dental Health Education and Prevention

Dental health education and programmes have traditionally comprised a significant portion of dental public health activities. Programmes devoted to school children have been particularly popular because children have been highly susceptible to dental caries. In addition, many children, especially those with the highest disease levels whose families may not be able or interested in providing for their oral health needs, do not visit dental offices. Yet virtually all of them attend school and therefore would be exposed to a school based programme. Enthusiasm for dental health education in many school programmes needs tempering because it promotes unrealistic expectations in caries control that are often not realized when programmes are carefully evaluated. When expectations are not realized, disappointment may be created as well as the attitude that all school based preventive programmes are not successful.

Rather than eliminate school based preventive programs that some might think are ineffective, it is important that they be maintained but that they employ careful evaluation methods designed to determine the impact of the programme on the oral health of the target population in terms of reduced disease.[2]

New Strategies

The principal dental diseases, caries and periodontal disease, are both infectious but also chronic and deserve their share of attention towards their prevention. Limited attention has been given in the past to public health periodontal programmes. This has been partially due to the fact that the majority of available resources have been allocated to caries control, for several reasons:

1. Caries was considered a disease of children for whom a great amount of sympathy existed; periodontal disease was considered a disease of adults, who could take care of themselves.
2. It was easier to target survey and preventive programs for children in conventional school settings than for adults scattered through out the work place.

The current caries pattern in children indicates that the fissured tooth surfaces experience the vast majority of caries attacks, while a decline has occurred on the smooth surfaces. Pit and fissure sealants offer a highly effective means to protect these vulnerable occlusal surfaces. Sealants can be used in innovative ways in public health programmes. They can be used effectively in conjunction with minimum restorations as well as over incipient lesions where, complete sealing is ensured to avoid the loss of tooth tissue. By using auxiliaries in their application wherever possible, allotted funds could be spread over a large population. The preventive benefit provided to a community by the initiation of flouridation or a changed practice act that permits hygienists to apply sealants may be greater than the benefit attained from a lifetime of practice by a dozen dentists. As caries control measures are increasing in effectiveness, emphasis has shifted to developing a nationwide periodontal disease control initiative.

Conclusion

Public health programs are usually identified with subsets of the population other than the affluent. There is a great need for methods that will permit better targeting of individuals at high risk to oral disease. Additional emphasis is needed on periodontal disease detection and treatment programs. Probably the two most cost-effective dental-preventive procedures are the combined use of fluorides and pit-and-fissure sealants. Educational and political methods should be used to ensure universal fluoridation, and greater use of auxiliaries is necessary in the delivery of preventive dentistry health services.

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CHAPTER

11

Examination Procedures

THE MOUTH MIRROR

I. Description

A. Parts

The mirror has three parts: The handle, shank and working end, which is the mounted mirror or mirror head.

B. Mirror Surfaces

1. ***Plane (flat)*:** May produce a double image.
2. ***Concave*:** Magnifying.
3. ***Front surface*:** The reflecting surface is on the front of the lens rather than on the back as with plane or magnifying mirrors. The front surface eliminates “ghost” images.

C. Diameters

Diameters vary from 5/8 to 1¼ inches. In addition, special examination mirrors are available in 1½ to 2-inch diameters.

D. Attachments

Mirrors may be threaded plain stem or cone socket to be joined to a handle. Because mirrors tend to become scratched, replacement of the working end is possible without purchasing new handles.

E. Handles

1. Thicker handles contribute to a more comfortable grasp and greater control.
2. Wider mirror handles are especially useful for mobility determination.

F. Disposable Mirrors

1. May be plastic in one piece or may be a handle with replaceable head for professional use; may have front surface.

2. Take-home mirrors for patient instruction. Patient may observe lingual and posterior aspects. One type of mirror has a light attachment.

II. Purpose and Uses

The mouth mirror is used to provide:

A. Indirect Vision

This is particularly needed for distal surfaces of posterior teeth and lingual surfaces of anterior teeth.

B. Indirect Illumination

Reflection of light from the dental overhead light to any area of the oral cavity can be accomplished by adapting the mirror.

C. Transillumination

Reflection of light through the teeth.

1. Mirror is held to reflect light from the lingual aspect while facial surfaces of the teeth are examined.
2. Mirror is held for indirect vision on the lingual while light from the overhead dental light passes through the teeth. Translucency of enamel can be seen clearly, whereas dental caries or calculus deposits appear opaque.

D. Retraction

The mirror is used to protect or prevent interference by the cheeks, tongue, or lips.

III. Procedure for Use

A. Grasp

Use modified pen grasp with finger rest on a tooth surface wherever possible to provide stability and control.

B. Retraction

1. Use a water-based lubricant on dry or cracked lips and corners of mouth.
2. Adjust the mirror position so that the angles of the mouth are protected from undue pressure of the shank of the mirror.
3. Insert and remove mirror carefully to avoid hitting the teeth, because this can be every disturbing to the patient.

C. Maintain Clear Vision

1. Warm mirror with water, rub along buccal mucosa to coat mirror with thin transparent film of saliva, and request patient to breath through the nose to prevent condensation of moisture on the mirror. Use a detergent or other means for keeping a clear surface.
2. Discard scratched mirrors.

IV. Care of Mirrors

a. Dismantle mirror and handle for sterilization.

b. Examine carefully after ultrasonic cleaning or scrubbing with brush prior to sterilization to assure removal of debris around back, shank, and rim of reflecting surface.

c. Handle carefully during sterilization procedures to prevent other instruments from scratching the reflecting surface.

d. Consult manufacturer’s specifications for sterilizing or disinfecting procedures that may cloud the mirror, particularly the front surface type.

INSTRUMENTS FOR APPLICATION OF AIR[3]

I. Purposes and Uses

With appropriate, timely application of air to clear saliva and debris and/or dry the tooth surfaces, the following can be accomplished:

A. Improve and Facilitate Examination Procedures

1. Make a thorough, more accurate examination.
2. Dry supragingival calculus to facilitate exploring and scaling. Small deposits may be light in colour and not visible until they are dried. Dried calculus appears chalky and presents a contrast to tooth colour.
3. Deflect the free gingival margin for observation into the area. Subgingival calculus usually appears dark.
4. Make identification of areas of demineralization and carious lesions easier.
5. Recognize location and condition of restorations, particularly tooth-colour restorations.

B. Improve Visibility of the Treatment Area During Instrumentation

1. Dry area for finger rest to provide stability during instrumentation.
2. Facilitate positive scaling techniques.
3. Minimize appointment time.
4. Evaluate complete removal of supragingival calculus after instrumentations.

C. Prepare Teeth and/or Gingiva for Certain Procedures

Examples are to dry surfaces for:

1. Application of caries-preventive agents.
2. Make impression for study cast.
3. Apply topical anaesthetic.

II. Compressed Air Syringe

A. Description

1. *Air source*: Air compressor with tubing attachment to syringe.
2. *Air tip*: Has angled working end that can be turned for maxillary or mandibular application. Tip may be disposable or removable for sterilization.

B. Procedure for Use

1. Use palm grasp about the handle of the syringe; place thumb on release lever or on button on handle.
2. Test the air flow so that the strength of flow can be controlled.
3. Make controlled relatively short, gentle applications of air.
4. Supplement air drying with use of saliva ejector and folded gauze sponge placed in vestibule.

C. Precautions

1. Avoid sharp blasts of air on sensitive cervical areas of teeth or open carious lesions such areas may be dried by blotting with a gauze sponge or cotton roll to avoid causing discomfort.
2. Avoid applying air directly into a pocket. Subgingival plaque may be forced into the tissues and bacteraemia created.
3. Avoid forceful application of air, which can direct saliva and debris out of the oral cavity which contaminate the working area and the clinician, and create aerosols. Air directed toward the posterior region of the patient’s mouth may cause coughing.
4. Avoid startling the patient; forewarn when air is to be applied.

PROBE[4]

Early in patient examination, the patient's periodontal disease status must be determined. Treatment planning varies depending on whether the condition is gingivitis, which may be reversible, or periodontitis with periodontal pockets; bone loss, and root surface involvement, which may require more extensive therapy (Fig. 11.1).

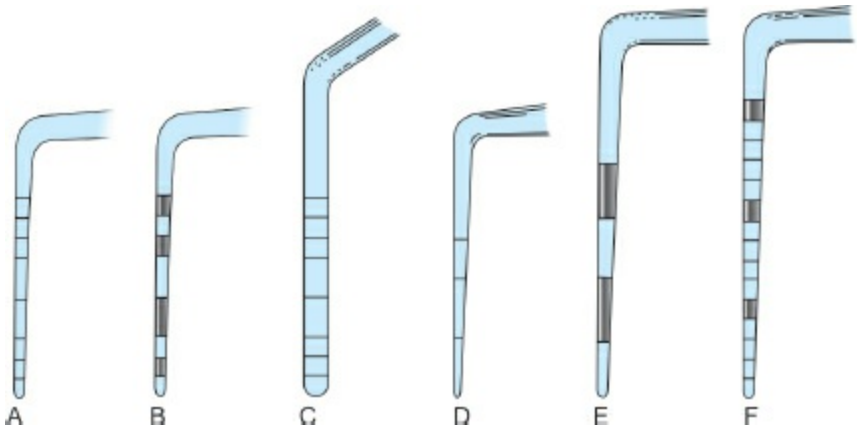


Fig. 11.1: Examples of probes

Two general types of probes available are the traditional or standard manual probes and the controlled force or automated probes. Automated probes were developed and researched in an attempt to overcome the problems in obtaining consistent readings with traditional probes.

Factors that influence probe determinations are variations in pressure (probing force) used, diameter, and other physical features, and the inconsistent depth or penetration during application.

A probe is used to make the initial assessment, followed by a detailed evaluation to determine the extent and degree of severity of disease and tissue destruction for specific treatment planning. During treatment, the probe is applied to assess progress.

After treatment, use of the probe helps to determine completion of professional services as recognized by the health status of the tissues. At each maintenance appointment, a re-evaluation with the probe is needed to ensure continued self-care by the patient and to identify early disease changes that require additional professional treatment.

I. Purposes and Uses

A probe is used to:

A. Assess the Periodontal Status for Preparation of a Treatment Plan

1. Classify the disease as gingivitis or periodontitis by determining whether bone loss has occurred and whether the pockets are gingival or periodontal. A systematic screening method can be used.
2. Determine the extent of inflammation in conjunction with the overall gingival examination. Bleeding on probing is an early sign of inflammation in the gingiva.

B. Make a Sulcus and Pocket Survey

1. Examine the shape, topography, and dimensions of sulci and pockets.
2. Measure and record probing depths.
3. Evaluate tooth-surface pocket wall.
    a. Chart calculus location and severity.
    b. Record other root surface irregularities discerned by the probe.
4. Determine clinical attachment level.

C. Make a Mucogingival Examination

1. Determine relationship of gingival margin, attachment level, and mucogingival junction.
2. Measure the width of the attached gingiva.

D. Make Other Gingival Determinations

1. Evaluate gingival bleeding on probing and prepare a gingival bleeding index.
2. Measure the extent of visible gingival recession.
3. Determine the consistency of the gingival tissue.

E. Guide Treatment

1. Determine gingival characteristics, including probing depth, bleeding, and consistency (all determined using a probe), to provide a basis for patient instruction as part of the total treatment.
2. Define probing depth of sulcus or pocket for application of instruments for scaling and root planning, and define depth for use of an explorer for evaluation of these procedures.
3. Detect anatomic configuration of roots, subgingival deposits, and root irregularities.

Probe markings (mm)	***Examples***	***Description***
Marks at 1–2–3—5–7–8–9–10	Williams University of Michigan with Williams marks Glickman Merritt A and B	Round, tapered (available with colour code) Round, narrow diameter, fine Round, with longer lower shank Round, single bend to shank
Marks at 3–3–2–123–6–8–11 (and other variations)	Hu Friedy QUILX Marquis Norrdent	Round, tapered, fine, colour-coded
Marks at each mm to 15	Hu-Friedy PCPUNC 15	Round, colour-coded at 5–10–15
Marks at 3.5–5.5–8.5–11.5	WHO probe (World Health Organization)	Round, tapered, fine, with ball end colour-coded
No marks	Gilmore Nabors 1N, 2N	Tapered, sharper than other probles. Curved, with curved shank for furcation examination

F. Evaluate Success and Completeness of Treatment

1. Evaluate post-treatment tissue response to professional treatment on an immediate, short-term basis, as well as at periodic maintenance examinations.
2. Evaluate patient’s self-treatment through therapeutic disease control procedures.
3. Signs of health revealed by probing:
    a. No bleeding; healthy tissue does not bleed.
    b. Reduced probing depth; comparison of pre- and post-treatment probing depth.
    c. Tissue is firm as shown by application of the probe to the surface of the free gingiva.

II. Description

A probe is a slender instrument with a smooth, rounded tip designed for examination of the depth and topography of an area. It has three parts: The handle, the angled shank, and the working end, which is the probe itself.

A. Materials

1. Stainless steel.
2. Plastic, for screenings and titanium implant probing.

B. Characteristics

1. *Straight working end:*
    a. Tapered, round, flat, or rectangular in cross-section with a smooth rounded end.
    b. Calibrated in millimetres at intervals specific for each kind of probe some have colour coding.
2. ***Curved working end*:** Paired furcation probes have a smooth, rounded end for investigation of the topography and anatomy around roots in a furca. Examples are the Nabers 1N and 2N probes.

C. Selection

The probe chosen for use by a clinician is frequently the instrument first used when a particular technique was learned, or one that provides comfort and ease of manipulation.

Another reason for selection is that consistency in reading can be accomplished.

Analysis of a probe and comparison with other probes are recommended. Important features to be considered in probe selection are

1. *Adaptability*: The probe should be adaptable around the complete circumference of each tooth, both posterior and anterior, so that no millimeter of probing depth can be neglected. Flat probes require more attention to adaptation and are useful primarily on facial and lingual surfaces.

2. *Markings*: Markings should be easy to read so that probing depth can

be readily identified and measured, and no disease area is over looked. Colour coding contributes to read ability.

GUIDE TO PROBING[1]

A pocket is a diseased gingival sulcus. The use of a probe is the only accurate, dependable method to locate, assess, and measure sulci and pockets.

I. Pocket Characteristics

a. A pocket is measured from the base of the pocket (top of attached periodontal tissue) to the gingival margin.

b. The pocket (or sulcus) is continuous around the entire tooth, and the entire pocket or sulcus must be measured. “Spot” probing is inadequate.

c. The depth varies around an individual tooth; probing depth rarely measures the same all around a tooth or even around one side of a tooth (Fig. 11.2).

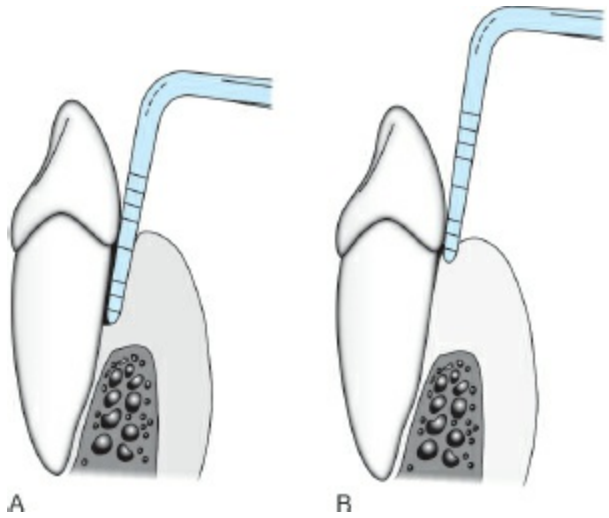


Fig. 11.2: Probing depth

1. The level of attached tissue assumes a varying position around the tooth.
2. The gingival margin varies in its position on the tooth.

d. Proximal surfaces must be approached by entering from both the facial and lingual aspects of the tooth (Fig. 11.3).

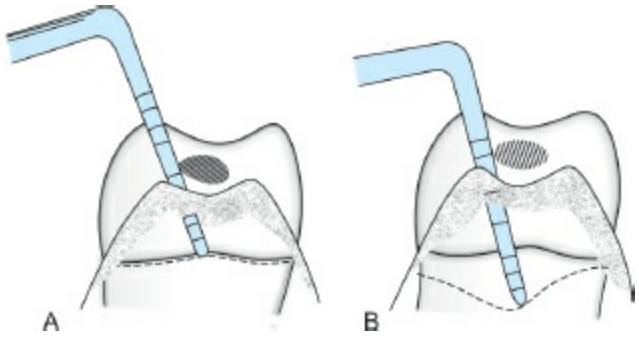


Fig. 11.3: Proximal surface probing

1. Gingival and periodontal infections begin in the col area more frequently than in other areas
2. Probing depth may be deepest directly under the contact area because of crater formation in the alveolar bone

e. Anatomic features of the tooth-surface wall of the pocket influence the direction of probing. Examples are concave surfaces, anomalies, shape of cervical third, and position of furcations.

II. Evaluation of Tooth Surface

During the movement of the probe, calculus and tooth surface irregularities can be felt and evaluated. The information obtained is used to plan the scaling and root planing appointments.

III. Factors that Affect Probe Determinations[2]

The general objectives of probing are, accuracy and consistency so that recordings are dependable for comparison with future probings as well as with colleagues in practice together. At the same time, patient discomfort and trauma to the tissues must be minimal. Probing is influenced by many factors, such as those that follow:

A. Severity and Extent of Periodontal Disease

With application of a light pressure, the probe passes along the tooth surface to the attached tissue level. Diseased tissue offers less resistance so that with increased severity of inflammation, the probe inserts to a deeper level[1]. Average levels show that the probe is stopped as follows:

1. ***Normal healthy tissue*:** The probe is at the base of the sulcus or crevice, at the coronal end of the junctional epithelium.
2. ***Gingivitis and early periodontitis*:** The probe is within the junctional epithelium.
3. ***Advanced periodontitis*:** Probe tip penetrate through the junctional epithelium to reach attached connective tissue fibers.

B. The Probe Itself

1. *Calibration*: Must be accurately marked.
2. *Thickness*: A thinner probe slips through narrow pocket more readily.
3. *Readability*: Aided by the markings and colour coding.

C. Technique

1. *Grasp*: Appropriate for maximum tactile sensitivity.
2. Finger rest placed on non-mobile tooth with uniformity.

D. Placement Problems

1. *Anatomic variations*: Tooth contours, furcations, contact areas, anomalies.
2. *Interferences*: Calculus, irregular margins of restorations, fixed dental

prostheses.

3. *Accessibility and visibility*: Obstructed by tissue bleeding, limited opening by patient, macroglossia.

E. Application of Pressure

Consistent pressure is accomplished by consistent grasp and finger rest in addition to keen tactile sensitivity.

PROBING PROCEDURES[1]

I. Probe Insertion

a. Grasp the probe with modified pen grasp.

b. Establish finger rest on a neighboring tooth, preferably in the same dental arch.

c. Hold the side of instrument tip flat against the tooth near the gingival margin. The cervical third of a primary tooth is more convex.

d. Gently slide the tip under the gingival margin.

1. *Healthy or firm fibrotic tissue*: Insertion is more difficult because of the close adaptation of the tissue to the tooth surface; underlying gingival fibres are strong and tight.
2. *Spongy, soft tissue*: Gingival margin is loose and flabby because of the destruction of underlying gingival fibers. Probe inserts readily, and bleeding can be expected on gentle probing (Fig. 11.4).

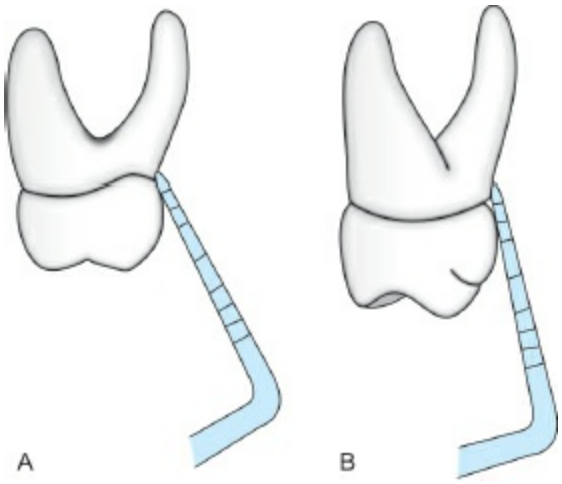


Fig. 11.4: Primary and permanent maxillary molars

II. Advance Probe to Base of Pocket

a. *Hold side of probe tip flat against the tooth surface*: Widespread roots of primary molars may make this probe position difficult unless the tissue is unduly distended by the probe.

b. Slide the probe along the tooth surface vertically down to the base of the sulcus or pocket.

   1. Maintain contact of the side of the tip of the probe with the tooth.

      a. *Gingival pocket*: Side of probe is on enamel.

      b. *Periodontal pocket*: Side of probe is on the cemental or dentinal surface when inserted to a level below the cemento-enamel junction.

   2. As the probe is passed down the side of the tooth, roughness may be felt. Evaluation of the topography and nature of the tooth surface is important to instrumentation.

   3. When obstruction by hard bulky calculus deposit is encountered, lift the probe awayfrom tooth and follow over the edge of the calculus until the probe can move vertically into the pocket again.

   4. The base of the sulcus or pocket feels soft and elastic (compared with the hard tooth surface and calculus deposits), and with slight pressure, the tension of the attached periodontal tissue at the base of the pocket can be felt.

c. Use only the pressure needed to detect by tactile means the level of the attached tissue, whether junctional epithelium or deep connective tissue fibers. A light pressure of 10 g, or of no more than 20 g, is ample.

d. *Position probe for reading*:

   1. Bring the probe to position as nearly parallel with the long axis of the tooth as possible for reading the depth.

   2. Interference of the contact area does not permit placing the probe parallel for the measurement directly beneath the contact area. Hold the side of shank of the probe against the contact to minimize the angle.

III. Read the Probe (Fig. 11.5)

a. Measurement for a probing depth is made from the gingival margin to the attached periodontal tissue.

b. Count the millimetres that show on the probe above the gingival margin and subtract the number from the total number of millimetres marked on the particular probe being used.

c. When the gingival margin appears at a level between probe marks, use the higher mark for the final reading.

d. Dry the area being probed to improve visibility for specific reading.

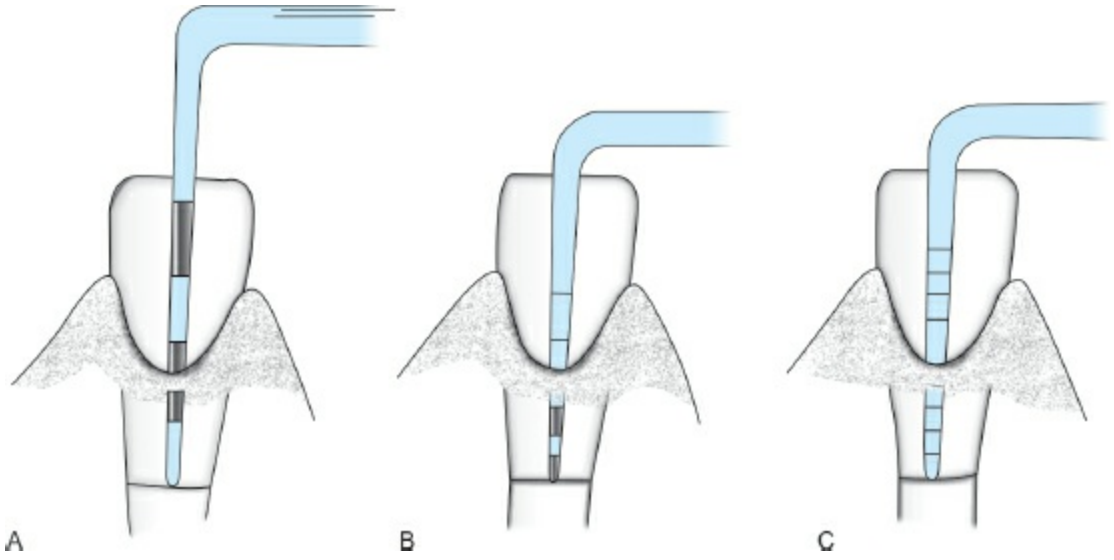


Fig. 11.5: Comparison of probe reading

IV. Circumferential Probing

A. Probe Stroke

Maintain the probe in the sulcus or pocket of each tooth as the probe is moved in a walking stroke (Fig. 11.6).

1. It is not necessary to remove the probe and reinsert it to make individual readings. Time would be wasted.
2. Repeated withdrawal and reinsertion cause unnecessary trauma to the gingival margin and hence increase post-treatment discomfort.

B. Walking Stroke (Fig. 11.6)

1. Hold the side of the tip against the tooth at the base of the pocket.
2. Slide the probe up (coronally) about 1 to 2 mm and back to the attachment in a “touch... touch... touch...” rhythm.
3. Observe probe measurement at the gingival margin at each touch.
4. Advance millimetre by millimetre along the facial and lingual surfaces into the proximal areas.

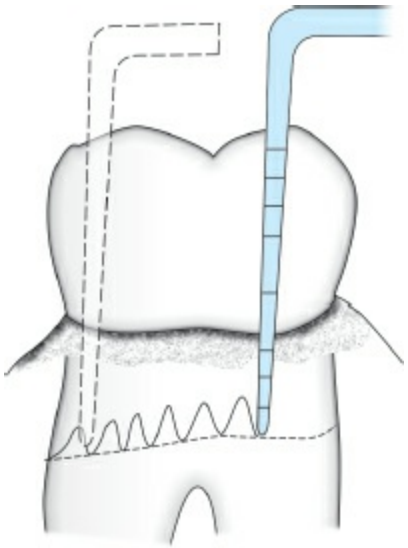


Fig. 11.6: Probe walking stroke

V. Adaptation of Probe for Individual Teeth

A. Molars and Premolars

1. Orient the probe at the distal line angle for both facial and lingual application.
2. Insert probe at the distal line angle and probe in a distal direction; adapt the probe around the line angle; probe across the distal surface until the side of the probe contacts the contact area, then slant the probe to continue under the contact area.
3. Note the probing depth and slide the probe back to the distal line angle. Proceed in the mesial direction around the mesial line angle and across the mesial surface.

B. Anterior Teeth

1. Initial insertion may be at the distal line angle or from the midline of the facial or lingual surfaces.
2. Proceed around the distal line angle and across the distal surface; reinsert and probe the other half of the tooth.

C. Proximal Surfaces

1. Continue the walking stroke around each line angle and on to the proximal surface.
2. Roll the instrument handle between the fingers to keep the side of the probe tip adapted to the tooth surface at line angles and as the tooth contour varies.
3. Continue the strokes under the contact area. Overlap strokes from facial surface with strokes from lingual surface to assure full coverage. Make sure that the col area under each contact has been thoroughly examined.

Clinical Attachment Level[5]

Attachment level refers to the position of the periodontal attached tissues at the base of a sulcus or pocket. It is measured from a fixed point to the attachment, whereas the probing depth is measured from a changeable point (the crest of the free gingiva) to the attachment (Fig. 11.7).

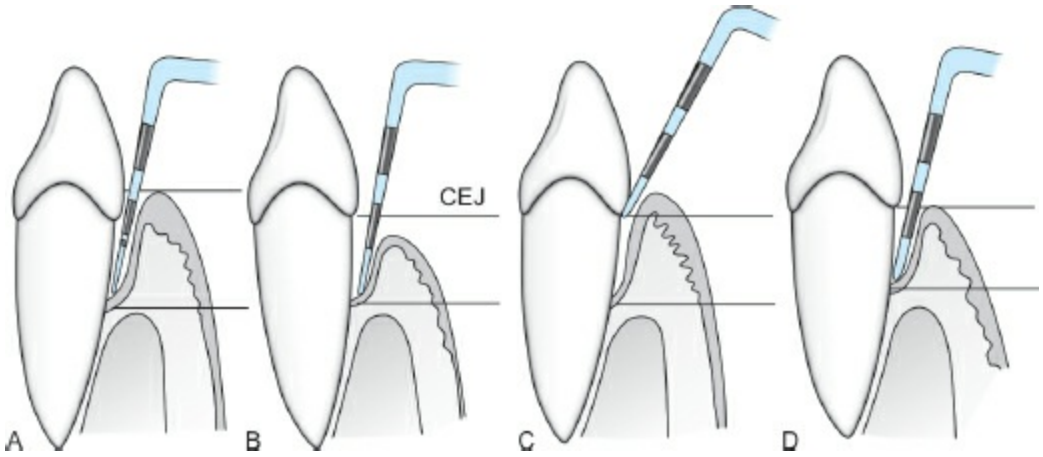


Fig. 11.7: Clinical attachment level

I. Rationale

A loss of attachment occurs in disease as the junctional epithelium migrates toward the apex. Stability of attachment is characteristic in health, and treatment procedures may be aimed to obtain a gain of attachment.

Evaluation can be made of the outcome of periodontal treatment and the stability of the attachment during maintenance examinations. When periodontal disease is active, pocket formation and migration of the attachment along the cemental surface continue.

II. Procedure

A. Selecting a fixed point

1. Cementoenamel junction is usually used.
2. Margin of a permanent restoration.
3. For animal research, a notch may be made in the tooth; in human

research studies, a template or splint may be made for each patient.

B. Measuring in the presence of visible recession

1. Cementoenamel junction is visible directly.
2. Measure from the cementoenamel junction to the attachment.
3. The clinical attachment level is greater than the probing depth when there is visible recession.

C. Measuring when the cementoenamel junction is covered by gingiva

1. Slide the probe along the tooth surface, into the pocket, until the cementoenamel junction is felt.
2. Remove the calculus when it covers the cementoenamel junction.
3. Measure from the gingival crest to the cementoenamel junction.
4. Subtract the millimeters from cemento enamel junction to gingival crest from the total probing depth to the attachment.
5. Probing depth is greater than the clinical attachment level when the cementoenamel junction is covered by free gingiva.

D. Measuring when the free gingival margin is level with the cementoenamel junction

1. Apply the probe as has been described.
2. The probing depth equals the clinical attachment level when the free gingival margin is level with the cementoenamel junction.

EXPLORERS (Fig. 11.8)

I. General Purposes and Uses[3]

An explorer is used to:

a. Detect by tactile sense, the texture and character of the tooth surface.

b. Examine the supragingival tooth surfaces for calculus, demineralized and carious lesions, defects or irregularities in the surfaces and margins of restorations, and other irregularities that are not apparent to direct observation. An explorer is used to confirm direct observation.

c. Examine the subgingival tooth surfaces for calculus, demineralized and carious lesions, diseased altered cementum, and other cemental changes that can result from periodontal pocket formation.

d. Define the extent of instrumentation needed and guide techniques for
   1. Scaling and root planing
   2. Finishing a restoration
   3. Removing an overhanging filling.

e. Evaluate the completeness of treatment as shown by the smooth tooth surface or the smooth restoration.

f. Identify pits and fissures appropriate for sealant application.

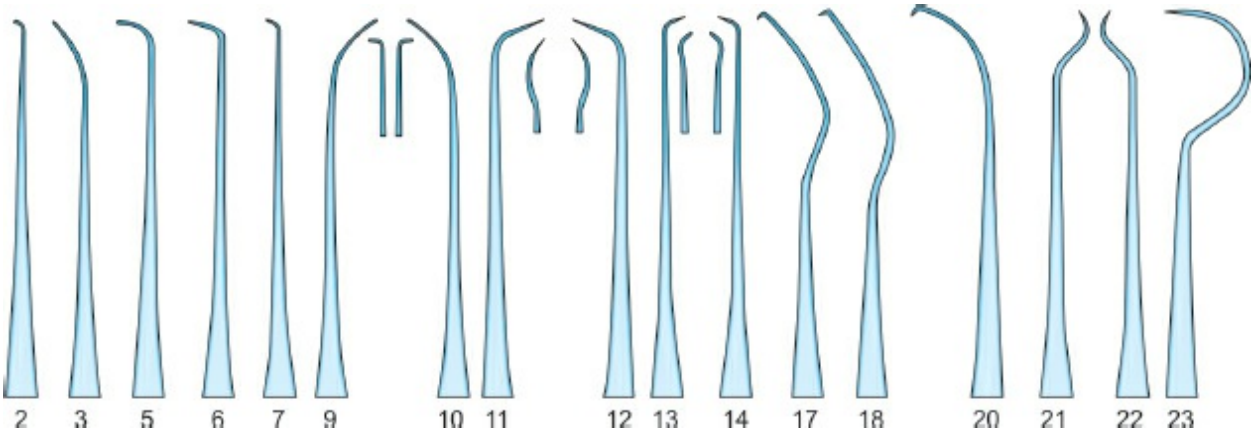


Fig. 11.8: Explorers

II. Description

The basic parts of an instrument are:

A. Working End

1. Slender, wirelike, metal tip that is circular in cross section and tapers to a fine sharp point.
2. ***Design*:**
    a. Single. A single instrument may be universal and adaptable to any tooth surface, or it may be designed for specific groups of surfaces.
    b. Paired. Paired instruments are mirror images of each other, curved to provide access to contralateral tooth surfaces.
    c. Design of a balanced instrument (Fig. 11.9). Middle of working end should be centered over the long axis of the handle.

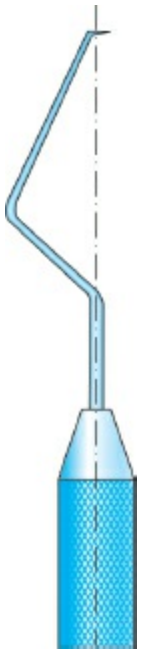


Fig. 11.9: Balanced explorer design

B. Shank

1. *Straight, curved, or angulated*. Whether a shank is straight, curved, or

angulated depends on the use and adaptation for which the explorer was designed. A curved shank may facilitate application of the instrument to proximal surfaces, particularly of posterior teeth.

2. ***Flexibility*:** The slender, wire-like explorers have a degree of flexibility that contributes to increased sensitivity.

C. Handle

1. *Weight*: For increased acute tactile sensitivity, a lightweight handle is more effective.
2. *Diameter*: A wider diameter with serrations for friction while grasping can prevent finger cramping from too tight a grasp. With a lighter grasp, tactile sensitivity can be increased.

D. Construction

1. *Single-ended*: A single-ended instrument has one working end on a separate handle.
2. ***Double-ended*:** A double-ended instrument has two working ends, one on each end of a common handle. Most paired instruments are available double-ended. Other double-ended instruments combine two single instruments, for example, two unpaired explorers or an explorer with a probe.

III. Preparation of Explorers

Sharpen and retaper a dull explorer tip. With the explorer tip sharp and tapered, the following can be expected:

a. Increased tactile sensitivity with less pressure required.

b. Prevention of unnecessary trauma to the gingival tissue, because less pressure allows greater control.

c. Decreased instrumentation time with increased patient comfort.

IV. Specific Explorers and their Uses

A variety of explorers are available as shown by the examples. The function of each type is related to its adaptability to specific surfaces of teeth at particular angulations. Certain explorers can be used effectively for detection of dental caries in pits and fissures, and others are designed to be adapted to examine proximal surfaces for calculus or dental caries. By other criteria, some can be used subgingivally, whereas others cannot be adapted subgingivally without inflicting damage to the sulcular epithelium. Therefore, such explorers are limited to supragingival adaptation only.

A. Subgingival Explorer

1. *Names and numbers*: Urban no. 20. TU.17. pocket explorer.
2. *Shape*: The pocket explorer has an angulated shank with a short tip. The tip should be measured to assure that it is less than 2 mm. A longer tip cannot be adapted to the line angles of narrow roots.
3. Features for subgingival root examination:
    a. Back of tip can be applied directly to the attached periodontal tissue at the base of the pocket without lacerating. When a straight or sickle explorer is directed towards the base of the pocket, the sharp tip can pass into the epithelium without resistance.
    b. The short tip can be adapted to rounded tooth surfaces and line angles. Long tips of other explorers have a tangential relationship with the tooth and cause distention and trauma to sulcular or pocket epithelium.
    c. Narrow short tip can be adapted atthe base where the pocket narrows without undue displacement of the pocket soft tissue wall.
4. *Supragingival use of no. TU-17*: It may be adapted to all surfaces and is especially useful for proximal surface examination. It is not readily adaptable to pits and fissures.

B. Sickle or Shepherd's Hook

1. *Use*: Examining pits and fissures and supragingival smooth surfaces; examining surgeons and margins of restorations and sealants.
2. *Adaptability*:
    a. Difficult to apply to proximal surfaces because the wide hook can contact an adjacent tooth and the straight long section the tip can pass over a small proximal carious lesion.
    b. Not adaptable for deep subgingival exploration. When the point is directed to the base of a pocket, trauma to the attachment area can result. In the attempt to prevent such damage, the clinician may not explore to the base of pocket, thus providing incomplete service.

C. Pigtail or Cowhorn

1. *Use*: Proximal surfaces for calculus, dental caries, or margins of restorations.
2. ***Adaptability*:** As paired, curved tips, they are applied to opposite tooth surfaces.

D. Straight

1. *Use*: Supragingival, for pits and fissures, tooth irregularities of smooth surfaces, and surfaces and margins of restorations and sealants.
2. *Adaptating*:
    a. For pit and fissure caries, the explorer tip is held parallel with the long axis of tooth and applied straight into a pit.
    b. Not adaptable deep in subgingival area. Straight shanked instruments or those with long tips cannot be adapted reading in the apical portion of the pocket near the attached tissue or on line angles.

BASIC PROCEDURES FOR USE OF EXPLORERS[3]

Development of ability to use an explorer and a probe is achieved first by learning the anatomic features of each tooth surface and the types of irregularities that may be encountered on the surfaces. The second step is repeated practice of careful and deliberate techniques for application of the instruments.

The objective is to adapt the instruments in a routine manner that relays consistent comparative information about the nature of the tooth surface. Concentration, patience, attention to detail, and alertness to each irregularity, however, small it may seen, are necessary.

I. Use of Sensory Stimuli

Both explorers and probes can transmit tactile stimuli from tooth surfaces to the fingers. A fine explorer usually gives a more acute sense of tactile discrimination to small irregularities than does a thicker explorer. Probes vary in diameter; the narrow types may provide greater sensitivity.

II. Tooth Surface Irregularities

Three basic tactile sensations must be distinguished when probing or exploring. These may be grouped as normal tooth surface, irregularities created by excess or elevations in the surface, and irregularities caused by depressions in the tooth surface. Examples of these are listed here.

A. Normal

1. *Tooth structure*: The smooth surface of enamel and root surface that has been planed, anatomic configurations, such as cingula, furcations.
2. *Restored surfaces*: Smooth surfaces of metal (gold, amalgam) and the softer feeling of plastic; smooth margin of a restoration.

B. Irregularities: Increases or Elevations in Tooth Surface

1. Deposits calculus.
2. *Anomalies*: Enamel pearl; unusually pronounced cementoenamel junction.
3. *Restorations*: Overcontoured, irregular margins (overhang).

C. Irregularities: Depressions, Grooves

1. *Tooth surface*: Demineralized or carious lesion, abrasion, erosion, pits such as those caused by enamel hypoplasia, areas of Cemental resorption on the root surface.
2. *Restorations*: Deficient margin, rough surface.

III. Types of Stimuli

During exploring and probing, distinction of irregularities can be made through auditory and tactile means.

A. Tactile

Tactile sensations pass through the instrument to the fingers and hand and to the brain for registration and action. Tactile sensations, for example, may be the result of catching on an over contoured restoration, dropping into a carious lesion, hooking the edge of a restoration or lesion, encountering an elevated deposit, or simply passing over a rough surface.

B. Auditory

As an explorer or probe moves over the surface of enamel, cementum, a metallic restoration, a plastic restoration, or any irregularity of tooth structure or restoration, a particular surface texture is apparent. With each contact, sound may be created. The clean smooth enamel is quiet; the rough cementum or calculus is scratchy or noisy. Sometimes a metallic restoration may squeak or have a metallic ring. With experience, differentiations can be made.

SUPRAGINGIVAL PROCEDURES[5]

I. Use of Vision

Supragingival exploration for defects of the tooth surface differs from subgingival in that, when a surface is dried, much of the actual exploration is performed to confirm visual observation. The exceptions are the proximal areas near and around contact areas that cannot be directly observed.

Unnecessary exploration should be avoided. With adequate light and a source of air, proper retraction, and use of mouth mirror, dried supragingival calculus can generally be seen as either chalky-white or brownish-yellow in contrast to tooth colour. A minimum of exploration can confirm the finding.

II. Facial and Lingual Surfaces

a. Adapt the side of tip with the point always on the tooth surface.

b. Move the instrument in short walking strokes over the surface being examined, or direct the tip gently into a suspected carious lesion.

c. Avoid deliberate exploration of cervical third areas where there is recession or where the patient has previously exhibited sensitivity. If a sensitive area must be dried, avoid an air blast, and blot with a gauze sponge or a cotton roll.

III. Proximal Surfaces

a. Lead with the tip on to a proximal surface, rolling the handle between the fingers to as sure adaptation around the line angle. Keep the side of the point of the explorer in contact with the tooth surface at all times.

b. Explore under the proximal contact area when there is recession of the papilla and the area is exposed. Overlap strokes from facial and lingual surfaces to ensure full coverage.

SUBGINGIVAL PROCEDURES (Fig. 11.10)

I. Essentials for Detection of Tooth Surface Irregularities[4]

a. Definite but light grasp.
b. Consistent finger rest with light pressure.
c. Definite contact of the instrument with the tooth.
d. Light touch as the instrument is moved over the tooth surface.

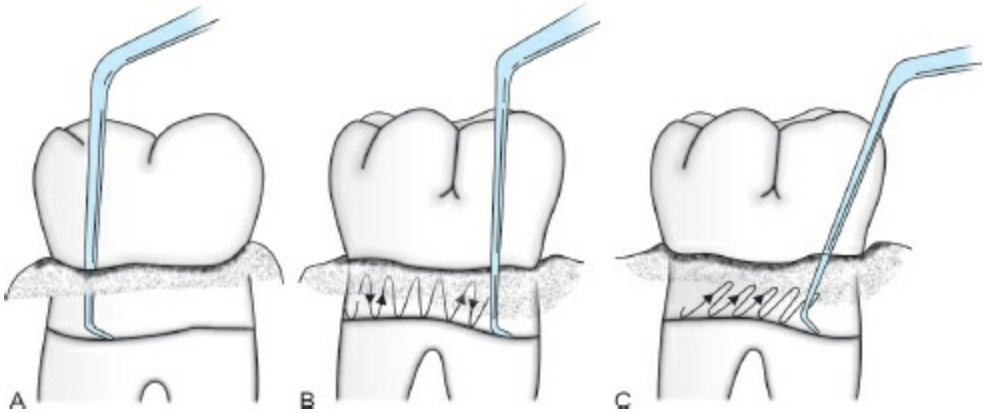


Fig. 11.10: Use of subgingival explorer

II. Steps

a. With the tip in contact with the tooth supragingivally, hold the lower shank (the part of the shank that is next to the tip) parallel with the long axis of the tooth. Gently slide the tip under the gingival margin into the sulcus or pocket.

b. Keep the point in contact with the tooth at all times to prevent unnecessary trauma to the pocket or sulcular epithelium. Adapt the tip closely to the tooth surface by applying the side of the point.

c. Slide the explorer tip over the tooth surface to the base of the pocket until, with the back of the tip, the resistance of the soft tissue of the attached periodontal tissue is felt. Calculus deposits may obstruct direct passage of the instrument to the base of the pocket. Lift the tip slightly away from the tooth surface and follow over the deposit to proceed to the base of the pocket.

d. Use a “walking” stroke, vertical or diagonal (oblique).

    1. Lead with the tip. Move it ahead as the strument progresses.
    2. Length of stroke depends on the depth of a pocket.
        a. ***Shallow pocket*****:** The stroke may extend the entire depth, from the base of pocket to just beneath the gingival margin.
        b. ***Deep pocket*****:** Controlled strokes 2 to 3 mm long can provide more acute sensitivity to the surface and allow improve adaptation of the instrument. A deep pocket should be explored in sections. One should first explore the apical area next to the base of the pocket, then move up to a higher section, overlaping for full coverage.
    3. Do not remove the explorer from the pocket for each stroke on a particular surface because
        a. Trauma to the gingival margin caused by repeated withdrawal and reinsertion can cause the patient post-treatment discomfort.
        b. Concentration on the texture of the tooth surface is interrupted.

c. More time is consumed

e. *Proximal surface:*

1. Lead with tip of instrument; do not “back into” an area.
2. Continue the strokes around the line angle. Roll the instrument handle between the fingers to keep the tip closely adapted as the tooth contour changes.
3. Continue strokes under the contact area. Overlap strokes from facial and lingual aspects for full coverage.

RECORD FINDINGS

I. Supragingival Calculus

A. Distribution

Supragingival calculus is generally localized. It is most commonly confined to the lingual surfaces of the mandibular anterior teeth and the facial surfaces of the maxillary first and second molars, opposite the openings to the salivary ducts.

B. Amount

Slight, moderate, heavy.

II. Subgingival Calculus

A. Distribution

Subgingival calculus can be either localized or generalized.

B. Amount

Slight, moderate, heavy.

III. Other Irregularities of Tooth Surface

Note on the chart or in the record any other deviation from normal detected while using the explorer.

RADIOGRAPHIC CHANGES IN PERIODONTAL INFECTIONS

I. Bone Level

A. Normal Bone Level (Fig. 11.11)

The crest of the interdental bone appears from 1.0 to 1.5 mm from the cementoenamel junction.



Fig. 11.11: Normal bone level

B. Bone Level in Periodontal Disease

The height of the bone is lowered progressively as the inflammation is extended and bone is resorbed.

II. Shape of Remaining Bone

A. Horizontal

1. When the crest of the bone is parallel with a line between the cementoenamel junctions of two adjacent teeth, the term “horizontal bone loss” is used (Figs 11.12 and 11.13).



Fig. 11.12: Horizontal bone loss



Fig. 11.13: Horizontal bone loss—second molar has drifted mesially

2. When inflammation is the sole destructive factor, the one loss usually appears horizontal.

3. When the amount of remaining bone is fairly evenly distributed throughout the dentition, the condition is described as generalized horizontal bone loss. It may be designated either by millimeters from the position of the normal bone level or by percentage. When making estimates, referral to the table of average root lengths can be helpful.
4. When bone loss is confined to specific areas. The condition is described as localized horizontal bone loss.

B. Angular or Vertical (Fig. 11.14)

1. Reduction in height of crestal bone that is irregular; the bone level is not parallel with a line joining the adjacent cementoenamel junctions; bone loss is greater on the proximal surface of one tooth than on the adjacent tooth.
2. Angular bone loss is more commonly localized; rarely generalized.
3. When inflammation and trauma from occlusion are combined in causing the destruction and irregular shape of the bone, the bone may appear with “angular defects” or with “vertical bone loss.”



Fig. 11.14: Angular or vertical bone loss; mesial of the first molar

III. Crestal Lamina Dura

A. Normal

White, radio-opaque; continuous with and connects the lamina dura of the roots of two adjacent teeth; covers the interdental bone

B. Evidence of Disease

The crestal lamina dura is indistinct, irregular, radiolucent, fuzzy.

IV. Furcation Involvement[2]

A. Normal

Bone fills the area between the roots.

B. Evidence of Disease

Radiolucent area in the furcation.

1. Early furcation involvement may appear as a small radiolucent black dot or as a slight thickening of the periodontal ligament space. It can be confirmed by probing. Early furcation involvement is shown in the second molar.
2. Furcation involvement of maxillary molars may become advanced before radiographic evidence can be seen. Superimposition of the palatal root may mask a small area of involvement. When the proximal bone level in the radiograph appears at the level where, the furcation is normally located, furcation involvement should be suspected and probed for confirmation.
3. Maxillary first premolar furcation involvement cannot be seen in a radiograph except at an unusual angulation or unusual position of the tooth. With correct vertical and horizontal angulation, the roots are superimposed.
4. Furcations may show at one angulation but not at another; variations in technique can obscure a furcation involvement. All furcations must be carefully probed.

V Periodontal Ligament Space[1]

A. Normal

The periodontal ligament is a connective tissue and, hence, appears radiolucent in a radiograph. It appears as a fine black radiolucent line next to the root surface. On its outer side is the lamina dura, the bone that lines the tooth socket and appears radio-opaque.

B. Evidence of Disease

Widening or thickening

1. Angular thickening or triangulation. The space is widened only near the coronal third, near the crest of the interdental bone.
2. Complete periodontal ligament thickened along an entire side of a root to the apex, or around the root. When viewed at different angulations (in the various radiographs of a complete survey), the ligament space may reveal varying thicknesses, thus showing that the disease involvement is not consistent around the entire root or that other structures are superimposed.

EARLY PERIODONTAL DISEASE[1]

The real preventive service is to recognize early signs of periodontal involvement so that treatment can be initiated to arrest the disease and prevent more severe involvement, which could lead to tooth loss recognition of severe bone loss, advanced furcation involvement, and marked thickening of the periodontal ligament space (Fig. 11.15) is not difficult after a basic understanding has been gained. The difficult part is to watch carefully for incipient, often isolated indications of early periodontal disease. These changes can be seen in all age groups, from young children to elderly patients.



Fig. 11.15: Periodontal ligament space

I. Earliest Signs

The earliest signs of periodontal involvement are not evident in a radiograph. Only after the inflammation has extended from the soft tissue (gingivitis) to the supporting periodontal tissues and bone resorption has come sufficient does radiographic evidence appear.

II. Initial Bone Destruction

a. The usual interproximal pathway of information from gingivitis to periodontitis is directly from the inflamed gingival connective tissue into the crest of the interdental bone

b. Initial bone destruction most frequently occurs at the crest of the interdental bone in the crestal lamina dura.

III. Radiographic Evidence

a. Crestal lamina dura may appear slightly regular, fuzzy, and radiolucent. At this stage, it is best examined with a hand magnifying glass.

b. Angular thickening of the periodontal ligament space (triangulation) may also be apparent.

OTHER RADIOGRAPHIC FINDINGS

Any other radiographic findings that may be related directly or indirectly to periodontal involvement and its contributing factors should be noted in the record. Certain findings have a direct relation to dental hygiene care and instruction, particularly local factor that contribute to food impaction or plaque retention.

I. Calculus

Gross deposits, primarily those on proximal surfaces, may be seen in radiographs. Observing these may be helpful, but the probe and explorer are needed to define the exact location and extent.

The density and contrast of the radiograph influence whether or not calculus is seen. Because all deposits are not visible, the use of radiographs has very limited value for specific calculus detection.

II. Overhanging Restorations

Some proximal overhanging margins may be seen in radiographs. The use of an explorer is necessary to detect irregular margins and to examine all proximal margins that do not reveal irregularities in the radiographs. Superimposition can mask an overhanging margin.

III. Dental Caries

Certain findings should be noted for their relationship to the periodontal tissues.

a. Large carious lesions may leave open contact areas that permit food impaction and hence damage to the periodontal tissues.

b. Carious lesions, either enamel or root caries, hold plaque and provide a rough surface for retention of food debris and bacterial plaque.

c. Root caries and demineralization may interfere with techniques of root planning and require instruction in remineralization procedures.

IV. Relationship to Pockets

Radiographs do not show pockets; soft tissue does not show in a radiographbecause a pocket is measured from the gingival margin to the base of the pocket, both of which are soft tissue, pockets cannot be seen in a radiograph. Probing is necessary to identify pockets.

i. Use topical anaesthetic to help to alleviate discomfort while probing.

ii. Avoid the most common errors in probing:

   a. Not passing the probe to the full pocket depth.

   b. Not measuring around the entire tooth and therefore missing pockets. This error most commonly applies to proximal surface probing. The probe must be passed more than halfway across from the facial aspect to overlap with the probe used on the lingual aspect, which should also be passed more than halfway across.

iii. Check the markings on a new probe by measuring on a standard millimeter ruler.

iv. When bleeding is readily elicited on probing or exploring and tooth surfaces are obscured so that examination is complicated, initiate toothbrushing and other appropriate disease control methods. Explain the problem to the patient, and outline a specific home care routine designed to reduce gingival inflammation. Postpone the complete examination for 1 week, after which the gingival condition should be improved.

v. Replace mirror heads frequently. Scratched mirrors obscure vision and delay procedures.

vi. Handle explorers and probes carefully. Because the tips are pliable and relatively fragile, precautions must be taken against breakage or bending.

FACTORS TO TEACH THE PATIENT

i. The need for a careful, thorough examination if treatment is to be complete and effective.

ii. Information about the instruments and how their use makes the examination complete. Examples are the complete radiographic survey, probing 360° around each tooth, and exploring each subgingival tooth surface.

iii. Why bleeding can occur when probing. Healthy tissue does not bleed.

iv. Relation of probing depth measurements to normal sulci.

v. Significance of mobility.

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CHAPTER

12

Indices for Oral Diseases

An index is an expression of clinical observations in numerical values. It is used to describe the status of the individual or group with respect to a condition being measured. Indices have been developed to compare the extent and severity of disease.

Definition

An index has been defined by Russell AL 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”.

Ideal Requisites

1. ***Clarity, simplicity, objectivity*:** The index should be simple and easy to carry out.
2. ***Validity*:** The index must measure what it is intended to measure, so it should correspond with clinical stages of the disease under study.
3. ***Reliability*:** The index should measure consistently at different times and under a variety of conditions.
4. ***Quantifiability*:** The index should be amenable to statistical analysis so that the status can be expressed by a number.
5. ***Sensitivity*:** The index should be able to detect small shifts in either direction.
6. ***Acceptability*:** The index should not be painful or demeaning to the subject.

Purposes and Uses of an Index

A distinction must be made between an individual oral health assessment score, a clinical trial and a community health epidemiological survey.

I. Individual Clinical Score

Purpose

In clinical practice, an index, plaque record, or scoring system for an individual patient can be used for education, motivation, and evaluation.

Uses

1. Provides individual assessment to help a patient recognize an oral problem.
2. Reveals the degree of effectiveness of present oral hygiene practices.
3. Motivates the person in preventing and obtaining professional care for the elimination and control of oral disease.
4. Evaluates the success of individual and professional treatment over a period of time by comparing index scores.

II. Clinical Trial

Purpose

A clinical trial is planned for the determination of the effect of an agent or procedure on the progression, control, or prevention of disease. The trial is conducted by comparing an experimental group with a control group that is similar to the experimental group in every way except for the variable being studied.

Uses

1. Determines baseline data before experimental factors are introduced.
2. Measures the effectiveness of specific agents for the prevention, control, or treatment of oral conditions.
3. Measures the effectiveness of mechanical devices for personal care, such as toothbrushes, interdental cleaning devices or water irrigators.

III. Epidemiologic Survey

Purpose

An epidemiologic survey is to study the disease characteristics of populations. It has been used with populations around the world to study the extent of diseases.

Uses

1. Shows the prevalence and incidence of a particular condition occurring within a given population.
2. Provides baseline data to show existing dental health practices.
3. Assesses the needs of a community.
4. Compares the effects of a community programmes and evaluates the results.

Descriptive Categories

1. General categories

a. *Simple index*: One that measures the presence or absence of a condition. For example, index that measures the presence of bacterial plaque without evaluating its effect on the gingiva.

b. ***Cumulative index*:** One that measures all the evidence of a condition, past and present, e.g. DMF Index for dental caries.

2. Types of simple and cumulative indices

a. *Irreversible*: One that measures conditions that will not change, e.g. DMF Index.

b. *Reversible*: One that measures conditions that can be changed, e.g. plaque index.

c. *Composite index*: Combination of reversible and irreversible aspect of disease, e.g. Russell periodontal index. Concerned with the clinical sign of active gingival inflammation (gingival indices) and the destructiveness of the condition by pocket deepening and bone resorption.

Selection criteria

A useful and effective index will:

a. Be simple to use and calculate.
b. Require minimal equipment and expense.
c. Require minimal amount of time to complete.
d. Not cause patient discomfort or otherwise be unacceptable to the patient.
e. Have clear-cut criteria that are readily understandable.
f. Be as free as possible from subjective interpretation.
g. Be reproducible by the same examiner or different examiners.
h. Be amenable to statistical analysis, have validity and reliability.

INDICES FOR ORAL DISEASES

I. Bacterial plaque.

Plaque Index (PlI)—Silness and Loe

II. Plaque, debris, calculus

Patient hygiene performance (PHP) index

Oral hygiene index

Simplified oral hygiene index (OHI-S)

III. Gingival bleeding Sulcus bleeding index (SBI)

IV. Gingival changes/gingivitis Gingival index (GI)—Loe and Silness

V. Periodontal diseases

Periodontal index (PI)—Russell AL

Periodontal disease index (PDI)—Ramfjord SP

Community periodontal index of treatment needs (CPITN)

Community periodontal index (CPI)

VI. Mobility index

VII. Dental caries

Permanent teeth

1. Decayed, missing and filled teeth (DMFT)
2. Decayed, missing and filled surface (DMFS)
3. SIC index

Primary teeth

1. Decayed and filled teeth (dft)
2. Decayed and filled surfaces (dfs)

Mixed dentition

1. Decayed and filled teeth (dft) and decayed, missing and filled teeth (DMFT)
2. Decayed and filled surfaces (dfs) and decayed, missing and filled surface (DMFS)

VIII. Dental fluorosis

Deans fluorosis index

Community fluorosis index (CFI)

IX. Malocclusion

X. Dental aesthetic index

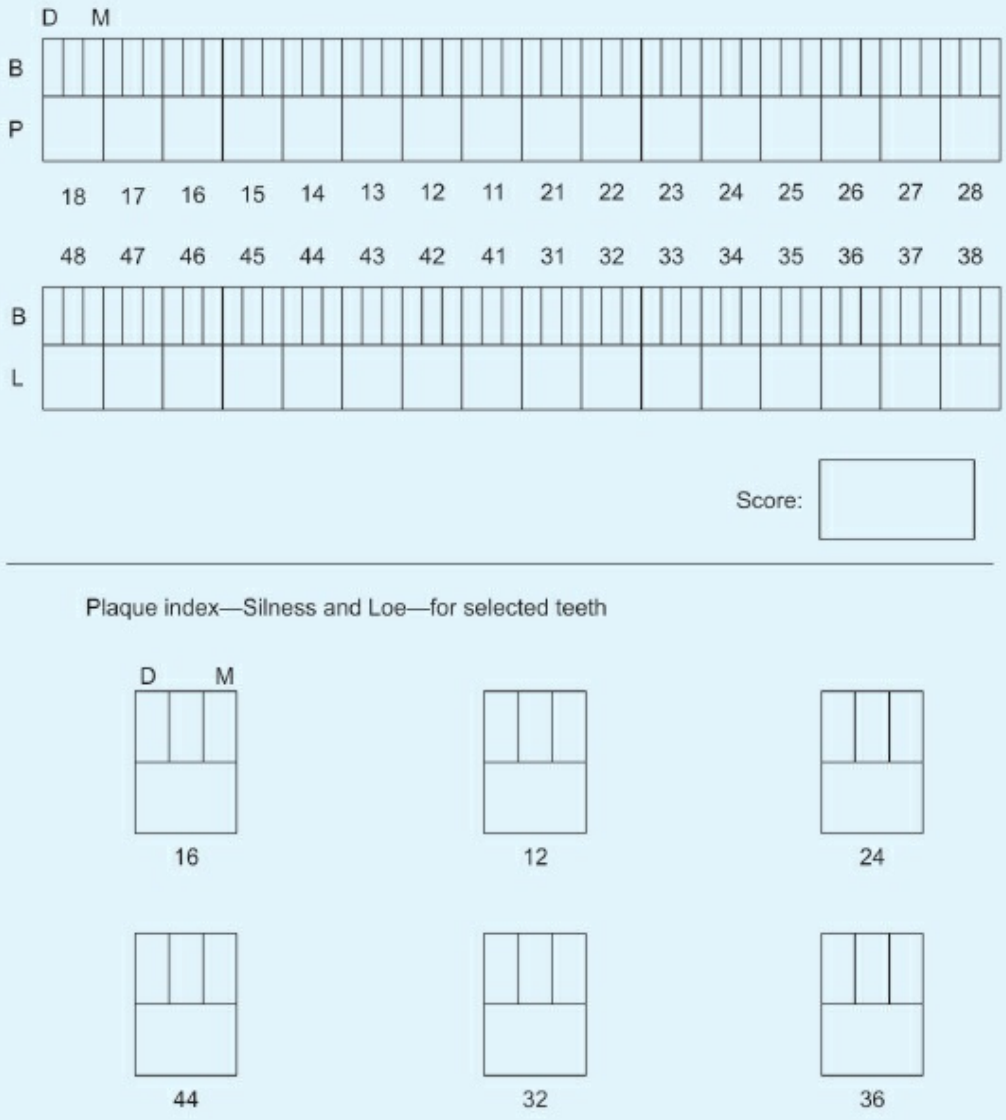
XI. Oral cancer

XII. WHO oral health assessment form.

PLAQUE INDEX (PlI)

Proposed by Silness J and Loe H in the year 1964 (Table 12.1).[1]

Table 12.1: Recording form for plaque index—Silness and Loe (1964)



Purpose

To assess the thickness of plaque at the gingival area.

Selection of Teeth

The entire dentition or selected teeth can be evaluated.

Areas examined

Four gingival areas (distal, facial, mesial, lingual) are examined systematically for each tooth.

Procedure

Dry the teeth and examine visually using adequate light, mouth mirror, and probe or explorer. Evaluate bacterial plaque on the cervical third; pay no attention to plaque that has extended to the middle or incisal thirds. Probe to test the surface when no plaque is visible. Pass the probe or explorer across the tooth surface in the cervical third and near the entrance to the sulcus. When no plaque adheres to the probe tip, the area is scored 0. When plaque adheres, a score of 1 is assigned.

Use a disclosing agent, if necessary, to assist evaluation for the 0 to 1 scores. When the Plaque index is used in conjunction with the gingival index (GI) the GI must be completed first because the disclosing agent masks the gingival characteristics.

Include plaque on the surface of the calculus and on dental restorations in the cervical third in the evaluation.

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 recognized only after application of disclosing agent or by running the explorer across the tooth surface.

2 = Moderate accumulation of the soft deposits within the gingival pocket that can be seen with the naked eye or on the tooth and gingival margin.

3 = Abundance of soft matter within the gingival pocket and/or the tooth and gingival margin.

Scoring

a. *PlI for area*: Each area (distal, facial, mesial, lingual, or palatal,) is assigned a score from 0 to 3.

b. *PlI for a tooth*: Scores for each area are totaled and divided by 4.

c. *PlI for groups of teeth*: Scores for individual teeth may be grouped and totalled and divided by the number of teeth. For instance, a *PlI* may be determined for specific teeth or groups of teeth. The right side may be compared with the left.

d. *PlI for the individual*: Add the scores for each tooth and divide by the number of teeth examined. The *PlI* score ranges from 0 to 3.

e. *Suggested nominal scale for patient reference*:

f. *PlI for a group*: Add the scores for each member of a group and divide by the number of individuals.

Rating	***Scores***
Excellent	0
Good	0.1–0.9
Fair	1.0–1.9
Poor	2.0–3.0

PATIENT HYGIENE PERFORMANCE (PHP) INDEX

This index was proposed by Podshadley AG and Haley JV in 1968.[2]

Purpose

To assess the extent of plaque and debris over a tooth surface. Debris is defined for the PHP index as the foreign material consisting of bacterial plaque, materia alba, and food debris that is loosely attached to tooth surfaces.

Selection of Teeth and Surfaces

a. ***Teeth examined*:** 16, 11, 26, 36, 31, 46.

b. ***Substitutions*:** When the first molar is missing, or less than three-fourths erupted, has a full crown, or is broken down, the second molar is used. The third molar is used when the second is missing. Provided it is functional the adjacent central incisor is used for a missing incisor.

c. ***Surfaces*:** The facial surfaces of incisors and maxillary molars and the lingual surfaces of mandibular molars are examined. These surfaces are the same as those used for the Simplified Oral Hygiene Index.

Procedure

Apply disclosing agent. Instruct the patient to swish for 30 seconds and expectorate but not to rinse.

Examination is made using a mouth mirror.

Each tooth surface to be evaluated is subdivided into 5 sections as follows (Figs 12.1 and 12.2).

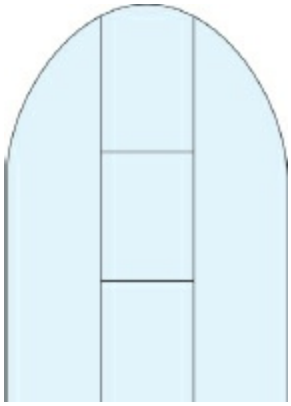


Fig. 12.1: Divisions for the PHP for the upper anterior teeth

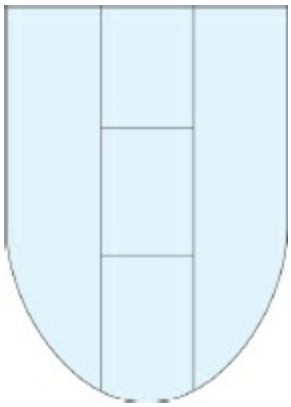


Fig. 12.2: Divisions for the PHP for the lower anterior teeth

1. *Vertically*: Three divisions—mesial, middle, distal.
2. *Horizontally*: The middle third is subdivided into gingival, middle, and occlusal or incisal thirds.

Each of the subdivisions is scored for the presence of stained debris as follows:

0 = No debris

1 = Debris definitely present

Identify by M when all three molars or both incisors are missing.

Identify by S when a substitute tooth is used.

Scoring (Table 12.2)

a. *Score for individual tooth*: Add the scores for each of the 5 subdivisions. The scores range from 0 to 5.

b. *Score for the individual*: Total the scores for the individual teeth and divide by the number of teeth examined. The score ranges 0 to 5.

c. To obtain the average score for a group, total the individual scores and divide by the number of the individuals examined.

Table 12.2: PHP recording form

Index teeth	*Surface*	*A*	*B*	*C*	*D*	*E*	*Total*
	F						
	L						
	F						
	L						
	F						
	L						
Total							

Suggested Nominal Scale

Rating	***Scores***
Excellent	0
Good	0.7–1.7
Fair	1.8–3.4
Poor	3.5–5.0

Uses of PHP Index

- It may be used to both document and assist in motivating changes in oral health habits.
- It is used to score the patient before and after oral hygiene instruction and at the follow-up visits.
- It can be used to analyze and evaluate the effectiveness of home care methods that are being used in the programme.

- It is used for individual patient education, e.g. as an educational aid.
- It is simple to use and can be performed quickly.

Basic Definitions

1. ***Biofilm*:** A biofilm is a complex aggregation of microorganisms growing on a solid substrate. Biofilms are characterized by structural heterogenecity, genetic diversity, complex community interactions, and an extracellular matrix of polymeric sub-stances.
2. ***Plaque*:** Dental plaque can be defined as the soft deposits that form the biofilm adhering to the tooth surface or other hard surfaces in the oral cavity, including removable and fixed restorations. It is of two types (Table 12.3):
   - Supragingival plaque—it is found at or above the gingival margin.
   - Subgingival plaque—it is found below the gingival margin, between the tooth and the gingival sulcular tissue.

Table 12.3: Differences between supragingival and subgingival plaques

	Supragingival plaque	***Subgingival plaque***
Location	Above the gingival margin	Below the gingival margin
Attachment	Enamel surface	Cemental surface
Bacteria	Aerobic	Anaerobic

3. ***Materia alba*:** It refers to the soft accumulations of bacteria and tissue cells that lack the organized structure of dental plaque and are easily displaced with a water spray.
4. ***Calculus*:** It is a hard deposit that forms by mineralization of dental plaque and is generally covered by a layer of unmineralized plaque. It is of two types (Table 12.4):
   - *Supragingival calculus*—denotes deposits, usually white to yellowish-brown in colour. Present occlusal to the free gingival margin.
   - *Subgingival calculus*—denotes deposits apical to the free gingival margin. These deposits usually are light brown to black in colour. A no. 5 explorer is used to estimate surface area covered by supragingival calculus and to probe for subgingival

calculus.

Table 12.4: Differences between supragingival calculus and subgingival calculus

	Supragingival calculus	***Subgingival calculus***
Location	Above the gingival margin	Below the gingival margin
Attachment	Enamel surface	Cemental surface
Bacteria	Aerobic	Anaerobic
Tenacity	Not much	Extremely tenacious
Colour	Light-coloured	Dark-coloured

5. ***Acquired pellicle*:** A thin film (about 1 pm), derived mainly from salivary glycoproteins, which forms over the surface of a cleansed tooth crown when it is exposed to the saliva.

ORAL HYGIENE INDEX (OHI)

Proposed by John C Greene and Jack R Vermillion in I960.[3]

Purpose

To measure existing debris and calculus as an indication of oral cleanliness.

a. ***Components*****:** The OHI has two components, the Debris Index and the Calculus Index. The two scores when added give the OHI score.

b. ***Selection*****:** Only fully erupted permanent teeth. (A tooth is considered fully erupted when it has reached the occlusal plane.)

c. ***Exclusion*****:** Third molars are excluded, teeth with full crown restorations, and teeth reduced in height—severe dental caries or trauma.

d. ***Method of examination*****:** The side of the number 23 explorer to be moved from the incisal to cervical end. Use an explorer to supplement visual examination for supragingival calculus deposits. Identify subgingival deposits by gently placing a dental explorer into the distal gingival crevice and drawing it subgingivally from the distal contact area to the mesial contact area. The maxium score per sextant to be examined on the buccal and lingual aspect for each segment (Figs 12.3 and 12.4).

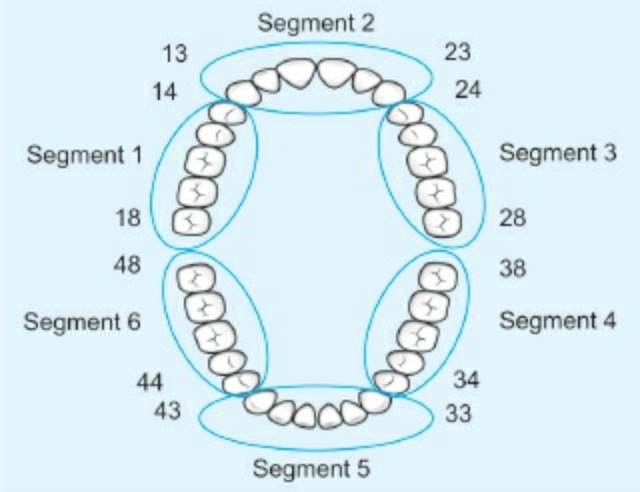


Fig. 12.3: O'Leary criteria of division of the oral cavity into sextants

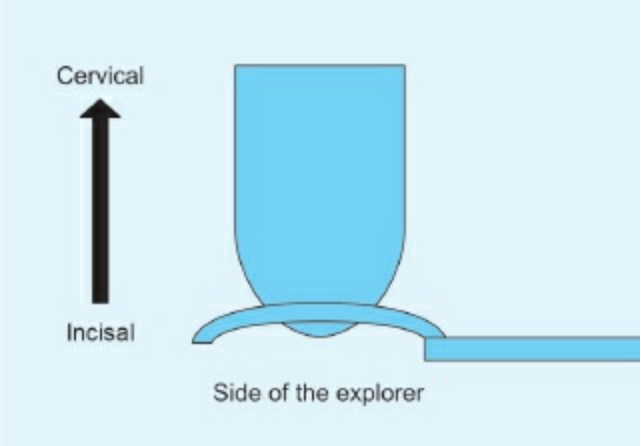
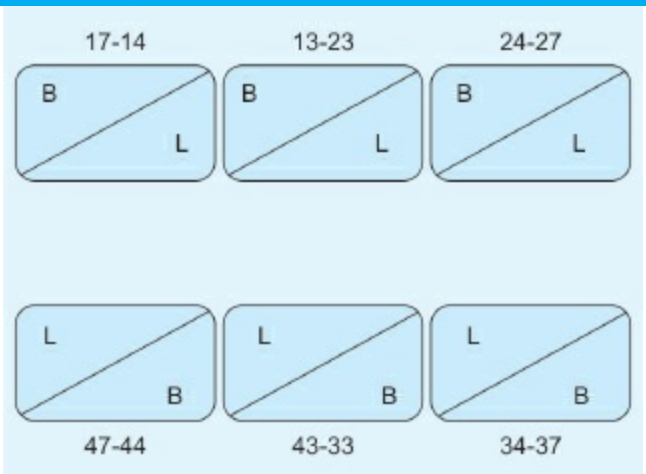


Fig. 12.4: Method of examination

Table 12.5: Recording form for OHI



Calculation for an Individual

$$DI = \frac{\text{Total debris score}}{\text{Number of teeth scored}}$$

$$CI = \frac{\text{Total calculus scores}}{\text{Number of teeth scored}}$$

i. Each selected surface has a severity score of 0 to 3.

ii. The total score for debris or calculus ranges from 0 to 36.

iii. The OHI score ranges from 0 to 12.

There is no interpretation of the OHI as good, fair or poor. The score is

written as it and is compared against the score of other individuals only. This is the limitation of the OHI.

Advantages

1. Sensitive to reflect the cleansing efficiency of the toothbrushing and the relationships between oral cleanliness and periodontal disease.
2. Simple, useful method for assessing a group of individual oral hygiene status quantitatively.
3. Useful tool in evaluation and monitoring oral hygiene maintenance programmes.
4. Can assess individual's attitude and effectiveness of tooth brushing in oral hygiene practices.

Limitations

1. Examination of all surfaces of all teeth present in the mouth (though only 12 surfaces are scored). More time consuming.
2. Since it is time consuming, it cannot be used in epidemiological surveys.
3. Intra- and interexaminer errors are more.

SIMPLIFIED ORAL HYGIENE INDEX (OHI-S)

Proposed by John C Greene and Jack R Vermillion in 1964.[4]

Purpose

To assess oral cleanliness by estimating the tooth surface covered with debris or calculus.

A. Components

The OHI-S has two components, the Simplified Debris Index and the Simplified Calculus Index. The two scores may be used separately or may be combined for the OHI-S.

B. Comparison with OHI

After experience with the Oral Hygiene Index, the need for simplification was recognized because of the length of the time required to evaluate debris and calculus, as well as to make subjective decisions on tooth selection.

1. ***Tooth selection*:** In the OHI, the examiner has to select the tooth with the most debris or calculus in each sextant. The OHI-S assess 6 specific teeth, 1 in each sextant.
2. ***Number of surfaces*:** In the OHI, 12 surfaces are evaluated; only 6 surfaces are used in the OHI-S.
3. ***Scoring*:** The OHI ranges from 0 to 12; the OHI-S ranges from 0 to 6.

Selection of Teeth and Surfaces

A. Identify the 6 Specific Teeth

1. ***Posterior*:** The first fully erupted tooth distal to each second premolar is examined. The facial surface of the maxillary molars and the lingual surfaces of the mandibular molars are used. Although usually the first molars, the second or third molars may be used.
2. ***Anterior*:** The facial surfaces of the maxillary right and the mandibular left central incisors are used. When either is missing, the opposite central incisor is scored.

B. Extent

A score represents half the circumference of the selected tooth; includes proximal surfaces to the contact areas.

Procedure

A. Qualification

At least two of the six possible surfaces must have been examined for an individual score to be expressed.

B. Record Debris Scores and Calculus Scores

a. Record debris scores

1. *Definition of oral debris*: Oral debris is the soft foreign matter on the surface of the teeth that consists of bacterial plaque, materia alba, and food debris.
2. *Examination*: The dental explorer is placed on the incisal third of the tooth and moved towards the gingival third according to the criteria.
3. *Criteria*:

   0 = No debris or stain present.

   1 = Soft debris covering not more than one-third of the tooth surface being examined, or the presence of extrinsic stains without 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.

b. *Record calculus scores*

1. *Definition of calculus*: Dental calculus is a hard deposit of inorganic salts composed primarily of calcium carbonate and phosphate mixed with debris, microorganisms, and desquamated epithelial cells.
2. *Examination*: Use an explorer to supplement visual examination for supragingival calculus deposits. Identify subgingival deposits by gently placing a dental explorer into the distal gingival crevice and drawing it subgingivally from the distal contact area to the mesial contact area.

3. *Criteria*:

0 = No calculus present.

1 = Supragingival calculus covering not more than one-third of the exposed tooth surface being examined.

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.

3 = Supragingival calculus covering more than two-thirds of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth.

4. Scoring (Table 12.6)

A. OHI-S for an Individual

1. Determine simplified debris index and simplified calculus index
   a. Divide total scores by number of surfaces examined.
   b. DI-S and CI-S values range from 0 to 3.
2. Simplified oral hygiene index
   a. Combine the DI-S and CI-S
   b. OHI-S value ranges from 0 to 6

Table 12.6: Recording form for OHI(S)

Debris scores:

16 11 26

46 31 36

$$\text{Debris index} = \frac{\text{Total score}}{\text{No of surfaces examined}}$$

Calculus scores:

16 11 26

46 31 36

$$\text{Calculus index} = \frac{\text{Total score}}{\text{No of surfaces examined}}$$

OHI-S=DI-S+CI-S

B. Suggested Nominal Scale

DI-S and CI-S	
Rating	***Scores***
Excellent	0
Good	0.1–0.6
Fair	0.7–1.8
Poor	1.9–3.0

OHI-S	
Excellent	0
Good	0.1–1.2
Fair	1.3–3.0
Poor	3.1–6.0

C. Calculation for an Individual

$$\text{DI-S} = \frac{\text{Total debris score}}{\text{Number of teeth scored}}$$

$$\text{CI-S} = \frac{\text{Total calculus scores}}{\text{Number of teeth scored}}$$

$$\text{OHI-S} = \text{DI-S} + \text{CI-S}$$

D. OHI-S Group Score

Compute the average of the individual scores by totalling the scores and dividing by the number of individuals.

SULCUS BLEEDING INDEX (SBI)

Proposed by Muhlemann HR, Son S 1971.[5]

Purpose

To locate areas of gingival sulcus bleeding upon gentle probing and thus recognize and record the presence of early (initial) inflammatory gingival disease.

Areas Examined

Four gingival units are scored systematically for each tooth. The marginal gingiva, (labial and lingual) and the papillary gingiva (mesial and distal).

Procedure

1. Use standardized lighting while probing each of the four areas.
2. Hold the probe parallel with the long axis of the tooth for marginal gingival units and direct the probe towards the col area for papillary gingival units.
3. Wait 30 seconds after probing before scoring apparently healthy gingival units.
4. Dry the gingiva gently, if necessary, to observe colour changes clearly.

Criteria

0 – Healthy appearance of papillary and marginal gingiva, no bleeding on sulcus probing.

1 – Apparently healthy papillary and marginal gingiva showing no change in colour and no swelling, but bleeding from sulcus on probing.

2 – Bleeding on probing and change of colour caused by inflammation. No swelling or macroscopic oedema.

3 – Bleeding on probing and change in colour and slight oedematous swelling

4 – a. Bleeding on probing and change in colour and obvious swelling

b. Bleeding on probing and obvious swelling

5 – Bleeding on probing and spontaneous bleeding and change in colour, marked swelling with or without ulceration.

Scoring

1. *SBI for area*: Each of the 4 gingival units is scored 0 to 5.
2. *SBI for tooth*: Scores for the 4 units are totalled and divided by 4.
3. *SBI for individual*: By totalling scores for individual teeth and dividing by the number of teeth, the SBI is determined. Indices range from 0 to 6.

GINGIVAL INDEX (GI)

Proposed by Loe. H and Silness J in 1963.[6]

1. Purpose

Assess the severity of gingivitis based on colour, consistency, and bleeding on probing.

2. Selection of Teeth and Gingival Areas

All the teeth are examined.

Areas examined: Four gingival areas (distal, facial, mesial, lingual) are examined.

3. Procedure

Teeth and gingiva are dried and are examined under adequate light, using a mouth mirror and probe. The probe is used to press on the gingiva to determine the degree of firmness. The probe is used to run along the soft tissue wall near the entrance to the gingival sulcus to evaluate bleeding.

4. Criteria

0 – Normal gingiva

1 – Mild inflammation—slight oedema, slight change in colour. No bleeding on probing

2 – Moderate inflammation—redness, oedema and glazing. Bleeding on probing.

3 – Severe inflammation—marked redness and oedema. Ulceration. Tendency to spontaneous bleeding.

5. Scoring (Table 12.7)

***GI for area*:** Each of 4 gingival surfaces is given a score of 0 to 3.

***GI for tooth*:** Scores for each area are totalled and divided by 4.

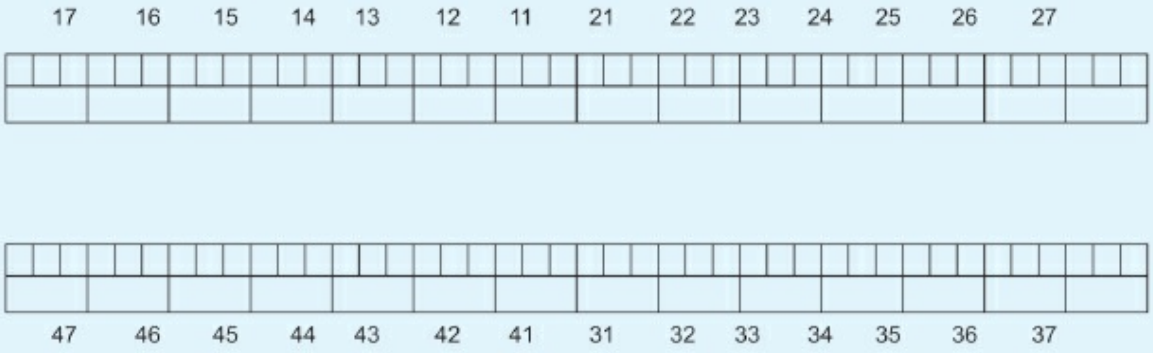
***GI for groups of teeth*:** Scores for individual teeth may be grouped and totalled, and divided by the number of teeth.

***GI for the individual*:** By totalling scores and dividing by the number of teeth examined, the gingival index is determined.

Total score for an individual = total score/number of surfaces examined

Rating	*Score*
Excellent (normal health tissue)	0
Good	0.1 – 0.9
Fair	1.0 – 1.9
Poor	2.0 – 3.0

Table 12.7: Recording form for gingival index



PERIODONTAL INDICES

Periodontal disease is a term, which includes all pathological conditions of the periodontium, e.g. gingival and the supporting structure that is cementum, periodontal ligament and alveolar bone).

The signs of periodontal pathologic alteration involve:

1. Colour change in soft tissues
2. Swelling
3. Bleeding
4. Pockets
5. Mobility

Epidemiologic studies dealing with periodontal disease frequently do not differentiate between gingivitis and the more destructive forms of disease.

Most of the indices used in periodontal diseases are based on the gingivitis—periodontitis continuum.

The choice of the periodontal index should relate to the type and objective of the study.

PERIODONTAL INDEX (PI)

Introduced by Russell AL in the year 1956.[7]

Periodontal index is a composite index because it records both the reversible changes due to gingivitis and the more destructive and presumably irreversible changes brought by deeper periodontal disease.

1. Purpose

To assess and score the periodontal disease status of populations.

2. Method

All the teeth are examined.

All of the tissue circumscribing a tooth is considered a scoring or gingival unit and is assessed for gingival inflammation and periodontal involvement (Table 12.9).

Table 12.9: Recording form for Russell's Periodontal Index

18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38

Total score=
Total no. of teeth examined=
Periodontal health condition=

PI= ——— =

3. Instruments Used

Each tooth is examined using a mouth mirror and explorer with adequate illumination. (In the original examination, a Jacquette scaler and chip blower were used to define the presence of periodontal pockets.) At present, a periodontal probe is used.

4. Scoring Criteria **Table 12.8.**

Table 12.8: Scoring criteria—periodontal index		
'0' Negative	There is neither overt inflammation in the investing tissues nor loss of function caused by destruction of supporting tissues.	Radiographic appearance is normal
'1' Mild gingivitis	There is an overt area of inflammation in the free gingiva that does not circumscribe the tooth.	
'2' Gingivitis	Inflammation completely circumscribes the tooth (but there is no apparent break in epithelial attachment).	
'4'		There is early notch like resorption of alveolar crest.
'6' Gingivitis with pocket formation	The epithelial attachment has been broken and there is a pocket not merely a deepened gingival crevice caused by swelling in the free gingiva. 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 tooth 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.	There is advanced bone loss involving more than one-half of the length of tooth root, or a definite infrabony pocket with widening of periodontal ligament. There may be root resorption or rarefaction at apex.
	Rule: When in doubt assign lesser score.	

5. Calculation

Each tooth is assigned a score from 0 (no disease) to 8 (severe disease with loss of function)

Individual score

$$= \frac{\text{Sum of individual scores}}{\text{Number of teeth present}}$$

While doing epidemiological studies Average score

$$= \frac{\text{Total of the individual scores}}{\text{Number of individuals examined}}$$

6. Interpretation

Clinical condition	*PI score*	*Stage of disease*
Clinically normal supportive tissues	0–0.2	
Simple gingivitis	0.3–0.9	
Beginning destructive periodontal disease	0.7–1.9	Reversible
Established destructive periodontal disease	1.6–5.0	Irreversible
Terminal disease	3.8–8.0	Irreversible

Revised Interpretation

Clinical condition	*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	2.0–5.0
Terminal disease	5.0–8.0

Disadvantages

1. Subjective variation.
2. Underestimates the actual condition, if tooth is already lost due to periodontal disease.
3. Overlapping of scores.
4. Scoring is not continuous.

Why breakdown of scores?

Initially bone loss was recorded by radiographs. Grading can be given in a sequence if radiographs are taken. Clinical signs and symptoms are taken from 0–8. It is difficult to differentiate clinically from one stage to another and hence let to the breakdown of scores.

PERIODONTAL DISEASE INDEX (PDI)

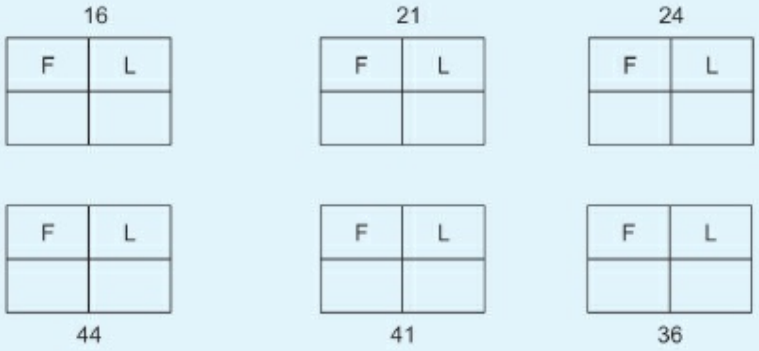
Introduced by Ramfjord SP in 1967.[8]

The PDI is a clinician's modification of Russell's Periodontal Index for epidemiological surveys of periodontal disease. The PDI combines the evaluation of gingival status with the probed attachment level. Although not part of PDI, a calculus index and plaque index have usually been included when making a survey (Table 12.10).

Table 12.10: Recording form Ramfjord's periodontal disease index

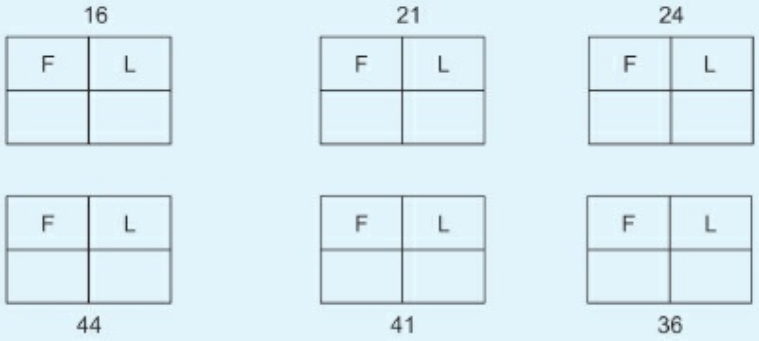
(a) Plaque component (Shick and Ash modification)
(b) Calculus component
(c) Gingival and periodontal component

(a) Plaque component



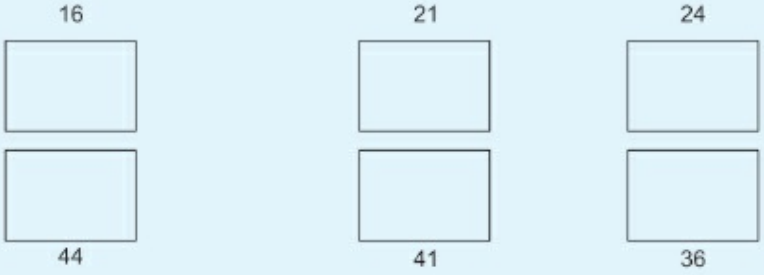
Score:

(b) Calculus component



Score:

(c) Gingival and periodontal component



Score:

1. Purpose

To assess the prevalence and severity of gingivitis and periodontitis and to show the periodontal status of an individual or a group.

2. Selection of Teeth

For short-term clinical trials and where a limited number of patients are available, one may concern all of the teeth in the mouth but otherwise.

Six teeth are used to represent the six segments of the dentition, i.e.

16	21	24
44	41	36

Only fully erupted teeth is scored.

Substitutions are not made for missing teeth.

3. Instruments Used

To obtain consistent readings Michigan probe “O” is used.

4. Procedure

A. Determine Gingival Status

1. Under standardized light, dry the gingiva with cotton to observe colour and form.
2. Apply gentle pressure with the probe to determine consistency. When the colour change definitely indicates the presence of inflammation, the consistency is not checked.

Scoring 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, not necessarily extending around the tooth.

Calculation

Individual

$$= \frac{\text{Add the scores for all examined teeth}}{\text{Total number of teeth examined}}$$

B. Determine Crevice Depth from CEJ

Instrument used: To obtain consistent readings, a probe is needed. Here a Michigan probe no. 0 is used.

Location of measurements

a. *Two measurements*: When two measurements are made, they are at the middle of the facial surface and at the facial aspect of the mesial contact area with the side of the probe held touching both teeth.

b. ***Four measurements*****:** Originally, four measurements were used, i.e. facial, lingual, distal and mesial. It was later found that no significant loss in accuracy resulted from using only 2 measurements.

Four measurements are still used.

Procedure

1. Locate the CEJ with probe tip and measure the distance from gingival margin.
2. When calculus interferes, scaling is performed.
3. Apply probe to measure the pocket depth from gingival margin to attached periodontal tissue and subtract the distance to the CEJ.
4. When there is apparent recession, the direct reading from the CEJ can be measured.

Scoring criteria

0–3 is gingival index.

4— A score is given when the pocket of any 2 or 4 recorded areas extend apically to the CEJ not more than 3 mm but including 3 mm.

5— When the pocket depth of any of the 2 or 4 recorded areas extend apically to the CEJ from 3 to 6 mm inclusive.

6— When the pocket depth of any of the 2 or 4 recorded areas extend apically more than 6 mm from the CEJ.

Calculation

$$\frac{\text{Add scores of individual teeth}}{\text{Number of teeth examined}}$$

THE COMMUNITY PERIODONTAL INDEX OF TREATMENT NEEDS (CPITN)

In 1977, the World Health Organization (WHO) appointed an expert committee to review the current methods available to assess periodontal status and treatment needs.

A Joint International Dental Federation (FDI) and World Health Organization (WHO) working group was established in 1979 to develop and test a survey method for assessing periodontal conditions suggested in a WHO technical report (WHO, 1978).

Following extensive discussions and testing, the CPITN was finalized and described in 1982 by Jukka Ainamo, David Barmes, George Beagrie, Terry Cutress, Jean Martin and Jennifer Sardo-Infirri.[9] Over the past few years, the CPITN has been increasingly adopted as a procedure for classifying periodontal conditions with respect to the complexity of care and oral health personnel required to restore periodontal tissues to a healthy condition. Some profiles of the periodontal conditions of populations are becoming evident from completed surveys. The Community Periodontal Index of Treatment Needs (CPITN) is a quick system which provides the information most necessary by simple examination procedure.[2]

It was initially used as a screening procedure for epidemiological purposes, later the index has been adopted for other purposes like in promoting periodontal health awareness programmes for initial screening and for monitoring changes in periodontal needs of individuals in clinical practice. It is a procedure which uses clinical parameters and criteria relevant to planning for the prevention and control of periodontal diseases. It records the common treatable conditions, viz. gingival inflammation (identified by bleeding on gentle probing), periodontal pockets, dental calculus and other plaque retentive factors. It is designed as an indicator of treatment need.

This index provides a rapid and reproducible method of assessing the periodontal condition of the patient at the first visit.

The World Health Organization Probe

The recommended periodontal probe for use with CPITN was first described in the WHO 621 technical report (WHO, 1978) and reported in detail by Emslie (1980). This type of tactile probing or sensing instrument is considered to be an extension of the examiner's fingers. The CPITN probe (Figs 12.5 and 12.6) is designed for gentle manipulation of the sensitive soft tissues around the teeth. The WHO probe has two special characteristics. Firstly, it has a ball ended tip of 0.5 mm in diameter. Secondly, the graduations are a band of 2 mm which is colour-coded on the shaft beginning 3.5 mm from the tip. A further modification of probe incorporates two further graduations at 8.5 mm and 11.5 mm. The rationale for ball-ended probe is a twofold: Firstly, detection of subgingival calculus is made easier, secondly, there is less likely that an excessive pressure be used to cause penetration of the tissue. The recommended probing force is between 15 and 25 grams.

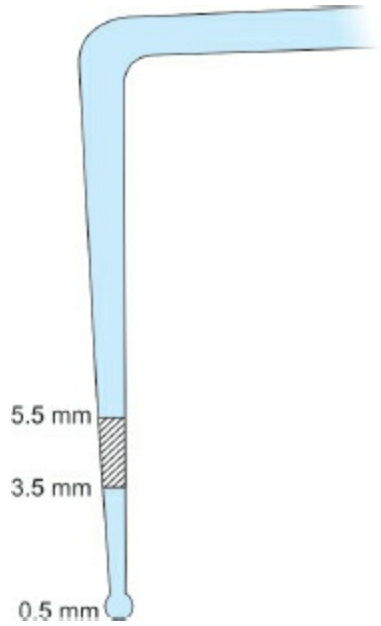


Fig. 12.5: CPITN—E probe

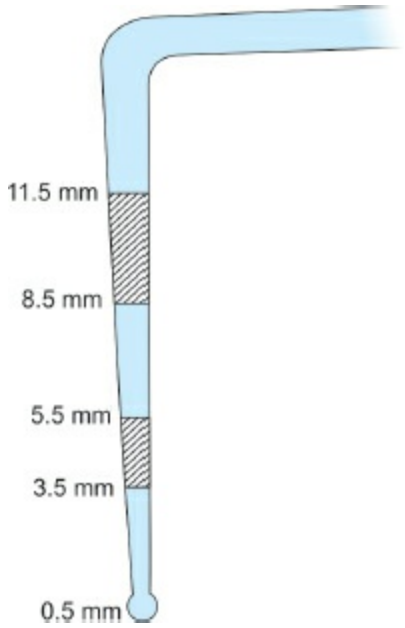


Fig. 12.6: CPITN—C probe

The first colour-coded band allows the operator to assess whether the probing depth is less than 3.5 mm, between 3.5 and 5.5 mm or in excess of 5.5 mm. These divisions divide periodontal pockets by depth, which helps in identifying different types of treatment needs.

Probing Procedure

A tooth is probed to determine pocket depth, to detect calculus and bleeding response.

Probing force is divided into: (i) a working component to determine pocket depth; and (ii) sensing component to determine the subgingival calculus and overhanging restorations. Use of standard force in probing is not more than 25 gm, since this amount of force is resisted by healthy epithelial attachment and it is sufficient to elicit bleeding from the area of inflammation.

When inserting the probe, into periodontal pocket, the ball point should follow the anatomic configuration of the root surface for sensing subgingival calculus. The probe is inserted between the tooth and the gingiva and the sulcus depth or pocket depth is sensed and read against the colour code or measuring lines. The direction of the probe should be in the same plane as the long axis of the tooth. The ball end should be kept in contact with the root surface. Pain to the patient during probing is an indication of a heavy sensing force.

A practical test for establishing the working force of not more than 25 gm is to gently insert the probe under the finger nail without causing pain or discomfort.

Recording Data

A box chart is recommended as the epidemiological and dual office chart for recording CPITN data.

17–14 13–23 24–27 47–44 43–33 34–37	16 11 26 46 31 36	17–16 11 26–27 47–46 31 36–37
Sextants	Index teeth for below 20 years	Index teeth for above 20 years

Assessing the Index

The index is used to detect the presence or absence of:

1. Bleeding on probing
2. Calculus or overhanging restorations
3. Periodontal pockets

In compiling this index, the teeth and their associated periodontal units are divided into six parts (sextants) and each sextant is given a score. All the surfaces of each standing tooth are examined and only the worst periodontal unit in each sextant is recorded. The six sextants are defined by tooth numbers—17–14, 13–23, 24–27, 37–34, 33–43, 44–47 (FDI nomenclature). The sextant is examined only if there are two or more teeth present and not indicated for extraction. When only one tooth remains in a sextant, it is included in the adjacent sextant.

Index Teeth

In epidemiological survey for adults aged 20 years and more, ten index teeth are examined. These teeth have been identified as the best estimators (WHO, 1984; Sivaneswaran, 1985) of the worst periodontal condition of the mouth.

The ten specified index teeth are:

17–16 11	26–27
47–46 31	36–37

The molars are examined in pairs and the highest score is recorded. Only one score is recorded from each sextant. For young people below 20 years, only six index teeth, 16, 11, 26, 36, 31, 46 are examined. The second molars are excluded because of high frequency of false pockets (non-inflammatory changes associated with tooth eruption). For screening and monitoring purposes, in adults over 19 years and above, highest score of any tooth in the sextant is recorded ignoring the lower scores.

In examination of children less than 15 years, pockets are not recorded although probing for bleeding and calculus is carried out in the same procedure.

Examination Procedure

The main aim is to determine the highest score for each sextant with minimal number of measurements. The requirement is that more than one functional tooth should be present. The tip of the CPITN probe is gently inserted between tooth and gingiva to the full depth of the sulcus or pocket and the probing depth is read by observation of the position of the black band. Recommended sites for probing are mesial, midline and distal on both facial and lingual/palatal surfaces.

The probing may be done by withdrawing the probe between each probing or alternatively with the probe tip remaining in the sulcus, the probe is ‘walked’ around the tooth.

Codes and Criteria (Table 12.11)

The appropriate code for each sextant is determined with respect to the following criteria.

***Code 4*:** Pathological pocket of 6 mm or more.
The coloured band of the CPITN probe is not visible.
If the designated tooth/teeth are found to have 6 mm or deep pockets in the sextant examined, and code 4 is given to the sextant, 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 to 5 mm that is, only a part of the coloured band is visible.
If the deepest pocket is between 4 and 5 mm found in a designated tooth/teeth and code 3 is given, there is no need for recording calculus or bleeding.

***Code 2*:** The whole of the coloured band of the probe is visible but supragingival or subgingival calculus or other plaque retentive factors such as ill fitting crowns or defective margin of a filling are either seen or felt during probing.
If no pockets which involve or exceed the coloured area of the CPITN probe, but supra- or subgingival calculus or other plaque retentive factors are detected, and code 2 is given, it is not necessary to examine for gingival bleeding.

***Code 1*:** Bleeding present.

***Code 0*:** Healthy tissues.

***Code X*:** When only one tooth or no teeth are present in a sextant (third molars are excluded unless they function in a place of second molars).

Treatment Needs

CPITN assess only those conditions potentially responsive to treatment. It does not analyse non-treatable or irreversible conditions like recession, attachment level. The term ‘treatment need’ is intended as a guide to the level of need for care using accepted periodontal criteria. It provides as indication of the nature of treatment needed to improve periodontal health. This can be used for a community, as a comprehensive programme of periodontal disease control and preventive measures.

Classification of Treatment Needs

The population groups or individuals are divided into appropriate treatment need (TN) category depending upon the severity of periodontal disease.

***TN-0*:**	No treatment When there is a recording of code 0 (health) or X (missing) for all six sextants.
***TN-1*:**	Improvement of personal oral hygiene. When there is a recording of a code of 1 or higher.
***TN-2*:**	Professional scaling and removal of plaque retentive factors and oral hygiene instruction. When there is a recording of a code of 2 or higher.
***TN-3*:**	Complex treatment which can involve deep scaling, root planing and complex procedures. When there is a recording of code 4.

The advantages of CPITN are that it is a simple and rapid recording system with international uniformity. Its limitations are partial recording, exclusion of important signs of past periodontal disease, e.g. attachment loss and it does not record any marker of disease activity. However, CPITN procedure provides an overview of the magnitude of periodontal health of the population.

MOBILITY INDEX

It was given by Miller PD in the year 1985.[10]

All teeth have a slight degree of physiologic mobility, which varies for different teeth and at different times of the day. Single-rooted teeth have more mobility than multi-rooted teeth, with incisors having the most.[3]

Tooth Examined

All the teeth are examined.

Procedure

The tooth is held firmly between the handles of two metallic instruments or with one metallic instrument and one finger and an effort is made to move it in all directions, abnormal mobility most often occurs faciolingually.

Scoring Criteria

***Class I*:** The tooth can be moved less than 1 mm in a buccolingual direction.

***Class II*:** The tooth can be moved 1 mm or more in a buccolingual direction, but does not exhibit abnormal mobility in an occlusoapical direction.

***Class III*:** The tooth can be moved bucco-lingually and occlusoapically.

DECAYED-MISSING-FILLED INDEX (DMF INDEX)

The Decayed-Missing-Filled Index was introduced by Henry T Klein, Carrole. E Palmer and Knutson JW in 1938.[11]

DMF index is the most universally employed index for measuring dental caries.

This index is based on the fact that the dental hard tissues are not self-healing, established caries leaves a scar of some sort. The tooth either remains decayed, or if treated it is extracted or it is filled. The DMFT index is, therefore, an irreversible index, meaning that it measures total lifetime caries experience.

Method

The DMF Index is applied only to permanent teeth. As described by the authors,

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.

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, 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.

Instruments Used

- Mouth mirror
- Explorer

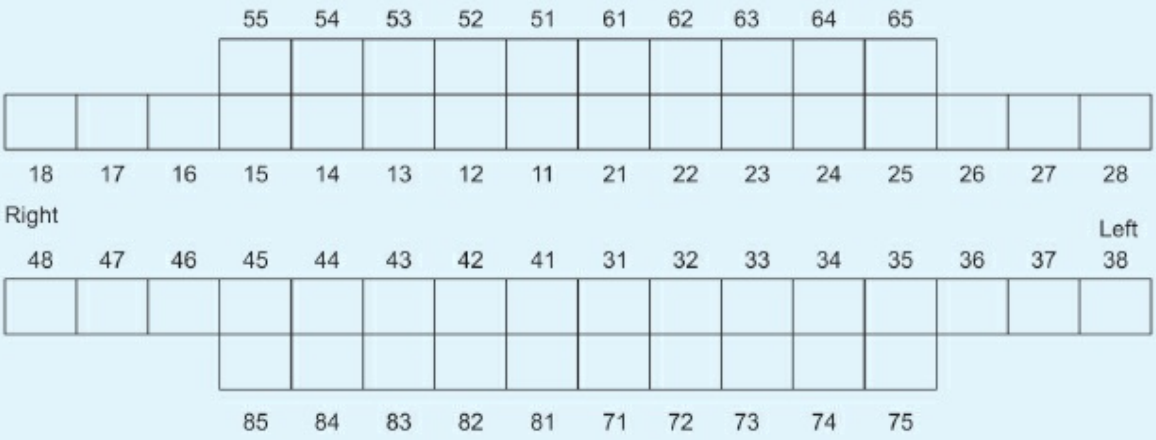
Criteria for Identification of Dental Caries

1. The lesion is clinically visible and obvious.
2. The explorer tip can penetrate deep into soft yielding material.
3. There is discolouration or loss of translucency typical of undermined or demineralized enamel.
4. 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 (Table 12.12)

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 DMFT 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.
    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 DMFT 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.

Table 12.12: Recording form dental caries missing and filled teeth index(DMFT)



DMFT

D=

M=

F=

DMFT=

Examination Method for DMFT (Permanent Teeth Only)

***'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 described, count it as decayed. Be sure the explorer falls into 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. Possible histories should be taken when it is suspected that teeth have been lost for reasons other than caries.

***'F'—Filled*:** Indicates the numbers of permanent teeth that have been attacked by caries, due to 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.

Calculation of the Index

a. ***Individual DMFT*:** Total each component, i.e. D, M and F separately, then total D + M + F = DMFT

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. For example,

Average DMFT

$$= \frac{\text{Total DMFT}}{\text{Total number of subjects examined}}$$

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.

For an individual, the individual component of the DMFT carry meaning. Whereas in a larger population, the cumulative value of dental caries when used to compare larger population. The DT represents present caries experience and MT and FT represents past caries experience.

Patient number	*DT*	*MT*	*FT*	*DMFT*
1	7	0	0	7
2	0	7	0	7
3	0	0	7	7

The DMFT value in all the three case here is 7. But looking at the caries status of each individual is different. In patient no. 1, the decay is 7 whereas there is no filled or missing component suggesting that he is ignorant about dental caries occurrence and treatment. Patient no 2 suggests that he is aware of dental caries and find that tooth extraction is the only possible treatment available. It is usually difficult to convince the patient to avail other treatment options. The third patient is the most aware patient and is easy to handle as he is well aware of the dental caries occurrence consequences and importance of teeth. Hence the DMFT index is used as an aid to understand the attitude of the patient

DECAYED-MISSING-FILLED-SURFACE (DMFS) INDEX

The Decayed-Missing-Filled Surface Index was introduced by Henry T Klein, Carrole. E Palmer and Knutson JW in 1938.[11]

When the DMFT index is employed to assess each individual surface of each tooth, it is termed as “Decayed-Missing-Filled-Surface Index” (DMFS Index).

The principles, rules and criteria for DMFS Index are the same as that of DMFT Index, which are described previously along with description of DMFT index. The only difference here, is that the surfaces are examined.

Surfaces Examined

1. ***Posterior teeth*:** Each tooth has five surfaces examined and recorded—facial, lingual, mesial, distal and occlusal.
2. ***Anterior teeth*:** Each tooth has four surfaces for evaluation—facial, lingual, mesial and distal.

Total Surface Count

If 28 teeth are examined

(i.e. third molars are excluded)

16 posterior teeth (16 × 5) = 80 surfaces

12 anterior teeth (12 × 4) = 48 surfaces

Total = 128 surfaces

If third molars are included (4 × 5)

= 20 surfaces

Total = 148 surfaces

Calculation of Index (Table 12.13)

Individual DMFS

Total number of decayed surfaces = DS

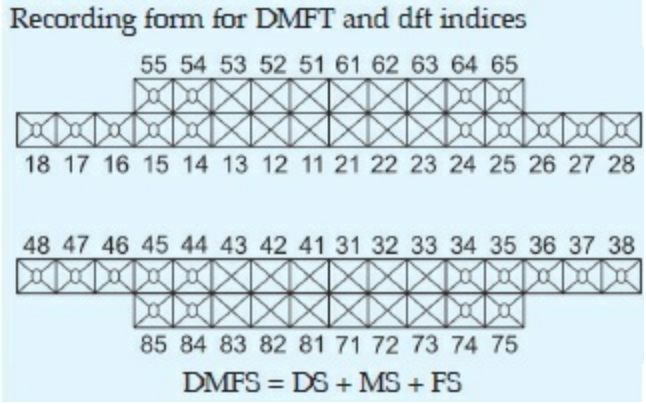
Total number of missing surfaces = MS

Total number of filled surfaces = FS

DMFS score = DS + MS + FS

The DMFS index is more sensitive and is usually the index of choice in a clinical trial of a caries preventive agent. This is because relative incidence is more likely to be detected over the limited time period of a clinical trial. But a DMFS examination takes longer, is more likely to produce inconsistencies in diagnosis and may require the use of radiographs to be fully accurate.

Table 12.13: Recording form dental caries missing and filled teeth index (DMFS)



SIC Index

Caries situation in many countries show that there is a skewed distribution of caries prevalence—meaning that a proportion of 12-year-old still has high or even very high DMFT values even though a proportion is totally caries free. Clearly, the mean DMFT value does not accurately reflect this skewed distribution leading to incorrect conclusion that the caries situation for the whole population is controlled while in reality several individuals still have caries. A new index, the *Significant Caries Index* was introduced by Bratthall. J in the year 2000[13] in order to bring attention to the individuals with the highest caries values in each population under investigation.

The significant caries index is calculated as follows: Individuals are sorted according to their DMFT values.

One-third of the population with the highest caries scores is selected.

The mean DMFT for this subgroup is calculated. This value is the SiC index.

CARIES INDICES FOR PRIMARY DENTITION

dft Index

This is the method of choice for World Health Organization[12] in their basic survey techniques. Here to prevent the confusion that arise dues to exfoliation the missing teeth are ignored. The ‘dft’ index can be applied to the whole tooth as the decayed-filled-tooth (‘dft’ index) or the individual surfaces as the decayed-filled-surfaces (‘dfs’ index).

Classification	***Criteria***
Normal (0)	The enamel represents the usual translucent semivitriform type of structure. The surface is smooth, glossy and usually of a pale, creamy white colour.
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 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.

DEAN’S FLUOROSIS INDEX

An index for assessment of dental fluorosis was introduced by Trendley H Dean in 1934[14]—known as ‘Dean’s classification system for dental fluorosis’ or ‘Dean’s fluorosis index’.

This classification system is the most widely adopted system for classifying dental fluorosis in use since 1942.

Calculation

The recording is made on the basis of the two teeth that are most affected (Table 12.14). If the two teeth are not equally affected, the score for the less affected of the two should be recorded.

Table 12.14: Recording form Dean's fluorosis index

18	17	23	16	24	15	25	14	26	13	27	12	28	11	21	22
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38

COMMUNITY FLUOROSIS INDEX (CFI)

To determine the severity of dental fluorosis as a public health problem, Trendley H Dean in 1935[15] 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).[6]

CFI numerical statistical values (weights) as a score for each degree of mottling. Each individual is allotted a score according to the following scale:

Fluorosis category	***Numerical weight***
Normal	0
Questionable	0.5
Very mild	1
Mild	2
Moderate	3
Severe	4

The score assigned to an individual is the one which corresponds to the two most severely affected teeth in the mouth.

On the basis of the number and distribution of the individual scores, a community index of dental fluorosis (CFI) can be calculated (Dean 1942) using the formula.

Range of scores for community fluorosis index	***Public health significance***
0.0–0.4	Negative
0.4–0.5	Borderline
0.5–1.0	Slight
1.0–2.0	Medium
2.0–3.0	Marked
3.0–4.0	Very marked

$$CFI = \frac{\text{Sum of (Number of individuals} \times \text{statistical weight)}}{\text{Number of individuals examined}}$$

In 1946, Dean HT related the numerical scale of CFI to what he defined as the ‘Public Health Significance of Community Fluorosis Index Scores’, which is as follows:

‘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.

Limitations

Clarkson summarizes as follows:

1. Since the index is based on the two most severely affected teeth, it does not allow for measurement of other teeth.
2. Gives no indication of the extent of defects or the tooth surfaces affected.
3. The use of the term “questionable” is too vague.
4. The index appears to describe the milder forms of fluorosis accurately, but is not sensitive enough to differentiate between fluorosis in high-fluoride areas.
5. The statistical basis for using the authentic mean to calculate the CFI is questionable. Further the classification is based on an ordinal and not an interval scale.
6. The CFI, because of its method of calculation, may not give a true reflection of the severity of fluorosis within a community.

ANGLE'S SYSTEM OF CLASSIFICATION

Edward Angle introduced a system of classifying malocclusion in the year 1899.[16] 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.

Angle classified malocclusion into the following broad categories

Class I

Class II

- Division 1
- Division 2

Class III

Angle’s Class I

The mesiobuccal 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.

Angle’s Class II

The distobuccal 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—division 1 and division 2.

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”.

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.

Class II, Sub-division

When a Class II molar relation exists on one side and a Class I relation on the other side, it is referred to as Class II, sub-division. Based on whether it is a division 1 or division 2 it can be called Class I, division 2, sub-division or Class II, division 2, sub-division.

Angle’s Class III

This malocclusion exhibits a Class III molar relation with the mesiobuccal 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 pseudoClass 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.

Patients can present with a normal overjet, an edge-to-edge incisor relation or an anterior crossbite.

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.

Class III, Sub-division

This is a condition characterized by a Class III molar relation on one side and a Class I relation on the other side.

Drawbacks of Angle's Classification

a. Angle considered malocclusion only in the anteroposterior plane. He did not consider malocclusions in the transverse and vertical planes.

b. Angle considered the first permanent molars as fixed points in the skull. But this is not found to be so.

c. The classification cannot be applied, if the first permanent molars are extracted or missing.

d. The classification cannot be applied to the deciduous dentition.

e. The classification does not differentiate between skeletal and dental malocclusions.

f. The classification does not highlight the aetiology of malocclusion. Individual tooth malpositions have not been considered by Angle.

Index of Orthodontic Treatment Need (IOTN)

The Index of Orthodontic Treatment Need (IOTN) was developed by Shaw, Richmond and O'Brien at Manchester Dental School in the 1990s.[17] They were based on a number of existing orthodontic indices. Since then the UK National Health survey (NHS) has introduced their use to limit access to orthodontic care.

IOTN has two components: Dental Health Component (DHC) and Aesthetic Component (AC). In the NHS, patients must score IOTN 4 or 5 for treatment. In patients with IOTN 3, the aesthetic component is applied, those patients with an IOTN DHC score of 3 and an IOTN AC score of 6 or greater, qualify for treatment.

The dental health component (DHC) has 5 grades:

IOTN 1	Almost perfection
IOTN 2	Minor irregularities
IOTN 3	Greater irregularities which normally do not need treatment for health reasons
IOTN 4	More severe degrees of irregularity and these do require treatment for health reasons
IOTN 5	Severe dental health problems

Grade 1: No treatment need

1. Extremely minor malocclusion with contact point displacements of less than 1 mm.

Grade 2: Minor anomaly, no treatment need

a. Overjet >3.5 mm and ≤6 mm (with competent lip closing)

b. Reverse overjet between 0 and ≤1 mm

c. Anterior or posterior crossbite with 1 mm discrepancy between RCP and ICP

d. Contact point displacements >1 mm and ≤2 mm

e. Anterior or posterior open bite >1 mm and ≤2 mm

f. Increased overbite of ≥3.5 mm (without gingival contact)

g. Class II or class III occlusion without other anomalies (up to half a premolar width).

Grade 3: Borderline treatment need

a. Overjet >3.5 mm and ≤6 mm (incompetent lip closing)

b. Reverse overjet between 1 and ≤3.5 mm

c. Anterior or posterior crossbite with > 1 mm and ≤2 mm discrepancy between RCP and ICP

d. Contact point displacements >2 mm and ≤4 mm

e. Lateral or anterior open bite >2 mm and ≤4 mm

f. Deep overbite with gingival contact or contact with palatal mucosa (but without trauma).

Grade 4: Treatment need

a. Overjet >6 mm and ≤9 mm

b. Reverse overjet >3.5 mm (without masticatory or speech problems)

c. Anterior or posterior crossbite with >2 mm discrepancy between RCP and ICP segments

d. Major contact point displacements >4 mm

e. Extreme lateral or anterior open bite >4 mm

f. Increased and complete overbite with gingival or palatal trauma

g. Less severe hypodontia requiring prerestorative orthodontics or orthodontic space closure to obviate the need for prosthetic restoration

h. Posterior lingual crossbite with no functional occlusal contact in one or both buccal

i. Partially erupted teeth, tipped and impacted against adjacent teeth

j. Existence of supernumerary teeth.

Grade 5: Treatment need

a. Impeded tooth eruption (3^{rd} molars) attributable to crowding, displacements, supernumerary teeth, retained deciduous teeth and all pathological reasons

b. Extensive hypodontia with restorative impact (more than 1 congenitally missing tooth in any quadrant) requiring prerestorative orthodontics

c. Increased overjet >9 mm

d. Reverse overjet >3.5 mm with masticatory problems and speech disorders

e. Cleft lip and palate and other craniofacial anomalies

f. Retained deciduous teeth

DENTAL AESTHETIC INDEX

The Dental Aesthetic Index (DAI), developed in the United States of America[18] and integrated into the International Collaboration Study of Oral Health Outcomes by the World Health Organization (WHO, 1989) as an international index, identifies occlusal traits and mathematically derives a single score (Table 12.15).

Table 12.15: Standard dental aesthetic index scoring

	DAI component	***Rounded weight***
1.	Number of missing visible teeth (incisors, canines, and premolars in maxillary and mandibular arch)	6
2.	Crowding in incisal segment (0 = no segments crowded, 1 = 1 segment crowded, 2 = 2 segments crowded)	1
3.	Spacing in incisal segment (0 = no spacing, 1 = 1 segment spaced, 2 = 2 segments spaced)	1
4.	Midline diastema, in millimetres	3
5.	Largest anterior maxillary irregularity, in millimetres	1
6.	Largest anterior mandibular irregularity, in millimetres	1
7.	Anterior maxillary overjet, in milimetres	2
8.	Anterior mandibular overjet, in millimetres	4
9.	Vertical anterior openbite, in millimetres	4
10.	Anteroposterior molar relationship, largest deviation from normal either left or right (0 = normal, 1 = ½ cusp mesial or distal, 2 = 1 full cusp or more mesial or distal)	3
11.	Constant	13

Total	DAI score

CLASSIFICATION AND STAGING OF MOUTH CANCER AND JAW TUMOURS

A universally acceptable classification system for cancer of the oral cavity is essential for clinical research and prognostic determination. The aim of such a classification is to obtain homogeneous statistically equivalent groups of patients or the purpose of assessing evaluating and comparing various therapeutic approaches. Another equally important purpose is the comparison of the efficacy of any given method of treatment in patients attending different hospitals.

The first acceptable classification for squamous tumours was developed by Pierre Denoix, between 1943 and 1952[18] based on extent of the primary tumour (T) the regional node (N) status and the presence or absence of distant metastases (M). This TNM classification has been the basis for all later systems.The development of a new classification and staging is proposed by JD Langdon.

Definition

TNM classification is a clinical classification and as such the information provided is entirely dependent upon the personal experience on opinions and skills of the examining clinician.

This was achieved by recording the size and degree of infiltration of the primary tumour (T) the presence and condition of the associated regional lymph nodes (N) and the presence or absence of distant metastases (M). When carefully evaluated, these variables should give an indication of the prognosis and help the clinician in the choice of treatment.

Need for Classification

Before the start of treatment for a patient with oral cancer; the patient's disease must be carefully evaluated.

Clinical assessment includes an exhaustive history, physical examination and laboratory and radiological studies, the purposes of which are to determine the extent of the tumour and the presence or absence of demonstrable regional lymph nodes or distant metastases. Every tumour should be biopsied and a histo-pathological diagnosis must be determined before the initiation of treatment. Because cancers arising from different sites in the oral cavity have distinctive clinical features, courses and prognosis, an individual therapeutic approach must be tailored for each patient.

The many therapeutic strategies that have been used in cancer of the head and neck suggest that a universally applicable form of treatment for a particular tumour in a specific stage of advancement in an individual patient is entirely dependent upon a meaningful comparison of the end results of similar cases reported from different centres. For these reasons, a classification system is essential, at present an ideal system does not exist.

Every classification system has the same basic concept of grouping together homogeneous and comparable elements for subsequent analysis. For reporting purposes, it is desirable to group together those permutations of T, N and M for which there is a similar survival rate. The prime purpose of such staging is to determine what forms of treatment will most favourably alter the natural course of the disease and any staging procedure must correlate with the actual survival of the patients.

The coordination of the data with particular clinical observation that patients with less extensive primary tumours have a longer survival time than those with extensive tumours.

In the most recent Union Internationale Centre le Cancer (UICC) TNM classification, two classifications are described for each tumour:

1. Pretreatment clinical classification (cTNM). This is based on evidence acquired prior to the decision as to definitive treatment. Such evidence arises from clinical, radiological and other investigations.
2. Postsurgical histopathological classification (pTNH). This is based on the evidence given in point 1 above supplemented by the surgical

findings and the examination of the therapeutically resected specimen. This predisposes that all treatment will be surgical. As applied to the oral cavity, the TNM pretreatment classification is as follows:

T: Primary tumour

TX: Primary tumour cannot be assessed

TO: No evidence of primary tumour

TIS: Preinvasive carcinoma (carcinoma-in situ)

T1: Tumour 2 cm or less in its greater dimension

T2: Tumour more than 2 cm but no more than 4 cm in its greatest dimension.

T3: Tumour more than 4 cm in its greatest dimension.

T4: Tumour invades adjacent structures, e.g. through cortical bone, into deep (extrinsic) muscles of tongue, maxillary sinus, skin.

N: Regional lymph nodes

NX: Regional lymph nodes cannot be assessed

NO: No regional lymph node metastasis

N1: Metastasis in a single ipsilateral lymph node 3 cm or less in its greatest dimension

N2: Metastasis in a single ipsilateral lymph node more than 3 cm but not more than 6 cm or in multiple ipsilateral lymph nodes, none more than 6 cm in its greatest dimension.

N2a: Metastasis in a single ipsilateral lymph node more than 3 cm but not more than 6 cm in its greatest dimension. N2b: Metastasis in multiple ipsilateral lymph nodes, none more than 6 cm in its greatest diinension.

N2c: Metastasis in bilateral or contralateral lymph nodes, none more than 6 cm in its greatest dimension.

N3: Metastasis in a lymph node more than 6 cm in its greatest dimension.

M: Distant metastasis MX: Presence of distant metastasis cannot be assessed.

MO: No distant metastases

Hl: Distant metastases

The postsurgical histopathological classification uses the same categories for pT, pN and pM.

In addition, a histopathological grading (G) has now been introduced:

GX: Grade of differentiation cannot be assessed

Gl: Well differentiated

G2: Moderately differentiated

G3: Poorly differentiated

The absence or presence of residual tumour after treatment is described by the symbol R:

RX: Presence of residual tumour cannot be assessed

RO: No residual tumour

Rl: Microscopic residual tumour

R2: Macroscopic residual tumour

The stage grouping in his current UICC classification is as follows:

Stage 0	TIS	NO	MO
Stage I	Tl	NO	HO
Stage II	T2	NO	MO
Stage III	T3	NO	HO
			T1,T2,T3
Stage IV	T4	NO, N1	HO
	Any T	N2, N3	MO
	Any T	Any N	H1

No account is taken of histopathological grading. This most recent UICC-TNM classification, although a development of earlier systems, has now become so complicated that its value is in doubt. Many of the specific criteria are confusing. For example, no importance is attached to fixation of lymph nodes.

Carcinomatous deposits in the regional lymph nodes from the primary lesion commonly occur in patients with oral cancer. Successful treatment of such spread requires a knowledge of lymphatic drainage and an awareness of the difficulties in the clinical assessment of the regional nodes. Considerable

difficulty arises in making a clinical distinction between those palpable nodes considered to contain near lesser and those considered to be enlarged due to reactionary hyperplasia or secondary infection.

Staging

All graduations of prognosis can be demonstrated by grouping the patients on the basis of the size of the primary tumour (T), the presence or absence of involved nodes (N) and the presence or absence of distant metastases (M) into groups with a similar survival rate.

The prime purpose of staining is that by knowing the prognosis, appropriate treatment can be selected which will most favourably alter the natural course of the disease. Any staging procedure must correlate with a reasonable spread of survival data.

WHO ASSESSMENT FORM[20]

Basic oral health surveys provide a sound basis for assessing the current oral health status of a population and its future needs for oral health care. The World Health Organization (WHO) has a long tradition of epidemiological survey methodology, which includes a description of the diagnostic criteria that can be readily understood and applied in public health programmes worldwide. Guidelines have been elaborated for practical and economical sample designs suitable for recording the prevalence of oral diseases required for planning oral health programmes. The World Health Organization (WHO) has a long tradition of epidemiological survey methodology and surveillance in oral health. Ever since 1971, the oral health assessment form has been the gold standard for recording and surveillance. The last updated version of 2013 is now in current use. The standard oral health assessment form for adults includes the following sections:

- Survey identification information
- General information
- Extraoral conditions
- Dentition status (crown, root)
- Periodontal status
- Loss of attachment
- Enamel fluorosis
- Dental erosion
- Dental trauma
- Oral mucosal lesions
- Denture status (fixed or removable dentures)
- Intervention urgency and need for referral notes.

The corresponding standard oral health assessment form for children includes the following sections:

- Survey identification
- General information

- Dentition status
- Gingival status
- Enamel fluorosis
- Dental erosion
- Dental trauma
- Oral mucosal lesions
- Intervention
- Urgency.

With regard to oral mucosal lesions, if the sample consists only of children, a decision may be made to record only those lesions that are frequently observed in children rather than all the lesions that may occur in adults. It is strongly recommended that the appropriate form is used when surveying children or adults.

Identification and General Information Sections

The investigator should write the name of the country in which the survey is being 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 will be carried out and should not be filled in by the investigator.

Essential information includes year, month and day of examination (Boxes 5–10). The identification number is the unique identifier for the individual person under examination (Boxes 11–14); codes are also given to indicate whether the examination is the original or duplicate examination (Box 15) and by the individual examiner responsible for the examination (Boxes 16 and 17).

In the general information section, the following points are recorded—the name (write-in response if permissible to record), sex (Box 18), date of birth (Boxes 19–24), age (Boxes 25 and 26), ethnic group (Boxes 27 and 28), other group (Boxes 29 and 30), years attended school (Boxes 31 and 32), occupation (Box 33), geographical location/community (Boxes 34 and 35), type of location (Box 36), and other survey specific data (Boxes 37–42). Findings from the extraoral examination are recorded in Boxes 43 and 44.

Date of Examination (Boxes 5–10)

The year, month and day should be recorded on the form at the time of examination. Recording the day enables an investigator to refer back to examinations held on any particular day which 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 1200 subjects, the first subject should be numbered 0001.

If possible, the identification numbers should be entered on the forms before commencing the examinations for the day, because it is important to ensure that each identification number is used only once. Cross-checking is

necessary when more than one examiner is participating in a survey. If a total of 1200 subjects are to be surveyed by two examiners, examiner 1 should use the numbers 0001–0600 and examiner 2 should use 0601–1200.

Original or Duplication Examination (Box 15)

If the subject will be re-examined to assess reproducibility, the first (original) examination is scored "1" and any subsequent, duplication examinations are coded "2", "3", "4", etc. in Box 15. For all subjects for whom duplicate examinations have been made, data from the first examination only are included in the survey analysis. To assess intraexaminer reproducibility, the first (original) examination is coded "1" and the second examination performed by the same examiner is coded "2". When the findings of the survey are analysed, the level of intra-examiner reproducibility, denoted by the percentage of agreement and the kappa statistic, can be calculated and reported. It is important that the method selected is clearly explained to avoid misinterpretations in data entry.

Examiner (Boxes 16 and 17)

If more than one examiner is participating in the survey, each examiner should be assigned a specific code, which should be entered in Boxes 16 and 17. If a validating examiner is participating in the survey, he or she should also be assigned a specific code.

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.

Sex (Box 18)

This information should be recorded at the time of examination because it is not always possible to tell a person's sex from the name alone (which may or may not be recorded). The relevant code (1 = male, 2 = female) is entered in Box 18.

Date *of Birth (Boxes 19–24)*

Where possible, the year (Boxes 19 and 20), month (Boxes 21 and 22), and day of birth (Boxes 23 and 24) should be entered for crosschecking purposes.

Age (Boxes 25 and 26)

Age should be recorded as age at last birthday (e.g. a child in the thirteenth year of life is 12 years old). If the age is less than 10 years, enter "0" in Box 25 (e.g. 6 years is coded as "06"). In communities where age is expressed in different terms, a conversion must be made. If the age of the subject is not known, it may be necessary to make an estimate on the basis of, for instance, status of tooth eruption or, for adults, major life events or occasions in the community. Where age has been estimated, the manner of estimation should be reported.

Ethnic Group (Boxes 27 and 28)

In different countries, ethnic and other groups are identified in different ways, by area or country of origin, race, colour, language, religion or tribal membership. Local health and education authorities should be consulted before making a decision about the relevant ethnic group classification/coding scheme to be used.

More than 10 ethnic groups may officially exist in a country; therefore, a two-digit entry code should be used. Since it is often not possible to identify a person's ethnic origin from their name alone, ethnic group information must be recorded at the time of the examination from information provided by the subject/parent. In some countries, information on ethnicity may be obtained from government agencies or school administrative data at the time of sample selection.

Other Group (Boxes 29 and 30)

Codes may be used to identify different subpopulation groups.

Number of Years in School (Boxes 31 and 32)

This information is useful for assessment of the level of education, which is important factor in the analysis of oral health. In children, the boxes may be used for recording the school grade achieved by a child.

Occupation (Box 33)

A coding system should be devised according to local usage to identify different occupations and the appropriate code entered.

Community—Geographical Location (Boxes 34 and 35)

In these surveys, using codes to identify schools as part of the survey is important since the information obtained on oral health status can be used for planning strategies applicable to specific age groups in a particular school. Once the schools have been selected, the codes can be designated.

Boxes 34 and 35 should be used to record the site where the examination is being conducted. This allows geographical locations (villages, etc.) to be identified (01–98). A list giving each location and its code number should be prepared. Usually, just a few codes are needed. The code "99" should be entered, if this information is not recorded.

Community information is very useful for health administrators for planning or revising programmes or strategies. If samples of drinking water are collected during the survey, the name of the community will be essential in mapping of fluoride in drinking water supplies and determining whether the concentration is below, at or above optimal levels.

Location Type (Box 36)

The rationale for including these data is to obtain general information about local environmental conditions and the availability of services at each site. Three codes are used:

1. Urban site.
2. *Periurban area*: This has been included in order to indicate areas surrounding major towns that may have characteristics similar to those of rural areas, with very few health facilities of any kind and usually with no or limited access to oral healthcare facilities.
3. Rural area or small village.

Other Data (Boxes 37–42)

Fields are provided for entering a two-digit code for up to three conditions or

data to be recorded. Conditions and codes must be agreed prior to commencing the survey. These fields have been provided for recording other information about the subjects examined or the survey location. Information such as exposure to a specific oral health programme, use of tobacco or chewing sticks, refugee status, socioeconomic status, physical environment, and level of fluoride in drinking water can be recorded here; if sugar intake was of interest, a coding system could be designed by the investigator whereby the amount and frequency of intake were given suitable codes.

Additionally, two boxes are reserved for recording any abnormality identified by the examiner during extraoral examination of the orofacial complex.

Clinical Examination (Boxes 43 and 44)

The oral cavity is part of the orofacial complex and examiners should record any evident abnormality of the tissues of the face, nose, cheek or chin. The condition and its location are recorded using the following recommended codes.

Condition (Box 43)

0 = Normal

1 = Ulceration, sores

2 = Erosions

3 = Fissures

4 = Cancrum oris

5 = Enlarged lymph nodes

6 = Any other abnormalities 9 = Not recorded

Location (Box 44)

1 = Face

2 = Neck

3 = Nose

4 = Cheeks

5 = Chin

6 = Commissures

7 = Vermillion border

8 = Jaws

Dentition Status

(Boxes 45–108 in the Oral Health Assessment Form for Adults and 45–72 in the Oral Health Assessment Form for Children)

The examination for dental caries should be conducted with a plane mouth mirror. The use of radiography for detection of approximal caries is not recommended because the equipment is impractical to utilize in most field situations. Likewise, the use of fibreoptics is not recommended. Although it is recognized that both these diagnostic aids reduce the underestimation of dental caries, logistical complications and frequent objections on the part of subjects to exposure to radiation outweigh any potential gains.

Examiners should adopt a systematic approach to the assessment of the dentition status, bearing the following points in mind: The examination should proceed in an orderly manner from 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.

Permanent dentition status (crown and roots) is recorded using numbered scores and the primary dentition status is recorded using letter in the same boxes. Boxes 45–76 are used for upper teeth and Boxes 77–108 for lower teeth. The corresponding boxes for the Oral Health Assessment

Forms for Children are Boxes 45–58 and 59–72.

An entry must be made in every box pertaining to the coronal and root status of a tooth. In children, root status is not assessed; therefore the corresponding boxes have been omitted in the Oral Health Assessment Form for Children.

Considerable care should be taken to identify tooth-coloured fillings, which may be extremely difficult to detect (Table 12.16).

Table 12.16: Coding the dentition status—primary and permanent teeth

Code			Condition/status
Primary teeth	*Permanent teeth*		
Crown	*Crown*	*Root*	
A	0	0	Sound
B	1	1	Caries
C	2	2	Filled, with caries
D	3	3	Filled, no caries
E	4	—	Missing due to caries
—	5	—	Missing for any other reason
F	6	—	Fissure sealant
G	7	7	Fixed dental prosthesis abutment, special crown or veneer/implant
—	8	8	Unerupted tooth (crown)/unexposed root
—	9	9	Not recorded

The criteria for diagnosing a tooth status and the coding are as follows (codes applied to primary teeth are given in parentheses):

0 (A) *Sound crown*. A crown is coded as sound, if it shows no evidence of treated or untreated clinical caries (*see* Plate 1, code

A, and Plate 6, code 0). 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 identified in most field conditions in which epidemiological surveys are conducted. Thus, a crown with the following defects, in the absence of other positive criteria, should be coded as sound:

- White or chalky spots; discoloured or rough spots that are not soft to touch with a metal CPI probe;
- Stained enamel pits or fissures that do not have visible cavitation 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 enamel fluorosis;
- Lesions that, on the basis of their distribution or history, or on examination, appear to be due to abrasion.

Sound root. A root is recorded as sound when it is exposed and shows

no evidence of treated or untreated clinical caries.

1(B) *Carious 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. A tooth with a temporary filling, or one which is sealed 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 in the crown and is, therefore, scored as crown caries only. The CPI probe should be used to confirm visual evidence of caries on the tooth surface(s). Where any doubt exists, caries should not be recorded as present. *Carious root*. Caries is recorded as present when a lesion feels soft or leathery on probing with the CPI probe. If the carious lesion on the root does not involve the crown, it should be recorded as root caries. For single carious lesions affecting both the crown and the root, the likely site of origin of the lesion should be recorded as the decayed site. When it is not possible to identify the site of origin, both the crown and the root should be coded as decayed. In general, root caries is not recorded for children and in youth or young adults.

2(C) *Filled crown, with caries*. A crown 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 and the same code applies regardless of whether the carious lesions are in contact with the restoration(s).

Filled root, with caries. A root is considered filled, with caries, 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 restorations involving both the crown and the root, identification 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 identify the site of origin of the primary carious lesion, both the crown and the root should be coded as filled, with caries.

3(D) *Filled crown, with no caries*. A crown is considered filled, without caries, 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 caries by means of a fixed dental prosthesis abutment is coded.

7(G) *Filled root, with no caries*. A root is considered filled, without caries, when one or more permanent restorations are present and there is no caries anywhere on the root. In the case of fillings involving both the crown and the root, identification of the site of 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 identify the site of origin, both the crown and the root should be coded as filled.

4(E) *Missing tooth, due to caries*. This code is used for permanent or primary teeth that have been extracted because of caries and are 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 (codes 4 or 5). Basic knowledge of tooth eruption patterns, the appearance of the 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 deciding whether a tooth is unerupted or has been extracted. Code 4 should not be used for teeth deemed to be missing for any reason other than caries. For convenience, in fully edentulous arches, a single "4" should be placed in Boxes 45 and 60; and 77–92, as appropriate, and the respective pairs of numbers linked with straight lines. Such procedure may also be applied where the record form for registration at tooth surface level is used.

5(–) *Permanent tooth missing due to any other reason*. This code is used for permanent teeth deemed 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, in pits or for teeth in which the occlusal fissure has been enlarged with a rounded or "flameshaped" bur, and a composite material placed. If a tooth with a sealant has caries, it should be coded as 1 or B.

7(G) *Fixed dental prosthesis abutment, special crown or veneer*. This code is used under coronal status to indicate that a tooth forms part of a fixed 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 fixed partial denture pontics are coded 4 or 5 under coronal status, while root status is scored 9*. This code is used under root status to indicate that an implant has been placed as an abutment.

8(–) *Unerupted tooth (crown)*. This classification is restricted to permanent teeth and used only for a tooth space with an unerupted permanent tooth but no 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; there is no gingival recession beyond the cemento-enamel junction (CEJ).

9(–) *Not recorded*. This code is used for an erupted permanent tooth that cannot be examined for any reason such as 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 root examination is not possible.

Dental Caries Indices: Tooth (DMFT, dmft) and Surface (DMFS, dmfs) Levels

Information on the Decayed, Missing and Filled Teeth Index (DMFT) can be derived directly from the data in Boxes 45–76 and 77–108. The D component includes all teeth with codes 1 or 2. The M component comprises teeth coded 4 in subjects under 30 years of age, and teeth coded 4 or 5 in subjects 30 years and older, i.e. missing due to caries or for any other reason. The F component includes teeth only with code 3. The basis for DMFT calculations is 32 teeth, i.e. all permanent teeth including wisdom teeth. Teeth coded 6 (fissure sealant) or 7 (fixed dental prosthesis/bridge abutment, special crown or veneer/implant) are not included in calculations of the DMFT index. In the case of the primary teeth, the calculation of the dmft index is similar, i.e. by deriving information from data codes A, B, C and D and E in the oral health assessment form.

When a survey is undertaken for a particular purpose, e.g. evaluation of a disease prevention programme, planners may wish to record dentition status by tooth surface and to calculate the DMFS and dmfs indices.

A DMFT index applicable to roots can easily be calculated as data for each tooth are collected during examination; this index is especially relevant in older population groups.

Periodontal Status: Community Periodontal Index (CPI) Modified

Two indicators of periodontal status are used for this assessment: Gingival bleeding and periodontal pockets. A specially designed, lightweight CPI metallic probe with a 0.5 mm ball tip is used, with a black band between 3.5 and 5.5 mm, and rings at 8.5 and 11.5 mm from the ball tip (Fig. 12.5)[19]. All teeth present in the mouth are examined for absence or presence of gingival bleeding and absence or presence of periodontal pockets; pocket depth is measured with the WHO CPI periodontal probe.

Assessing for Gingival Bleeding and Measuring Periodontal Pockets

Gingivae of all teeth present in the mouth should be examined by carefully inserting the tip of the WHO CPI probe between the gingiva and the tooth to assess absence or presence of bleeding response. The sensing force used should be no more than 20 g. A practical test for establishing this force is to ask examiners to place the probe point under their thumbnail and press until blanching occurs. Alternatively, examiners can use a mirror and insert the probe into the gingival sulcus of their own anterior teeth using the lightest possible force that will allow movement of the probe ball tip along the tooth surface. These exercises should be conducted as part of the training when examiners are calibrated for reliability and consistency.

When the probe is inserted, the ball tip should follow the anatomical configuration of the surface of the tooth root. If the subject being examined feels pain during probing, this is indicative of the use of too much force. The probe tip should be inserted gently into the gingival sulcus or pocket and the full extent of the sulcus or pocket explored. For example, place the probe in the pocket at the distobuccal surface of the second molar, as close as possible to the contact point with the third molar, keeping the probe parallel to the long axis of the tooth. Move the probe gently, with short upward and downward movements, along the buccal sulcus or pocket, to the mesial surface of the second molar. A similar procedure is carried out for lingual surfaces, starting on the distolingual aspect of the second molar.

All teeth present should be probed and scored in the corresponding box.

Periodontal pockets are not recorded in individuals younger than 15 years of age. The codes for scoring bleeding and pocketing are given below.

Gingival Bleeding Scores

(Boxes 109–124 and 141–156 in the Oral Health Assessment Form for Adults; Boxes 73–86 and 87–100 in the Oral Health Assessment Form for Children)

0 = Absence of condition.

1 = Presence of condition.

9 = Tooth excluded.

X = Tooth not present.

Pocket Scores (Boxes 125–140 and 157–172)

0 = Absence of condition.

1 = Pocket 4–5 mm.

2 = Pocket 6 mm or more.

9 = Tooth excluded.

X = Tooth not present.

Loss of Attachment (Boxes 173–178 Oral Health Assessment Form for Adults)

Information on loss of attachment may be collected from the index teeth. The CPI system is designed to obtain an estimate of the lifetime accumulated destruction of the periodontal attachment and thereby permits comparisons between population groups. It is not designed to describe the full extent of loss of attachment in an individual. Loss of attachment is recorded by dividing the mouth in sextants, defined by tooth numbers: 18–14, 13–23, 2428, 38–34, 33–43, and 44–48. The most reliable method of examination for loss of attachment in each sextant is to record this immediately after recording the gingival status and pocket scores. As mentioned above, loss of attachment should not be recorded for individuals under the age of 15.

Index Teeth

The index teeth, which are the teeth to be examined, are 16/17, 11, 26/17, 36/37, 31, 46/47. The two molars in each posterior sextant are paired for recording and, if one is missing, there is no replacement. If no index tooth is present in a sextant qualifying for examination, all the teeth that are present in that sextant are examined and the highest score is recorded as the score for the sextant.

The extent of loss of attachment is recorded using the CPI probe and applying the following codes:

0 = 0–3 mm

1 = 4–5 mm (CEJ within black band) (*see* Plate 26)

2 = 6–8 mm (CEJ between upper limit of black band and 8.5 mm ring) 3 = 9–11 mm (CEJ between 8.5 mm and 11.5 mm ring)

4 = 12 mm or more (CEJ beyond 11.5 mm ring) (*see* Plate 28, tooth 16) X = Excluded sextant

9 = Not recorded

Enamel Fluorosis

(Box 179 in the Oral Health Assessment Form for Adults; Box 101 in the Oral Health Assessment Form for Children)

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 maxillary incisors. The mandibular incisors are least affected.

The examiner should note the distribution pattern of any defects, using Dean's index criteria, and make a decision as to whether they are typical of fluorosis. Defects falling into the "questionable" to "mild" categories—the conditions most likely to be encountered—may consist of fine white lines or patches and tend to fade into the surrounding enamel. To facilitate differentiating fluorosis lesions from other opacities not related to fluoride, it is important to remember that fluorosis lesions are usually observed near the edges of incisors or cusp tips; however, depending on severity, the lesions may be readily apparent on other areas of the tooth and be readily visible in premolars and molars. Nonfluoride-related opacities can be localized to the centre of the smooth surface, although they can affect the entire crown. Fluorosis lesions generally appear as fine lines, frosted in appearance and non-fluoride opacities appear round or oval in shape. Fluorosis lesions also can be more easily observed with the light directed in a tangential direction whereas nonfluoride opacities can be easily observed with the light directed perpendicularly to the tooth surface.

Coding is done on the basis of the two most severely affected teeth. If the two teeth are not equally severely affected, the score is based on the appearance of the less affected tooth. When the teeth are scored, the examiner should start at the higher end of the index, "severe", and eliminate each score until he or she arrives at the condition present. If there is any doubt, the lower score should be given.

The codes and criteria are as follows:

0 = *Normal*. Enamel surface is smooth, glossy and usually a pale creamy-white colour.

1 = *Questionable*. The enamel shows slight aberrations in the translucent

normal enamel and which may range from a few white flecks to occasional spots.

2 = *Very mild*. Small, opaque, paper-white areas scattered irregularly over the tooth but involving less than 25% of the labial tooth surface.

3 = *Mild*. White opacities of the enamel involving more than 25% (*see* Code 2) but less than 50% of the tooth surface

4 = *Moderate*. The enamel surfaces show marked wear, and brown staining is frequently a disfiguring feature.

5 = *Severe*. The enamel surfaces are severely affected and the hypoplasia is so marked that the general form of the tooth may be affected. There are pitted or worn areas and brown stains are widespread; the teeth often have a corroded appearance

8 = *Excluded* (e.g. a crowned tooth)

9 = *Not recorded*

Dental Erosion

(Boxes 180–182 in the Oral Health Assessment Form for Adults; Boxes 102–104 in the Oral Health Assessment Form for Children)

Data on prevalence, severity and number of teeth affected by dental erosion would assist public health administrators in estimating whether this condition is a public health problem. Dental erosion results from the progressive loss of calcified dental tissue by chemical processes not associated with bacterial action. Enamel tissue is lost by exposure to acids which may come from dietary sources or may be intrinsic, i.e. in individuals suffering from bulimia, gastro-oesophageal reflux or heavy alcohol consumption and chronic vomit.

The following codes (1–3) are used where the crown of a tooth shows an erosion lesion at different levels:

0 = No sign of erosion

1 = Enamel lesion

2 = Dentinal lesion

3 = Pulp involvement

Severity of dental erosion is recorded according to the tooth with the highest score of erosion. In addition, the number of teeth involved is recorded.

Traumatic Dental Injuries

(Boxes 183–185 in the Oral Health Assessment Form for Adults; Boxes 105–107 in the Oral Health Assessment form for Children)

Teeth affected by dental trauma are coded as follows:

0 = No sign of injury

1 = Treated injury

2 = Enamel fracture only

3 = Enamel and dentin fracture

4 = Pulp involvement

5 = Missing tooth due to trauma

6 = Other damage

9 = Excluded tooth

In addition to the degree/status of trauma, the severity of dental trauma can be measured in terms of the number of teeth involved.

Oral Mucosal Lesions

(Boxes 186–191 in the Oral Health Assessment Form for Adults; Boxes 108–113 in the Oral Health Assessment Form for Children)

The oral mucosa and soft tissues in and around the mouth should be examined in every subject. The examination should be thorough and systematic, and performed in the following sequence:

1. Labial mucosa and labial sulci (upper and lower)
2. Labial part of the commissures and buccal mucosa (right and left)
3. Tongue (dorsal and ventral surfaces, margins)
4. Floor of the mouth
5. Hard and soft palate
6. Alveolar ridges/gingiva (upper and lower).

Either two plane mouth mirrors or one mirror and the handle of the periodontal probe can be used to retract the tissues. Boxes 186–188 (108–110 in children) should be used to record the absence, presence, or *suspected* presence of the conditions coded 1–7. Examiners should be alert to, and can make a tentative diagnosis for, these conditions during clinical examination. Code 8 should be used to record a condition not mentioned in the list; for example, hairy leukoplakia or Kaposi sarcoma. Whenever possible, the tentative diagnosis should be specified in the space provided, for up to three conditions.

The following codes apply for adults:

0 = No abnormal condition

1 = Malignant tumour (oral cancer)

2 = Leukoplakia

3 = Lichen planus

4 = Ulceration (aphthous, herpetic, traumatic)

5 = Acute necrotizing ulcerative gingivitis

6 = Candidiasis

7 = Abscess

8 = Other condition (specify if possible) (e.g. keratosis, and Koplik spots)

9 = Not recorded

Recording of leukoplakia and lichen planus is not considered important in children.

In addition, all the main locations of the oral mucosal lesion should be recorded in Boxes 189–191 for adults and Boxes 111–113 for children, as follows:

0 = Vermillion 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.

Denture Status

(Boxes 192 and 193 in the Oral Health Assessment Form for Adults)

The presence of removable dentures should be recorded for each jaw (Box 192, upper jaw; Box 193, lower jaw). The codes are as follows:

0 = No denture

1 = Partial denture

2 = Complete denture 9 = Not recorded

Intervention Urgency

(Box 194 in the Oral Health Assessment Form for Adults; Box 114 in the Oral Health Assessment Form for Children)

It is the responsibility of the examiner or team leader to ensure that referral to an appropriate healthcare facility is made, if needed. There is a need for immediate care if pain, infection or serious illness is present or is likely to occur 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 are periapical abscess and ANUG. Advanced dental caries and chronic alveolar abscesses may also be recorded in this box. A life-threatening condition (oral cancer or precancerous lesions) or any other severe condition that is a clear oral manifestation of a systemic disease should have been recorded in the oral mucosa section and a code should also be entered in Box 194 in the form for adults or in Box 114 in the form for children.

The following intervention urgency codes are recommended:

0 = No treatment needed

1 = Preventive or routine treatment needed

2 = Prompt treatment including scaling needed

3 = Immediate (urgent) treatment needed due to pain or infection of dental and/or oral origin

4 = Referred for comprehensive evaluation or medical/dental treatment (systemic condition).

Table 12.17: Oral health assessment form for adults (by tooth surface), 2013

(1) Leave blank (4) (5) Year Month Day (10) (11) Identification No. (14) Orig/Dupl (15) (16) Examiner (17)

General informatin: **Sex** 1=M, 2=F (18) (19) **Date of birth** (24) (25) **Age in years** (26)

(Name)

Ethnic group (27) (28) **Other group** (29) (30) **Years in school** (31) (32) **Occupation** (33)

Community (geographical location) (34) (35)

Location Urban (1) Periurban (2) Rural (3) (36)

Other data (37) (38)

Other data (39) (40)

Other data (41) (42)

Extraoral examination (43) (44)

Dentition status by tooth surface

	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28	
Occ																	(45–54)
Mcs																	(55–70)
Buc																	(70–86)
Dis																	(87–102)
Oral																	(103–118)

	48	47	46	45	44	43	42	41	31	23	33	34	35	36	37	38	
Occ																	(119–128)
Mes																	(129–144)
Buc																	(145–160)
Dis																	(161–176)
Oral																	(177–192)

Permanent teeth

Status

0 = Healthy
1 = Caries
2 = Filled w/caries
3 = Filled no/caries
4 = Missing due to caries
5 = Missing for another reason
6 =Fissure scalant
7 = Fixed partial denture,/crown, abutment, veneer, implant
8 = Unerupted
9 = Not recorded

Periodontal status (CPI modified)

	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28	
Bleeding (193)																	(208)
Pocket (209)																	(224)
Bleeding (225)																	(240)
Pocket (241)																	(256)
	48	47	46	45	44	43	42	41	31	23	33	34	35	36	37	38	

Gingival bleeding

Score

0 = Absence of condition
1 = Presence of condition
9 = Tooth excluded
x = Tooth not present

Pocket score

0 =Absence of condition
1 = Pocket 4–5 mm
2 = Pocket 6 mm or morc
9 = Tooth excluded
x = Tooth not present

Loss of attachment

Severity
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 8.5 mm ring
3 = 9–11 mm CEJ between 8.5 mm and 11.5 mm ring
4 = 12 mm or more CEJ beyong 11.5 mm ring
X = Excluded sextant
9 = Not recorded

* Not recorded under 15 years of age

Index teeth

17/16 11 26/27
(257) (259)
(260) (262)
47/46 31 36/37

Enamel fluorosis (263)

Severity
0 = Normal
1 = Questionable
2 = Very mild
3 = Mild
4 = Moderate
5 = Severe
8 = Excluded (crown, restoration, "bracket")
9 = Not recorded (unerupted tooth)

Dental erosion

Severity (264)

0 = No sign of erosion
1 = Enamel lesion
2 = Dentinal lesion
3 = Pulp involvement

Number of teeth affected

(265) (266)

Dental trauma

Status (267)

0 = No sign of injury
1 = Treated injury
2 = Enamel fracture only
3 = Enamel and dentine fracture
4 = Pulp involvement
5 = Missing tooth due to trauma
6 = Other damage
9 = Excluded tooth

Number of teeth affected

(268) (269)

Oral mucosal lession

(270)
(271)
(272)
(273)
(274)
(275)

Denture (s)

Upper (276) **Lower** (277)

Condition

0 = No abnormal condiiton
1 = Malignant tumour (oral cancer)
2 = Leukoplakia
3 = Lichen planus
4 = Ulceration (aphthous, herpetic, traumation)
5 = Acute necrotizing ulcerative gingivitis (ANUG)
6 = Candidiasis
7 = Abscess
8 = Other condition (specify if possible)
9 = Not recorded

Location

0 = Vermillion 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

Status

0 = No denture
1 = Partial denture
2 = Complete denture
9 = Not recorded

Intervention urgency (278)

0 = No treatment needed
1 = Preventive or routine treatment needed
2 = Prompt treatment (including scaling) needed
3 = Immediate (urgent) treatment needed due to pain or infection of dental and/or oral origin
4 = referred for comprehensive evaluation or medicaltreatment (systemic condition)

Table 12.18: Oral health assessment form for children (by tooth surface), 2013

(1) Leave blank (4) (5) Year Month Day (10) (11) Identification No. (14) Orig/Dupl (15) (16) Examiner (17)

General informatin:

(Name)

Sex 1=M, 2=F (18) (19) **Date of birth** (24) (25) **Age in years** (26)

Ethnic group (27) (28) **Other group** (29) (30) **Years in school** (31) (32) **Occupation** (33)

Community (geographical location) (34) (35)

Other data (37) (38)

Other data (41) (42)

Location Urban (1) Periurban (2) Rural (3) (36)

Other data (39) (40)

Extra-oral examination (43) (44)

Dentition status by tooth surface

	17	16	55 15	54 14	53 13	52 12	51 11	61 21	62 22	63 23	64 24	65 25	26	27	
Occ															(45–52)
Mcs															(53–66)
Buc															(67–80)
Dis															(81–94)
Oral															(95–108)

	47	46	85 45	84 44	83 43	82 42	81 41	71 31	72 32	73 33	74 34	75 35	36	37	
Occ															(109–116)
Mes															(117–130)
Buc															(131–144)
Dis															(145–158)
Oral															(159–172)

Primary teeth	Permanent teeth
	Status
A	0 = Sound
B	1 = Caries
C	2 = Filled w/caries
D	3 = Filled no caries
E	4 = Missing due to caries
—	5 = Missing for another reason
F	6 =Fissure sealant
G	7 = Fixed dental prosthesis/crown, abutment, veneer
—	8 = Unerupted
—	9 = Not recorded

Periodontal status

	55	54	53	52	51	61	62	63	64	65		
17	16	15	14	13	12	11	21	22	23	24	25	26	27
(173)													(186)
(187)													(200)
	85	84	83	82	81	71	72	73	74	75		
47	46	45	44	43	42	41	31	32	33	34	35	36	37

Enamel fluorosis Severity (201)

0 = Normal
1 = Questionable
2 = Very mild
3 = Mild
4 = Moderate
2 = Severe
8 = Excluded (crown, restoration, "bracket")
9 = Not recorded (unerupted tooth)

Gingival bleeding Score

(0) = Absence of condition
(9) = Tooth excluded
(1) = Presence of condition
(X) = Tooth not present

Dental erosion Severity

(202)

0 = No sign of erosion
1 = Enamel lesion
2 = Dentinal lesion
3 = Pulp involvement

No. of teeth

(203) (204)

Dental trauma Status

(205)

0 = No sign of injury
1 = Treated injury
2 = Enamel fracture only
3 = Enamel and dentine fracture
4 = Pulp involvement
5 = Missing tooth due to trauma
6 = Other damage
9 = Excluded tooth

(206) (206)

Oral mucosal lesions

Condition

(208)
(209)
(210)

0 = No abnormal condition
1 = Ulceration (aphthous herpetic, traumatic)
2 = Acute necrotizing ulcerative gingivitis (ANUG)
3 = Candidiasis
4 = Abscess
8 = Other condition
9 = Not recorded

Location

(211)
(212)
(213)

0 = Vermillion border
1 = Commissure
2 = Lips
3 = Sulci
4 = Buccal mucosa
5 = Floor of mouth
6 = Tongue
7 = Hard/soft palate
8 = Alveolar ridges/gingiva
9 = Not recorded

Intervention URGENCY (214)

0 = No curative treatment needed
1 = Preventive or routine treatment needed
2 = Prompt treatment (including scaling) needed
3 = Immediate (urgent) treatment due to pain or infection of dentel and/or oral oral
4 = Referred for comprehensive evaluation or medical treatment (systemic condition)

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CHAPTER

13

Planning, Survey and Evaluation

PLANNING

The increasing demand for medical and health care services, in the face of limited resources has brought out the need for careful planning and management of health services. Planning a programme requires a deep understanding of the system as a whole and the individuals that make up the system. It is a dynamic process which must remain flexible and responsive to the presentation of new factors.

Hence **planning** is “the systematic approach to defining the problem, setting priorities, developing specific goals and objectives, determining alternative strategies and a method of implementation.[1]

A **plan** is a “decision about a course of action” [EC Banfield].[1]

Purpose of Planning

1. To match the limited resources with many problems;
2. To eliminate wasteful expenditure or duplication of expenditure;
3. To develop the best course of action to accomplish a defined objective.

Types of Health Planning: (Spiegel and Associates)

Fig. 13.1 shows types of health planning.

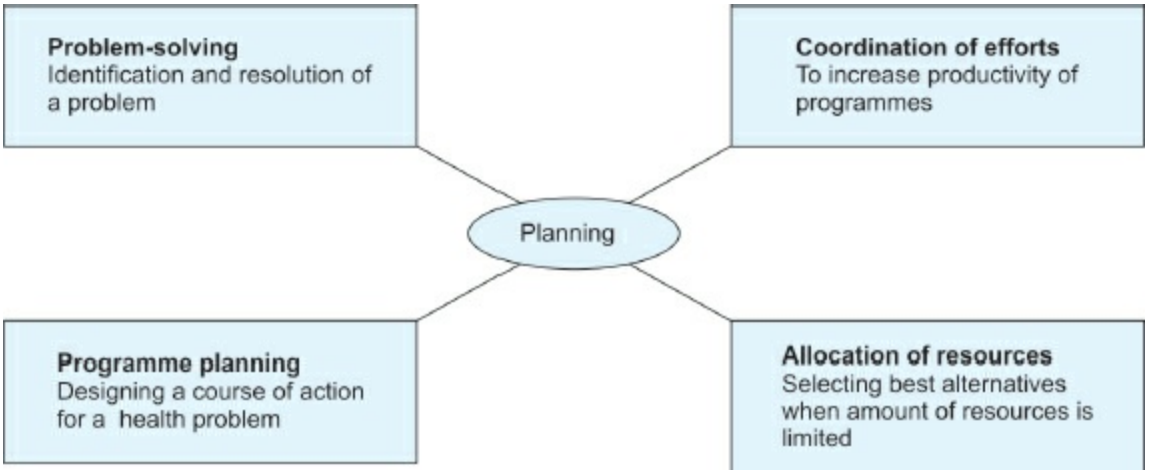


Fig. 13.1: Types of health planning

Steps in Planning Process[5] (Fig. 13.2)

1. Needs assessment
2. Determining priorities
3. Development of goals, objectives and activities
4. Identification of resource and constraints
5. Alternative strategies
6. Implementation
7. Supervision
8. Evaluation and revision.

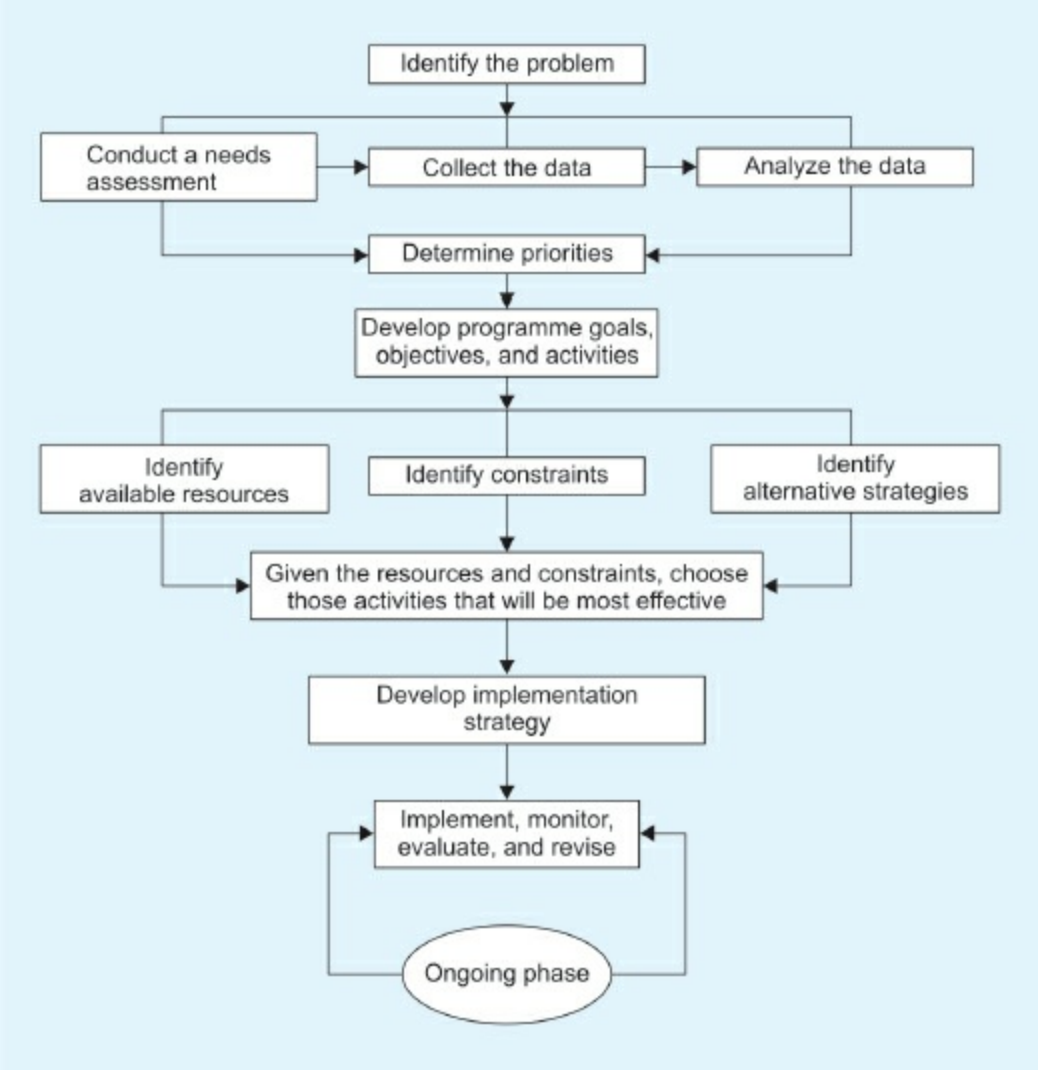


Fig. 13.2: Planning and implementation strategy flowchart[1]

1. Needs Assessment

A planner should conduct a needs assessment for the following reasons:

a. To define the problem, its extent and severity.

b. To obtain a profile of the target community, to ascertain the causes of the problem.

c. To evaluate the effectiveness of the programme by obtaining baseline information and comparing with information obtained at a later date.

This is a very costly endeavour. If the funds are not readily available, the planner may coordinate with the research activities of other agencies interested in obtaining similar health information on the given population or investigate surveys that have been done in the past by other organisations.

***The information gathered are*:**

- General information regarding the number of individuals, geographic distribution, diet, socioeconomic status, ethnic background, public services available, school systems.
- Pattern and distribution of dental disease which can be obtained through clinical examination records, or consult national health survey for data.
- Current status of dental health programmes being implemented in that population.
- Learn the way policies are developed and decisions are made.
- Funds, facilities and labour available.
- Preventive dental programme existing in the community like water fluoridation.

The information so obtained is analysed for the following:

1. *Socioeconomic structure*: It tells whether this population can afford dental care through their jobs.
2. ***Population breakdown*:** It tells the cultural and language issues that should be considered.

3. ***Age distribution*:** It tells where the target groups are and thus sets up certain priorities for planning.
4. ***Educational status*:** It tells the educational level and also what the community's values are toward obtaining an education.
5. ***Public transport system*:** A look into the communitiy's public transport system gives an idea regarding a population's ability to get to health care services.
6. ***Health care facilities*:** It tells the planner what type of services are being provided, the amount of services and the cost of receiving those services.
7. ***Labour data*:** It gives us information as to the number of dentists providing care, and the type of care they are able to provide.
8. ***Fluoride status*:** Fluoride status of a community is also essential for dental planning.

2. Determining Priorities

Since resources may be limited, priorities are established to allow for the most efficient allocation. It is used to set priorities among problems and rank solutions.

If priorities are not determined, the programme may not serve those individuals or groups who need the care most. Priority is given to:

1. Those who need care most
2. Diseases affecting large number of people
3. High-risk groups.

Once the target group and disease has been identified based on the dental problem, the type of programme is established.

3. Development of Programme Goals, Objectives and Activities

Programme goals are broad statements on the overall purpose of a programme to meet a defined problem. Programme objectives are more specific and describe in a measurable way the desired end result of programme activities. It should specify the following:

1. What is the nature of the situation or condition to be attained?
2. Extent or magnitude of the situation to be obtained.
3. For whom is it going to be attained?
4. Where is it going to be conducted?
5. The time “at” or “by” which the desired situation or condition is intended to exist.

For example, 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.

Programme activities include the following components:

1. What is going to be done?
2. Who will be doing it?
3. When it will be done?

4. Identification of Resources and Constraints

Resources

The resources to be considered are personnel, equipment and supplies, facilities and financial resources needed for the programme. Some of the criteria to determine what resources should be used includes:

1. ***Appropriateness*:** The most suitable resources to get the job done should be selected.
2. ***Adequacy*:** Refers to the extent or degree to which the resources would complete the job.
3. ***Effectiveness*:** Refers to how capable the resources are at fulfilling the objective.
4. ***Efficiency*:** Refers to the cost and the amount of time expended to complete the job.

Constraints

The most obvious constraints or obstacles to meeting the programme objectives are determined. By identifying these constraints early in the planning, one can modify the design of the programme and there by create a

more practical and realistic plan.[1]

Constraints that commonly occur in community dental programmes are:

a. Lack of funding.
b. Inadequate transportation system.
c. Labour shortages.
d. Lack of or inadequate facilities.
e. Negative community attitudes towards dentistry.
f. Lack of time, etc.

5. Alternative Strategies

Being aware of the existing constraints and given available resources, it is important to generate a number of alternate plans so that at least one may be considered to be acceptable. With limited resources, the planner needs to consider the anticipated cost and the effectiveness of each alternative.

6–8. Implementation, Supervision, Evaluation and Revision

Implementation

The process of putting the plan into operation is referred to as the implementation phase. It involves individuals, organizations and community. Only through teamwork between the individuals and the environment can the implementation be successful.

Rules for implementation

1. Specify clearly the activity (who does what and for whom).
2. Be sure that someone is responsible for the whole activity.
3. Identify all the preparatory steps prior to doing the activity (e.g. prepare training manual, prepare materials, write articles, acquire equipment, train volunteers, determine treatment protocol).
4. List steps in the order in which they must occur and check for missing steps.
5. Determine when each step should begin and end.

6. Consult with organizations affected by the activity, identify potential problems, opportunity, etc.
7. Specify what resources will be needed and their source.
8. Specify what constraints will need to be addressed.
9. Make sure all people involved know what is expected of them and by when.

Supervision

Once it has been implemented, the programme requires continuous surveillance of all activities. The programme's success is determined by monitoring how well the programme is meeting its stated objectives, how well individuals are doing their jobs, how well equipment functions, and how appropriate and adequate facilities are.

Evaluation and revision

Evaluation, both formal and informal, is done in terms of programme structure, techniques or methods employed and the programme's impact on the target disease or population. Before problems arise in any of these areas, revision must be made to fine tune the programme.

Conclusion

Consumers are more involved than ever before in learning about the types of health care they should be receiving and are actively questioning the choices available to them. We must be prepared to meet the challenges of the coming years through the development of good planning skills, which can then be used to achieve the necessary goals for the betterment of the community.

SURVEY

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. Hence **survey is defined as** an investigation in which information is systematically collected, but in which experimental method is not used. There is no active intervention.

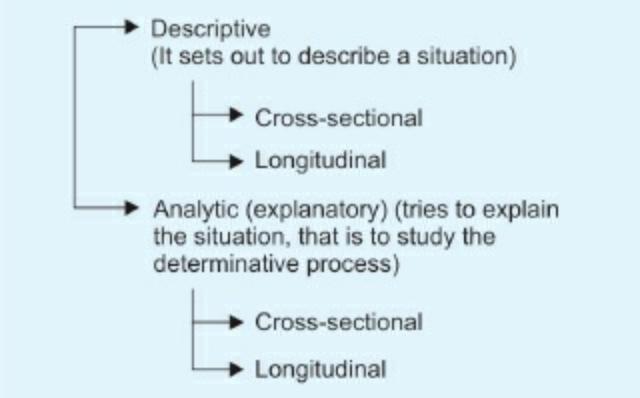
In short, survey is a **“non-experimental investigation.”**

Advantages

1. Provide information on some aspects of oral health about which information may not be available from any other source.
2. Rates and indices can be calculated.
3. Associations and correlations can be identified and studied.
4. Reasons for utilization as well as nonutilization of oral health services can be studied.
5. Information from a well-planned systematic survey is more reliable, complete and accurate compared to information collected routinely.

Types of Investigations

Surveys



Basic Oral Health Survey

Basic oral health surveys are defined as surveys to collect the basic information about oral disease status and treatment needs that is needed for planning or monitoring oral health care programmes.[3]

Special Characteristics of Oral Diseases[4]

1. The diseases are strongly age-related.
2. One of the dental diseases, dental caries is irreversible and thus information on current status provides data not only on the amount of disease present, but also on the previous disease experience.
3. These common oral diseases exist in all populations, varying only in intensity and prevalence.
4. There is extensive documentation on variation of profiles of dental caries for population groups with different socioeconomic levels and environmental conditions.
5. The observations can be recorded on a standard measurement, facilitating comparison between groups.

Objectives

1. Initially to provide a full picture of the oral health status and needs of a population.
2. Subsequently, to monitor changes in disease levels or patterns.

Stepwise approach (Fig. 13.3):[4] It starts with the compilation of key information on risk factors and self-reported health using questionnaire (Step 1), and then moves on to simple physical measurements (Step 2) followed by more complex measurements for biochemical analysis (Step 3). It may include core and extended areas of investigation.

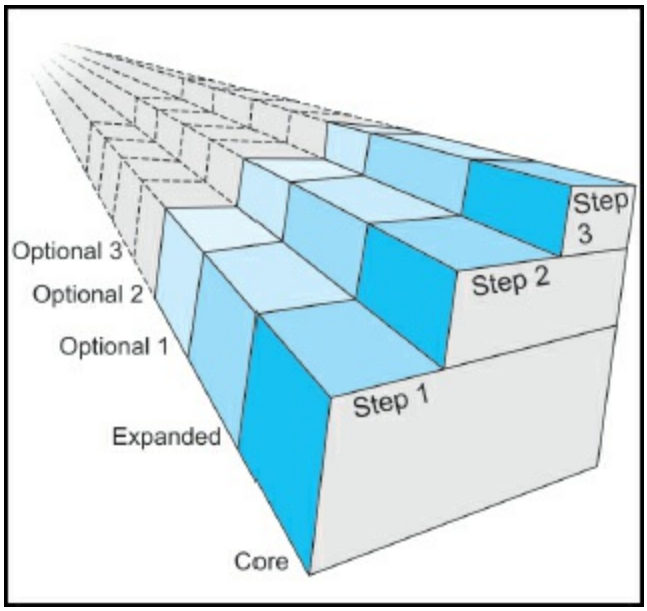


Fig. 13.3: Stepwise approach

Steps emphasize that fewer good quality data are more valuable than large quantities of poor quality data. However, WHO does not recommend advanced oral health measurements for countries with limited resources.

In this way, it is possible to assess the appropriateness and effectiveness of services being provided and to plan, or re-plan, oral care services and training programmes as needed.

Pathfinder Survey[4]

It is a practical, economic survey sampling methodology. The method used is a stratified cluster sampling technique, which aims to include the most important population subgroups likely to have differing disease levels, and to cover a standard number of subjects in specific index age groups in any one location. In this way, statistically significant and clinically relevant information for planning is obtained at minimum expense.

This methodology is suitable for obtaining the following information:

1. Prevalence of the various oral diseases affecting the population.
2. Important variations in disease level, severity and need for treatment in subgroups of the population.
3. A picture of the age profiles of oral diseases in the population to

provide information about severity and progression of disease, and to give an indication as to whether the levels are increasing or decreasing.

Pathfinder survey is classified as either pilot or national level surveys.

Pilot survey is one that includes only the most important subgroups in the population and only 1 or 2 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 in order to provide a reliable baseline for the implementation and monitoring of services.

National pathfinder survey incorporates sufficient examination sites to cover allimportant subgroups that may have differing disease levels or treatment needs and at least three of index ages. This type of survey design is suitable for the collection of data for the planning and monitoring of services in all countries regardless of the level of disease, availability of resources or complexity of care.

Index Age and Age Groups[4]

Those recommended are 5 years for primary teeth, 12, 15, 35–44, 65–74 years for permanent teeth. In each age group, minimum of 25–50 subjects is to be considered.[3]

***5 years*:** 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 at other index ages.

***12 years*:** This is the age at which children leave primary school, and is also the last age at which reliable sample may be obtained easily through the school system. At this age, all permanent molars would have erupted except the third molars. This age is also chosen as the global monitoring age for caries for international comparisons and monitoring of disease trends.

***15 years*:** At this age, the permanent teeth have been exposed to the oral environment for 3 to 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 to 44 years*:** This age group is the standard monitoring group for health conditions of adults. The full effect of dental caries, the level of periodontal involvement and the general effects of care provided can be monitored in this age group.

***65 to 74 years*:** This age group has become more important with the changes in age distribution and increases in lifespan. Data for this group are needed both for planning appropriate care for the elderly and for monitoring overall effects of oral care services.

***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 disease.

An example of a sample design for a national pathfinder survey is as follows:

Urban: 4 sites in capital city or metropolitan area (4 × 25 = 100)

2 sites in each of 2 large towns (2 × 2 × 25 = 100)

Rural: 1 site in each of 4 villages in different regions (4 × 25 = 100)

Total for one index age or age group:

12 sites × 25 subjects = 300

Applied to 4 index ages: 4 × 300 = 1200

Considering the number of subjects under each index age group [5, 12, 15, 35 to 44, 65 to 74 years] to be 25,

Total number of subjects inclusive of all index age groups: 5 × 25 = 125 Total sample size from all 8 sites:

125 × 8 = 1000

Steps in Survey

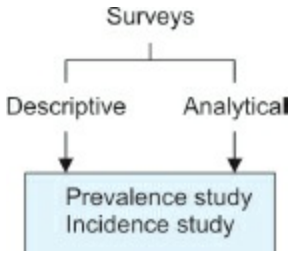
1. Establishing the objective.
2. Designing the investigation.
3. Selecting the sample.
4. Conducting the examinations.
5. Analyzing the data.
6. Drawing the conclusions.
7. Publishing the reports.

1. Establishing the Objective

The design of the investigation entirely depends on the objectives. Hence, the objective may be stated by describing what is to be measured, to determine the resources necessary to provide a service, etc. depending upon the type of investigation.

2. Designing the Investigation

a. ***Types of survey*:** Surveys may be descriptive or analytical,which are further subdivided into prevalence or incidence studies.



Prevalence studies are commonly used for making comparisons between two or more populations, or between the same populations at different times. *Incidence studies* are used, where the amount of new disease in a population is measured over a period of time. The incidence study is concerned with events, which happen during the investigation.

b. ***Controls*:** When an investigation is to be carried out to know the possible effects of a factor it is not enough to confine the examination

to the group exposed to the factor under scrutiny. A parallel group not exposed must also be studied which is called the control group. Control group must be as similar as possible to the test group except in respect of the factor under investigation. The control group is necessary in order to establish a cause and effect relationship.

c. ***Method of study*:** It could be case control study or cohort study. In the case control study, the starting point is a group with the disease under investigation. Assessment is made of the factors which have influenced these subjects in the past and which might be associated with the disease, and the findings are compared with those from a suitable control. Cohort is a group of people who share a common characteristic on experience within a defined time period. During a follow-up period, assessment is made of the influence that these factors may have on the occurrence of the disease.

3. Selecting the Sample

When designing a study it is usually impossible to examine every individual in the population under investigation. Resources in terms of time, money and manpower are not available for the collection and analysis of such vast amounts of data. For this reason, it is often decided to study only a part, or sample, of the study population. Sample is a group of individuals who are actually available for the investigation. The sample is selected using one of the sampling designs, which may be simple random sampling, systematic random sampling, stratified random sampling, cluster sampling, or multiphase sampling.

4. Conducting the Examinations

The following are to be considered while conducting a survey:

a. ***Obtaining approval from the authorities*:** Permission to examine population groups must be obtained from a local, regional or national authority. In case of school children, permission must be obtained from the school authority.

b. ***Budgeting*:** A budget should be prepared, which should include all the resources required, including personnel to carry out the survey.

c. ***Scheduling*:** Basic oral health examination of child takes 5 to 10

minutes and for adult it takes 15 to 20 minutes. Using this as the guide, daily and weekly schedules can then be prepared and handed over to the survey personnel, school as well as health authorities.

d. ***Emergency care and referral*****:** A list of referral facilities and addresses should be prepared before the survey so that the emergency conditions can be referred to appropriate care.

e. ***Standardization and calibration*****:** To ensure uniform interpretation, understanding and application by all examiners of the codes and criteria and to ensure that each examiner can examine consistently, it is essential to train and calibrate them. Furthermore, the diagnostic method choosen should be both valid and reliable.

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.
4. Divergences of opinion or of observation can be discussed and minimized.
5. Circulate among examiners any rules or systems which may seem pertinent.
6. Conduct duplicate examination of 5–10% of the samples.
7. Estimate reproducibility of recordings using Kappa statistics.

f. ***Personnel and organization*****:**

- *Recording clerk*: The recording clerk is one who is able to follow the instructions exactly and to print numbers and letters clearly as instructed by the examiner.
- ***Organising clerk*****:** The organising clerk helps to maintain a constant flow of subjects and to enter general descriptive information on the recorded forms. He is also responsible for the adequate supply of sterile instruments.

g. ***Instruments and supplies*****:**

- Plane mouth mirrors—30 per examiner
- Periodontal probes—30 per examiner

- Several pair of tweezers
- Containers and concentrated sterilizing solution
- A washbasin
- Cloth or paper hand towels
- Gauze.

h. ***Infection control*****:** All the personnel participating in the survey must be made aware of the possibility of cross-infection when conducting examinations or handling contaminated instruments. Current national standards should be followed for both infection control and waste disposal.

i. ***Examination area*****:** The area for conducting examinations should be planned and arranged for maximum efficiency and ease of operation. The most comfortable situation is for the subject to be on a table or a bench, and the examiner to sit behind the subject's head. If possible, natural light should be used at all locations. If not, electricity or battery-operated lights can be used. The recording clerk must be seated close to the examiner for instructions and codes to be easily heard. Crowding and noise must be avoided.

j. ***Methods of examination***, criteria for diagnosis and indices to be used are established. A classification of examination types suggested by the American Dental Association (1970) is as follows:

Type 1: Complete examination: Involves a very complete examination using mouth mirror and explorer, good illumination, full mouth radiographs, and such additional diagnostic methods, as study models, pulp testing, transillumination and laboratory investigation. Used in intensive clinical studies of special groups.

Type 2: Limited examination: This is more limited examination, using mirror and explorer, good illumination, bitewing and or periapical radiographs.

Type 3: Inspection: This is done using a mirror and explorer under good illumination.

Type 4: Screening procedure: In this, only tongue depressor is used with available illumination.

k. ***Courtesy reporting*****:** Survey findings should be reported to local

authorities. A simple summary of the total number of people examined and general observations can be reported.

5. Analyzing the Data

If the methods recommended in the WHO manual are followed, computer analysis of collected data can be done. If a different proforma is used, analysis is to be done according to preset methods. Different tables and graphical presentation of data enable meaningful conclusions to be drawn.

6. Drawing the Conclusion

Care must be taken that the conclusions are specifically related to the investigation that has been carried out and that no extrapolation is made to the population as whole unless the investigation was designed accordingly.

7. Publishing the Reports

The report of the survey should contain the following information:

a. ***Statements and purposes of the survey*:** Include a brief and clear description of the aims of the survey.

b. ***Materials and methods*:** Include area and population surveyed, sampling method, statistical analysis and reliability and reproducibility of the results.

c. ***Results*:** A few diagrams, graphs, histograms, bar charts or pie charts may be used to illustrate points.

d. ***Discussion and conclusions*:** The results should be compared with the data from the previous surveys of the same population or with the results of surveys in similar or neighbouring population.

e. ***Summary or abstract*:** A brief overview of the objectives, methodology and conclusion is given. Any unusual or unexpected results obtained should be noted.

Surveys and Surveillance[4]

Surveillance provides an on going, continuous or periodic, collection, analysis and interpretation of population health data and the timely dissemination of such data to users.

Properly conducted surveillance ensures that public health administrators have the information they need to control diseases now or to plan strategies in the future. In this way, emerging disease patterns and trends can be observed and evaluated.

Oral health surveillance can be successfully incorporated into national health surveillance schemes as measurement of just a few crucial indicators, e.g. percentage of adults with access to primary oral health care services. For effective surveillance, WHO suggests that clinical oral health surveys should be conducted regularly every 5 to 6 years in the same community or setting.

Conclusion

Surveying is far more than collecting and arranging of facts. It is a task through participation in which many key people in a community become aware of the dental needs of the community and what can be done about them. They also lay foundation for ensuring programmes.

EVALUATION

Evaluation is the judgement of merit or worth about a particular person, place or thing. In the context of community activities, **evaluation** is the collection and analysis of information to determine the programme performance.

Purpose of Evaluation

1. To find out how well the programme works, i.e. to measure its success.
2. To provide information for decision making.
3. To measure the effect.
4. If there is a lack of success then modifications are to be done to improve the programme.

Criteria

For evaluation of dental services (given by WHO)

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 programme?
3. ***Appropriateness*:** Is the programme acceptable to both the 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?

Types of Evaluation

According to Scriven, the two types are:

1. Formative evaluation
2. Summative evaluation

***Formative evaluation*:** It is an examination of the process or activities of a programme *as they are taking place*. It is usually carried out to aid in the development of a programme in its early phases. For example, a fluoride rinse programme is initiated at a neighbourhood in which paraprofessionals are trained to administer three types of fluoride rinses. After three days of operation, the work of the para-professionals is observed to determine the extent to which the sequence is being maintained.[5]

If the sequence is incorrect formative evaluation allows the programme to make remedial changes at that point and thereby improve performance.

It is used by programme developers to ascertain whether various components of a programme are workable or whether changes should be made to improve programme activities.

***Summative evaluation*:** Summative evaluation judges the merit or worth of a programme *after it has been in operation*. It is an attempt to determine whether a fully operational programme is meeting the goals for which it was developed. Summative evaluation is aimed at programme decision makers, who will decide whether to continue or terminate a programme.[5]

Elements of Evaluation

1. ***Relevance*:** It relates to the appropriateness of the service, whether it is needed at all. If there is no need, the service can hardly be of any value. For example, vaccination against smallpox is irrelevant because the disease no longer exist.
2. ***Adequacy*:** It implies that sufficient attention has been paid to certain previously determined course of action. For example, if staff allocation is such that targets can be achieved without work overload.
3. ***Accessibility*:** It implies whether the patient can reach you easily. The barriers of accessibility may be physical (distance, travel, time).

   Economic (travel cost, free charged) social and cultural (caste or language barrier).
4. ***Acceptability*:** The patient has to accept the programme.
5. ***Effectiveness*:** It is a measure to determine, if the objectives have been achieved.
6. ***Efficiency*:** It is a measure of how well resources (money, manpower, material and time) are utilized to achieve a given outcome.
7. ***Impact*:** It is an expression of long-term outcome of the programme. For example, if the number of children who brush their teeth twice a day has increased after a session of health education, the programme is considered impactful.

Basic Steps in Evaluation

1. ***Determine what is to be evaluated*:**
    a. *Evaluation of the structure*: This is evaluation of whether facilities, equipment, manpower and organisation meet the standards.
    b. *Evaluation of the process*: The process of dental care includes the problems of recognition, diagnostic procedures, treatment and clinical management, care and prevention. The way in which the activities of the programme is carried out is evaluated by comparing with predetermined standard.
    c. *Evaluation of outcome*: This is concerned with end results of a programme. The end results should improve dental health in a community.
2. ***Establishment of standard and criteria*:** Standards and criteria must be developed in accordance with the focus of evaluation.
    a. *Structural criteria*: For example, physical facilities and equipment.
    b. *Process criteria*: For example, every prenatal mother must receive 6 checkups.
    c. *Outcome criteria*: For example, alteration in patient's health status.
3. ***Planning the methodology*:** The methodology of evaluation in terms of criteria and standards against which the current programme is to be evaluated are established.
4. ***Gathering information*:** Evaluation requires collection of data. The types of information may include, political, cultural, economic, environmental and administrative factors. The above factors influence the health situation as well as the morbidity and mortality statistics.
5. ***Analysis of results*:** Once information has been gathered, the analysis and interpretation of data should take place within the shortest time. Then opportunities should be provided for discussing evaluation results.
6. ***Taking action*:** Based on the outcome of the evaluation, shifting

priorities, revising objectives, or development of new programmes or services to meet previously unidentified needs may be implemented.

7. ***Revaluation*:** Evaluation is an on-going process and may be repeated, if required.

***Evaluation of quality of dental care programmes*:** Schonfeld suggested four levels of evaluation.[2]

1. Evaluate the individual restoration, procedure or service.
2. Evaluate the mouth that is the relationship of one dental procedure to another.
3. Consider the patient's total oral health and the influence that dental care has had on the attitude toward dentistry and on dentally related behaviour.
4. A look at the family and community, evaluate the dental services provided for groups and communities and determine the number of and social distribution of persons receiving adequate dental care.

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CHAPTER

14

Dental Auxiliaries

Social forces are the principal determinants of the structure and process of health services. The types of dental personnel in a society are a part of the structure: Their number and distribution are part of the process. The concept of the dental team encompasses the various providers of dental care who have different roles, functions and periods of training and who combine to treat patients.

With increasing health consciousness the demand for dental care increases among the public. There was a necessity to make it affordable and available to all. In order to provide cost effective services and satisfy demand, the dedication of some responsibility to suitably trained para-professionals became inescapable in the dental field. These new para-professionals receive a less rigorous training of a shorter duration compared to the dentist. They were expected to perform well demarcated tasks efficiently. Dental auxiliary is a generic term for all persons who assist the dentist in treating the patients. In Britain, they have been known as “dental ancillaries”.[1]

Definition

A dental auxiliary or ancillary 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.[3]

CLASSIFICATION

WHO Classification[3]

1. Non-Operating Auxiliary

a. ***Clinical*:** This is a person who assists the professional 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 ancillaries***
    1. Dental surgery assistant
    2. Dental secretary/receptionist
    3. Dental laboratory technician
    4. Dental health educator
2. ***Operating ancillaries***
    1. School dental nurse
    2. Dental therapist
    3. Dental hygienist
    4. Expanded function dental ancillaries

1. Dental Surgery Assistant

The employment of women as dental assistants was started in the USA more than a century ago. Dr C Edmund Kells of New Orleans employed a woman as a "lady in attendance" in 1885, so that unaccompanied female patients could come to his clinic. This practice became popular.[4] The assistants started helping the dentist in his business office as well as by chair. The utilisation improved during World War II due to acute shortage of professionals to meet the demands of the armed forces. The dental assistants now assist the dentist in performing certain tasks which are non-technical in nature and do not require any or much training. The dentist thus can concentrate and devote full attention to care of patient. In fact, at many places including India, the assistant gets on-the-job training from the dentist he serves.

The duties of the dental surgery assistants are as follows:

a. Reception of the patient.

b. Preparation of the patient for any treatment he or she may need.

c. Preparation and provision of all necessary facilities such as mouthwashes and napkins.

d. Sterilization care and preparation of instruments.

e. Preparation and mixing of restorative materials including both fillings and impression materials.

f. Care of the patient after treatment until he or she leaves, including clearing away of instruments and preparation of instruments for reuse.

g. Preparation of the surgery for next patient.

h. Presentation of documents to the surgeon for his completion and filing of these.

i. Assistance with X-ray work and the processing and mounting of X-rays.

j. Instruction of the patient, where necessary, in the correct use of the toothbrush.

k. After care of persons who have had general anaesthetic.

2. Dental Secretary/Receptionist

This is a person who assists the dentist with his secretarial work and patient reception duties.

3. Dental Laboratory Technician

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 known as dental mechanics. The functions of dental technician in addition to the casting of models from impression made by dentists, include the fabrication of dentures, splints, orthodontic appliances, inlays, crowns and special trays.

Denturist is a term applied to those dental lab technicians who are permitted in some states in the US and elsewhere 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 has led to the formation of "denturists". Their craft is called 'denturism'. That is, 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.[2]

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 make impressions and fit dentures but only under the direction of a dentist.

The ADA has vigorously opposed the denturists movement at the political level. The Association’s principal argument is that denturists are unqualified to treat patients and the poor-quality care and even actual harm could result to patients.[5]

4. The 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 intraorally.

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 ancillaries are allowed to conduct fluoride mouthrinsing programmes to groups of schoolchildren. They are, however, not allowed to undertake any intraoral procedures.

5. School Dental Nurse

School dental nurse is a person 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 schoolchildren.

Interest to improve dental conditions among children in New Zealand became evident in 1905. Treatment of children was particularly difficult on account of the distance which often separated small communities. The Dental Nurse Scheme was established in Wellington, New Zealand in 1921 due to extensive dental diseases found in army recruits during World War 1914–

1918. The man who influenced its formation was TA. Hunter, a pioneer in the establishment of a dental school in New Zealand. The name of the school was ‘the dominion training school for dental nurses’. The training was for a period of two years to cover both 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 of between 450 and 700 children.

School dental nurse is accepted as a member of the school. They 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 duties of the school dental nurses as listed by the New Zealand Department of Health Division includes:

a. Oral examination.
b. Prophylaxis.
c. Topical fluoride application.
d. Advice on dietary fluoride supplements.
e. Administration of local anaesthesia.
f. Cavity preparation and placement of amalgam filling in primary and permanent teeth.
g. Pulp capping.
h. Extraction of primary teeth.
i. Individual patient instruction in tooth brushing and oral hygiene.
j. Classroom and parent – teacher dental health education.
k. Referral of patient to private practitioners for more complex services, such as extraction of permanent teeth, restoration of fractured permanent incisors and orthodontic treatment.

6. The Dental Therapist

This is a person 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.[1] In the United Kingdom, they came into being because of a shortage of dentists to work in the school dental service. They are likened to New Zealand type school

dental nurse but, they are not permitted to diagnose and plan dental care. 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 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 training includes clinical caries diagnosis, technique of cavity preparation in deciduous and permanent teeth, material handling and restorative skills, vital pulpotomies under rubber dam in deciduous teeth and extraction of deciduous teeth under local anaesthesia. They have a little training in interpretation of X-rays. They are not trained to provide enodontic care. The dental therapists are widely used in the public dental service.

Apart from Australia and the United Kingdom, other countries using the services of therapists include Hong Kong, Singapore, Vietnam and Tanzania.[2]

7. Dental Hygienist

Earlier, the Ohio college of dental surgery had developed a program for hygienists and assistants in 1910, but it had to be discontinued due to pressure from the dentists. The duration of training is 1–2 years.

As per the Indian Dentist Act of 1948, a dental hygienist means a person not being a dentist or a medical practitioner, who scales, cleans or polishes teeth, or gives instructions in dental hygiene.

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 hygienists work under the supervision of dentists.

The usual functions of dental hygienists are:

a. Cleaning of mouths and teeth with particular attention to calculus and stains.

b. Topical application of fluorides, sealants, and other prophylactic solutions.

c. Screening or preliminary examination of patients as individuals or in

group (school children or industrial employees) so that they may be referred to dentists for treatment.

d. Instruction in oral hygiene.

e. Resource work in the field of dental health.

8. Expanded Functions Dental Auxiliary

They have been referred to as expanded function dental assistant, expanded function dental hygienist, expanded function auxiliary, technotherapist, expanded duty dental auxiliary.

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 direct supervision of a dentist. They are allowed to carry out 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 alongside the dentist and take over routine restorative procedures, as soon as the cavity preparation and base have been completed.[3]

Duties of dental assistant in extended function

1. Retraction of gingiva
2. Impressions for cast restoration, space maintainers, orthodontic appliances
3. Etching of teeth
4. Determine root length and fitting of trial endodontic filling points
5. Pit and fissure sealants.

Duties of dental hygienist in extended function

1. Retraction of gingiva
2. Impressions for cast restoration, space maintainers, orthodontic appliances
3. Temporary stabilization procedures
4. Debridement of the periodontal surgical site
5. Suture placement

In 1958, WHO introduced two new types of auxiliaries.

1. *Dental Licentiate*: He is a semiindependent operator trained for 2 years. Their dental knowledge and skill are equivalent to New Zealand dental nurse. They work under a wider variety of conditions and for all age. Their functions include dental prophylaxis, cavity preparation and fillings of primary and permanent teeth, extraction under local anaesthesia, drainage of dental abscesses, treatment of prevalent diseases of supporting tissues, early recognition of serious 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.

2. *Dental aide*: Among native populations the dental aides provide elementary first aid procedures for the relief of pain, including extraction of teeth under local anesthesia, control of haemorrhage, recognition of dental disease.

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 6 months, followed by a period of field training under direct and constant supervision.

***Frontier auxiliaries*:** They include capable lay people, in particular nurses and former dental assistants with minimum training. Their functions include dental prophylaxis, dental health education, relief of pain, referral, fluoride rinse program, simple denture repairs.

***Future developments*:** Predicting the future is a thankless task at best, and the task of attempting to predict future developments in dental care is more thankless than most. Rate of population growth, types of healthcare systems that evolve, economic developments, consumers demands, and legislative action will all be major factors in shaping the future of the dental care system. Within dentistry, the growth of specialists, the ability to increase productivity in the dental office, and the apparent growing restlessness of auxiliary groups will all exert their influences. The demands of society mean that the cherished autonomy of the dental profession may be curtailed to some extent.

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CHAPTER

15

School Dental Health

It is well recognized that the children of today are the citizens of tomorrow. The prosperity of a nation depends upon the health of its future citizens.

School health is an important aspect of any community health programme. The school health programme is a powerful, yet economical approach towards raising the level of community health. Its basic aim is to provide a comprehensive healthcare programme for children of school going age.

The school age is a formative period, physically as well as mentally, transforming the schoolchild into a promising adult. Health habits formed at this stage will be carried to the adult age, old age and to the next generation. Thus a school dental health service is a giant leap for the improvement of the nation.

Aims of School Dental Service

1. To help every schoolchild appreciate the importance of a healthy mouth.
2. To help every schoolchild appreciate the relationship of dental health, general health and appearance.
3. To encourage the observance of dental health practices, including personal care, professional care, proper diet and oral habits.
4. To correlate dental health activities with the total school health programme.
5. To stimulate the development of resources to make dental care available to all children and youths.
6. To stimulate dentists to perform adequate health services for children.

Peep into the Past

No authentic records are available in India regarding initiation of school health services. Way back in 1909 medical examination of schoolchildren is reported to have been carried out in Baroda city for the first time in India. In 1946, Bhore committee noted that school health services were non-existent in India.

In 1960, Government of India constituted a school health committee to assess the standards of health and nutrition and also assigned the task of suggesting ways and means to improve the health status of school going children.

In 1961, the committee submitted its report, which contained many useful suggestions and recommendations.

In view of the crucial importance of school health, the Government of India constituted a task force to propose an intensive school health service project. The task force submitted its report in 1982 and identified the following reasons for the poor state of school health programme.

1. Lack of transport facilities for the primary healthcare medical officer.
2. Lack of budget for printing health cards, etc.
3. Lack of properly trained schoolteachers, multipurpose workers and other education and health personnel who can ensure effective functioning of the school health programme.
4. Lack of proper documentation and evaluation.
5. Lack of co-ordination between
    - Different schemes and health programmes within the health department.
    - Health department and outside agencies particularly the education department.

The task force then suggested an intensive pilot project fully sponsored by the central government. It was started in 25 blocks from remote and underdeveloped areas of different states in 1982–83. Then in 1984–85 it was extended to 75 more blocks.

The central government's school health project is a step in the right

direction, but it suffers from the major drawback that it is essentially a project of the health department, there being very little coordination with the education department.

COMPONENTS

The school health programme has three major components.[2]

1. Healthy environment
2. Health education
3. Health services

Healthy Environment

This should include not only the sanitation of the school premises but also the surroundings, which have moral, physical and mental effect on the schoolchildren. The site and maintenance of school building is important.[2] The medical officer should advice the school authorities on different items of sanitation such as

a. Water supply
b. Drainage
c. Urinals
d. Latrines
e. Refuse
f. Ventilation
g. Playground.

Health Education

This is the most important element of a school health programme. It does not merely imply inclusion of health lessons in the textbooks but also includes the following.

1. Insisting on high standards of cleanliness.
2. Introducing healthy practices in the diet.
3. Demonstrating personal hygiene like tooth-brushing, cutting nails, dressing of hair. The teacher plays a very vital role in all elements of the school health programme especially in health education.

Personnel involved in Dental Education

1. The dentist
2. Dental hygienist
3. Dental therapist
4. Health educator
5. Classroom teacher

The teaching of oral hygiene is and must be a primary responsibility of the classroom teacher. The teacher's interest in securing dental corrections is a major factor in developing pupil's interest and action. Teachers properly instructed in the principles of oral hygiene and gifted with enthusiasm and persistence can stimulate children to seek dental service.[2]

Other Personal

- The science teacher should be supplied with facts on dental development and dental diseases.
- The physical education teacher must know how to prevent accidents to teeth.
- The nutritionist should be in a position to help put dietary recommendations into action.
- The guidance counselor in a secondary school can assist in personal health counseling.

Dental health education, like education on any other subject, depends on the child's ability to learn and his stage of development.

Kasey suggests some examples of age specific dental subject materials.[2]

Kindergarten

First grade

- Brushing the teeth.
- Rinsing the mouth.

Second grade to fourth grade

- Teach the importance of preservation of the teeth through proper care.
- Teach the importance of visit to the dentist and keeping teeth clean.

Fifth grade to sixth grade

- Teach the importance of good dental health to overall physical health.

Junior high

- This is the scientific age and the beginning of interest in appearance.
- Emphasis can be made on
  - Chemical aspects of tooth formation.
  - Importance of preventive measures.
  - Dental healthcare.
  - Prevention of periodontal disease.

Senior high

Stress the importance of

- Making decisions.
- Scientific causes of dental diseases including periodontal disease, oral cancer and preventive measures.

Problems of Dental Education in Schools

According to Kennedy there are four prime reasons.

1. Decision makers for preschool programmes are not aware of need and effectiveness of preventive dentistry practice that can be accomplished within a school environment.
2. Parents and community leaders are not committed to oral health.
3. Public health officials have not demonstrated aggressive leadership in establishing meaningful school oral health programme.
4. Individual dentist show a little support of school health programmes.

Healthcare Services

It should be promotive, protective and curative as well as rehabilitative. Initial care and maintenance care is together called comprehensive dental care.

COMPREHENSIVE DENTAL CARE

Definition

It is defined as the meeting of accumulated dental needs at the time a population group is taken into the programmes and the detection and correction of new increments of dental disease on a semi-annual or other periodic basis.[2]

Advantages

- Less money spend on permanent teeth
- Interruptions are less
- Psychologically better

Usually self-motivated teenagers are treated here, so it is psychologically better as they are in need for the treatment and because of the same reason they avoid interruption to treatment.

Disadvantages

- Disease has already occurred
- Initial cost of controlling the disease is more
- More dental man-hours required

A strong emphasis on preventive dentistry programmes would reduce the learning time lost in going and coming from a treatment facility as well as actual operative time. In comprehensive care we not only think in terms of eliminating pain and infection but in terms of restoration of serviceable tooth to good functional form, replacement of missing teeth, maintenance care for control of early lesion of dental disease and also preventive and educational measures so that the population may experience a lower prevalence of disease.

Comprehensive Health Service Criteria

1. Provision of adequate preventive, curative and promotive health service.
2. To be as close to the beneficiaries as possible.
3. To have the widest co-operation between the people, the service and the profession.
4. To be available for all irrespective of their ability to pay for it.
5. To look after more specifically the vulnerable and weaker section of the community.
6. To create and maintain a healthy environment both in home and working places. Such a care needs to be complete, competent, continuous, co-ordinate compassionate and for the community.

INCREMENTAL DENTAL CARE

It is defined as a periodic care so spaced that increments of dental diseases 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.[2]

In schoolchildren incremental dental care represents ideal pattern for the care and appreciable incidence of new dental disease is to be expected each year.

In private practice 6 months is the commonest, though not the only interval between the visits. In public health programmes one-year interval is usually employed.

Aim

It is basically a rational approach on annual basis to the dental problems and a plan for life long dental care.

Advantages

1. Aims at prevention and maintenance as the programme starts at an early age. It provides a complete oral examination during early childhood.
2. Initial cost is less.
3. Man-hours for initial care is less.
4. Early lesions of dental caries are treated before the involvement of pulp.
5. Topical and other preventive measures can be maintained on a periodic basis.
6. Periodontal disease is interrupted at/near beginning.
7. Bills for services are equalized and regularly spaced.
8. Child develops the habit of visiting the dentist periodically.
9. The programme helps the community to obtain a favourable impression on the dentist.

Disadvantages

1. Time consuming, e.g. multiple fillings.
2. ***Psychologic*:** Young people develop their own habits, so habits learned in childhood would not necessarily be carried to adulthood.
3. There is exhaustion of financial resources as it is a long and periodic programme.
4. Interruptions in dental healthcare programme may occur due to migration.

Dunning has pointed out that there are several advantages to a school-based programme.

1. The children are available for preventive or treatment procedures.

2. School clinics are less threatening than private offices.
3. A school dental programme facilitates central education on dental subjects.
4. The dental service supplements, the nursing services by helping to provide total health care for schoolchildren.

Student Participation in School Programme

Programmes devoted to schoolchildren have been particularly popular because children have been highly susceptible to dental caries. Many children especially those with the highest disease levels whose families may not be able (or) interested in providing for their oral health needs, do not visit dental offices. Yet virtually all of them attend school and therefore, would be exposed to a school-based programme.[3]

In developing countries like India such care for participation implies awareness and acceptance of modern concepts in health and sickness and it involves a change in traditional pattern of living and availability of basic sanitary amenities.

Philosophically all children should be entitled to receive maximum primary preventive dental care that includes the use of fluorides, pit and fissure sealants, reduced sugar consumption, plaque control and education.

How to Start a School Health Programme?

1. Organize the principals of schools.
2. Motivate and involve the teachers.
3. Provide health education to teachers.
4. Develop resource materials and child-to-child activities.
5. Implement the programme. It is essential to form a coordinating health committee for this purpose, consisting of the principal, teachers, community leaders, parents and children.

SCHOOL DENTAL HEALTH PROGRAMMES[1]

1. Askov Dental Health Education

It is a classical example of a school dental health programme.

Askov is a small farming community in Minnesota. It showed very high dental caries in the initial survey made in 1943 and 1946. During 1949–1957, Minnesota health department supervised a demonstration school dental health programme 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.

Dental findings are available through a 10-year period, which includes:

- 28% reduction in dental caries in deciduous teeth of 3–5 years old.
- 34% reduction in caries in permanent teeth of children 6–12 years old.
- 14% reduction in children 13–14 years old.

The cost of the programme was greater and the caries reduction was smaller than are now occurring with water fluoridation in the same community.

But fluoridation is by no means a substitute for such a programme. Good health habits are valuable even for persons with resistant teeth, and dental care for the indigent is still needed in the fluoridated areas.

2. School Dental Health Nurse Programme

The New Zealand School Dental Nurse Plan was introduced in the year 1921. When the service began, care was offered only to younger school-age children, but eligibility now extends to all children in primary and intermediate school (2 V to 13 V) years of age.

The New Zealand school dental nurse plan has attracted tremendous attention in dental circles all over the world. Other countries that have adopted similar programmes, with modifications to suit the local government include Canada, Britain, Australia, Malaysia, Singapore, Brunei, Hong Kong and Indonesia.

In Canada, Saskatchewan dental nurse programme was introduced in 1974, where children aged 3–12 years are to be treated by dental nurses and services provided are free of direct charge.

In Britain, “New Cross” dental nurse model was introduced in 1962 for school dental service. They also started child-to-child health programme.

Several Australian States have now started wide dental plans in which direct patient care for children up to 15 years of age is provided by dental therapists.

3. Learning About Your Oral Health (A Prevention Oriented School Programme)

Development

'Learning about your oral health' was developed by ADA, Bureau of dental health education and its consultants in response to a request from 1971 ADA house of delegates.

The programme is available to school systems throughout the United States.

Programme Philosophy and Goals

1. Learning about your oral health is a comprehensive programme covering current dental concepts.
2. The goal of the programme is to develop the knowledge, skills, attitudes needed for the prevention of dental disease.
3. The priority of the programme is to develop effective plaque control knowledge and skills.

Programme Implementation

1. The programme format is divided into four levels with specific content for each level.
2. Levels are:
    - Pre-school (for children too young to read)
    - Level 1 (Kindergarten to Std. 3)
    - Level 2 (from Std. 4 to 6)
    - Level 3 (from Std. 7 to 9)
    - Level 4 (from Std. 10 to 12)
3. Supplementary printed material and seven films that specifically co-ordinate with each level have been developed.
4. A plaque control kit is also available.

Cost of Materials

The teaching packet for each level costs $8.00 (₹ 256/-) per level. The cost of plaque control kit for a class of 35 is $12.95 (₹ 426/-).

Programme Evaluation

The behavioural objectives provide the basis for evaluating the effectiveness of lessons at all levels.

4. Tattle Tooth Programme

Development

The tattle tooth programme was developed as a cooperative effort between

- Texas dental health professional organization
- Texas department of health and
- Texas education agency.

Programme Philosophy and Goals

1. Tattle tooth programme relates dental health of the individuals and focuses on a total person.
2. The goal of the programme is to reduce dental disease and develop dental habits to last a lifetime.

Programme Implementation

1. Statewide implementation plan.
2. Teachers are trained to present dental health information.

Cost of Materials

It is less than $1.00 per child.

Evaluation

1. Field testing
2. State wide continuous monitoring

5. Tooth Keeper Programme

Development

Tooth keeper programme originally sponsored by the American society of preventive dentistry. A programme from kindergarten to Std. VI.

Philosophy and Goals

1. Capitalizes on reinforcement activities and helps children to develop personal responsibility for healthcare.
2. Primary goal of tooth keeper programme is education rather than oral hygiene. With emphasis on establishing positive health values.

Implementation

1. Teachers are trained each year by dental health consultants.
2. All necessary information and teaching resources are provided by this system.
3. The teachers are requested to carry out the programme for 16 consecutive weeks.

Cost of Materials

Tooth keeper programme for 6,000 students in 15 schools was $ 11,000 (₹ 35,200/-).

Evaluation

- The patient hygiene performance score (PHPS) has been utilized to evaluate plaque removal both prior and after 16 weeks programme.
- Questionnaires and surveys for parents and teachers are used to determine acceptance of curriculum.

6. THETA (Teenage Health Education Teaching Assistants) Programme

Development

Developed by the United States public health service division of dentistry.

Philosophy and Goals

1. Utilizes qualified dental personnel to train interested high school students to teach preventive dentistry to elementary students.
2. The programme goal is to give young children the knowledge and skills to start them on the way to lifetime of preventive dentistry practice.

Implementation

Suggested guidelines and a THETA teacher's manual are forwarded to the interested party.

Cost of Materials

- Training manual cost is $0.50.
- Plaque control kit for a class of 35 is $8.00.

Evaluation

There is no formal evaluation for a teenage health education teaching assistants programme.

Parent Programme

1. This programme is coordinated by the Texas department of dental health hygienists.
2. It is presented in formats like flip charts, slide, and video cassette.
3. The content covers dental disease problems and their prevention as well as diet.
4. It also describes characteristics of children's dental development

ranging from prenatal to late adolescence.

SCHOOL HEALTH PROGRAMMES IN INDIA

- Dental health is a part of general health in programmes run by certain voluntary association of India. They conduct teacher training programmes in which a dental health is a part of total health curriculum.
- Voluntary agencies like the Lions, Rotary and others conduct school dental health programme.
- Colgate's Bright Smiles, Bright Futures Education Programme (BSBF)—Bright Smiles, Bright Future (BSBF) is committed to educating children about oral healthcare. The aim is to spread awareness among children about the correct oral health habits, basic hygiene and diet, using engaging aids to ensure they retain the learning.
- Indian Dental Association launches 'Smile Through The Millennium' National Oral Health Programme—A key element of the Programme is the 'Oral Health Week' which will be conducted for both the general public as well as school children across the country it will include free dental check-ups, dental health exhibitions, brushing demonstrations as well as contests for children like the Beautiful Smile Contest, Collage Competitions, Painting Competitions and Elocution Contests.
- India Smiles campaign: India Smiles campaign, a joint initiative of Saveetha University and Times of India, to create awareness on the importance of oral hygiene and dental healthcare among the children, their parents and teachers. The children were given pamphlets on maintaining oral health and various types of treatment were suggested. A total of 1,01,309 schoolchildren were screened for dental problems in a single day at 77 centres across the country, earning the event an entry in the Guinness Book of Records

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CHAPTER

16

Payment for Dental Care

Healthcare services traditionally have been provided on a fee for service basis, whereby the patient receives specific services and pays the provider for them directly. This two party system is a private contract in which the only parties involved are the provider and the recipient of services.

Dentistry's entry into the third party system has been relatively recent, but third party dental care is now a major and still expanding part of dental services. As the cost of health care continue to rise, methods will be sought to ease costs either by legislation or by the development of a variety of funding approaches.[3]

The acceleration in the rate of increase of healthcare costs have been attributed to a number of factors, principally

1. The public's increasing demand for health services.
2. The ever-growing technology of health care.
3. The probably higher quality of care now being delivered.
4. General inflation.
5. The lack of incentives in medical care to keep costs down.
6. The increasing practice of "defensive medicine" in which diagnostic tests and prescribed treatment are aimed at avoiding lawsuits rather than at meeting the patients real needs.

MECHANISM OF PAYMENT FOR DENTAL CARE

The mechanism by which dental practitioners receive payment for their services can be grouped into the following general categories.[3]

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 such as delta dental plans and blue cross/blue shield
    c. Prepaid group practice including health maintenance organization and independent practice associations
    d. Capitation plans
4. Salary
5. Public programmes
    a. Medicare
    b. Medicaid
    c. Veterans administration (VA)
    d. National health insurance (NHI)

1. Private Fee for Service

Private fee for service, the two party arrangement is the traditional form of reimbursement for dental services in most countries. Although alternative forms of payment for dental services are growing rapidly, at present the private fee for service arrangement is still the method by which dental patients pay for their care.

Advantages

1. It is culturally acceptable—the concept of the individual establishing a fee for the service rendered is inherent in the way of doing business.
2. It is flexible-fees can be charged in accordance with the market conditions.
3. It is administratively simple.

Disadvantages

In spite of its advantages there are still some potential patients who simply cannot afford the dental care offered. These persons would thus be unable to receive dental care if private fee for service were the only financing mechanism for dental care.

2. Postpayment Plans

It was first introduced in the late 1930’s by local dental societies in Pennsylvania and Michigan. It is also known as budget payment plans.

Under a budget payment plan the patient borrows money from a bank or finance company to pay the dentist fee at the time that the agreement to receive care is made. After the application is approved by the lending institution, the dentist is paid the entire fees less a discount charge. The patient then repays the loan (with interest of course) to the bank in budgeted amounts.

It was developed with the intention of providing dental care to large segments of population, and it was primarily used by people of middle income rather than the low income. It was also primarily to finance for prosthetic treatment. Given the current trend of the widespread use of credit cards, it is unlikely that postpayment plans will develop any further.

3. Private Third Party Prepayment Plans

Third party payment for dental services 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. The third party is also known as the carrier, insurer, underwriter or administrative agent.

Private third party plans are now almost totally prepayment plans. This form of prepayment is frequently referred to as dental insurance.

Reimbursement of Dentists in Prepayment Plans

The preferred method for reimbursement for dentist in prepayment plans is[3] as follows.

***Usual, customary and reasonable (UCR) fee Usual fee*:** The fee usually charged for a given service by an individual dentist to private patients—that is, his or her own usual fee.

***Customary fee*:** A fee is customary when it is in the range of the usual fee charged by dentist 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 these two criteria.

The evolution of the UCR fee concept as a mechanism acceptable to dentists and to carriers has allowed third party dental care to be provided while still permitting the individual dentist to charge what he or she believes the services are worth.

Table of allowances

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. For example, if a third party plan permits a fee of ₹ 80 for a particular service for which the dentists usual fee is ₹ 100, the dentist will carry out the service, pick up ₹ 80 from the carrier and may charge the

patient ₹ 20 to make up the usual fee.

The ADA is opposed to:

1. Capitation
2. Fee schedules

Capitation

A capitation fee is defined as a fixed monthly or yearly payment paid by a carrier to a dentist in a closed panel, based on the number of patients assigned to the dentist for treatment.

The money is paid regardless of whether the patients participate in the plan, receive no care, a little care or great deal of care.

Fee *Schedules*

A fee schedule is defined as maximum dollar allowances for dental procedures that apply under a specific contract. The difference is that a fee schedule is usually taken to mean payment in full, whereas a table of allowance may not.

a. Commercial Insurance Companies

Many persons have dental insurance from commercial insurance carriers than they do from any other type of carriers. The fundamental difference between commercial insurance carriers and others is that commercial insurance carriers operate for profit.

Commercial insurance companies have become competitive through a variety of other mechanisms

- They can be more selective about the group to which it chooses to offer dental insurance.
- They claim no obligation towards the dental health of the community.
- They sometimes arrange an identity programme, which provides specific cash payment reimbursement for specified covered services. These payments can be made directly to the patients or it can be assigned by the patient to be paid directly to the dentist.

- They present attractive total health package to potential purchasers.

Advantages

1. Many pay the dentist directly for provision of covered services and hence payment is quicker and hassle free.
2. They do not conduct fee audits and posttreatment dental examinations to assess the quality of care delivered.

Disadvantages

1. They do not encourage utilization of professional services.
2. In order to allow for the profit margin they need to charge higher premiums.

b. Non-profit Health Service Corporation

1. *Delta dental plans*: In June 1954, the Seattle district dental society in Washington state was approached with a request for a comprehensive dental care programme for children up to 14 years of age. The union was requesting their employers to add a programme of dental care for their children. It was clear that a statewide programme was really being requested, so the Washington States Dental Association soon became involved. Shortly thereafter, the first dental service corporation was born.[1]

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.

As the number of corporations grew and the size of the groups for which dental care benefits were negotiated grew in size, the need for a national organization became apparent. Accordingly the National Association of Dental Service Plans (NADSP) was formed in June 1966. The NADSP changed its name to delta dental plans association in April 1969.

The majority of the board of directors of most delta plans are dentists who are elected from a slate approved by the state dental society. Other board members represent the worlds of finance, insurance, labour and consumer groups.

Delta plans also have specific approaches to ensure the quality of care provided and to keep a programme's costs within its limits. Quality of care is monitored by a series of post treatment examinations, whereby a sample of individual patients who have received care through a Delta plan is examined by a panel of disinterested dentist to ensure that:[1]

1. The care claimed and paid for has in fact been provided.
2. That it is of "acceptable" quality.

Mechanism of cost control includes coinsurance, preauthorization procedures for certain treatment and annual limits on specific items of care that can be expensive, such as orthodontic care. Unlike commercial insurance companies, they do not run on profit and have an obligation towards the community since Delta primarily reflects the view of dental professional and they encourage utilization of services. Delta plans are small in comparison to the giants of the commercial insurance world but they have managed to grow to a healthy state and to compete quite successfully. Delta attractiveness as a carrier rests on

1. Control of costs.
2. Quality assurance procedures.
3. That individual patients know they will not have to pay extra for their treatment, since participating dentist agree to receive payment in full from delta.
4. Wide support from dental practitioners.

Reimbursement of Dentists in Delta Plans

Delta plans use the UCR concept almost exclusively. The way in which a dentist is reimbursed depends on whether the dentist is participating or non-participating in the plan. A participating dentist has a contractual agreement with Delta plan to render care to covered subscribers.[1]

Delta plans encourage all dentists to participate. Those who do agree to the following conditions.

1. Prefiling of their usual and customary fees.
2. Acceptance of payment for their services at the 90^{th} percentile of fees as payment in full, which means they will not assess the patient

for further charges.

3. Fee audits by auditors from Delta. The purpose is to ensure that the dentists are charging their Delta plan patients the same fees as they charge their other patients.
4. Post-treatment inspection of randomly chosen patients. This is to ensure that quality care is rendered.

Non-participating dentist can also treat patients covered under Delta plans and be reimbursed by Delta. They do not need to prefile their fees and are not subject to fee audits, however, they are paid at a lower percentile than the 90^{th}, often at the median, or the 50^{th} percentile.

90^{th} Percentile

The percentiles of a set of data divide the total frequency into hundredths, so that the 90^{th} percentile is that value below which 90 percent of the observations lie.

For example, suppose in a given area there are 100 participating dentists who have filed their fee for a particular service. The fee filed will vary from one dentist to another. In this instance the fee charged vary from ₹ 50 to ₹ 150. If each of these fee is spread out in a frequency distribution, from the lowest to the highest, the result will be as shown in Fig. 14.1.

Only 10 dentists charge ₹ 50 and 20 of them charge ₹ 60 and 30 of them charge ₹ 70 or less and so on. There are a few dentists who charge considerably higher for the service. The 95^{th} percentile is ₹ 140 and the 100^{th} percentile is at ₹ 150. The median fee which is equivalent to the 50^{th} percentile would be ₹ 90. The key point to note is that if payment is made at the 90^{th} percentile, (₹ 120) 90 percent of the participating dentists receive their full fee for the service and only 10 percent of the participating dentists would be less than their usual fee. Non-participating dentist is paid at the 50^{th} percentile.

The rationale behind paying at the 90^{th} percentile is to exclude those dentists at the top end of the scale who charge fees considerably higher than the norm of an area. Thus it is cost control mechanism.

2. *Blue cross/blue shield*: The health service corporations of which blue cross/blue shield is the most important, have for years offered limited dental

coverage as a part of hospital/surgical/medical policies. They have adopted many of the cost control features pioneered by delta plans and in some states it is difficult to distinguish blue cross/blue shield dental plans from delta dental plans in terms of benefits and administration.

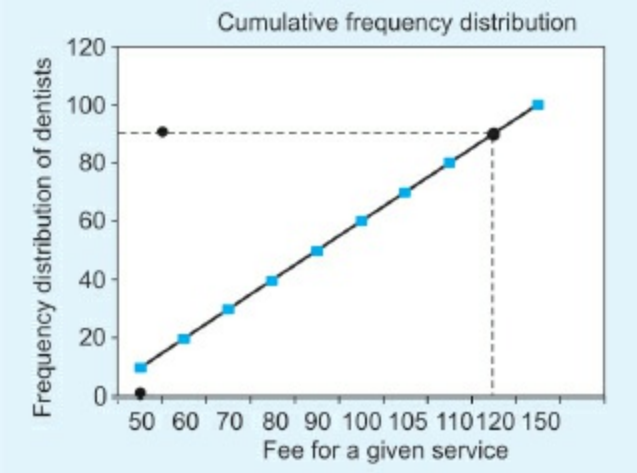


Fig. 16.1: Cumulative frequency distribution of fees for a given dental service

c. Prepaid Group Practice

The term group practice simply means a number of dentists practicing together under certain organizational arrangements. The definition adopted by ADA is as follows: "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."[3]

There is no inherent relation between group practice and prepaid care. Net income in a group practice can be divided equally or prorated according to patient load, years of service, specialty, etc., whereas majority of patients who receive care through group practices do so on the usual private patient fee for service basis. Prepaid group dental practice could move the dental profession closer to the moral and ethical ideals of dentistry than typical fee for service can and that the quality of care improves when the dentist does not have to worry about the patient's ability to pay.

Advantages

1. Better ways of organizing one's life-vacations and continuing education leaves can be planned more readily.
2. Less disruption in practice caused by illness to the dentist.
3. Quality of care is said to be improved.
4. Financial fringe benefits.
5. Economies of scale through the sharing of pieces of equipment, personnel and other resources.

Disadvantages

1. *Personality*: It is essential that dentist in a group be temperamentally compatible.
2. Dentist unlike physicians are taught to work independently and this desire for independence is one reason suggested for the slow growth of dental group practice.

d. Health Maintenance Organisation (HMO)

An 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 payment.[3]

Dental personnel in HMO

1. *Staff model*: Dentists, dental hygienists and dental assistants are salaried employees of the HMO.
2. ***Group model*:** The HMO contracts directly with a group practice, partnership or corporation for the provision of dental services.
3. ***Direct contract model*:** The HMO contracts directly with the individual provider for provision of services.

Independent practice association

It is an association of independent dentists that develops its own management and fiscal structure for the treatment of patients enrolled in an HMO.

e. Capitation Plans

A capitation fee is defined as a fixed monthly or yearly payment paid by a

carrier to a dentist in a closed panel, based on the number of patients assigned to the dentist for treatment.

The money is paid regardless of whether the patients utilize care or not.

Closed panel

Closed panel practice exists when a group of dentists who share office facilities provide stipulated services to an eligible group for a set premium. For beneficiaries of plans using closed panels, choice of dentist is limited to panel members, and dentist must accept any beneficiary as a patient.[1]

Open panel

Any licensed dentist can participate, the beneficiary has choice from among all licensed dentists, and the dentist may accept or refuse any beneficiary.

4. Salary

Dentist in some group practices (especially closed panel clinics), those in the armed forces and those employed by public agencies are salaried. A new graduate beginning a career in an established practice may draw a salary for a temporary period.

Advantages

- Dentist will be largely free of the business concerns of running a practice and thereby allows the dentist to concentrate on clinical matters.
- Fringe benefits are also often attractive.

Disadvantage: Lack of financial incentives.

PUBLIC PROGRAMMES

Dentistry did not play a significant part in the early development of public medical care programmes. Oral health was of relatively little concern in a period when the population was decimated periodically by typhoid, diphtheria, cholera and smallpox. Although a few public clinics were established on a voluntary basis by dentists as early as mid 19th century. Public dental care facilities remained nonexistent for many years. The US public health service did not employ dentists on a regular basis until 1919.[2]

a. Medicare

Title XVIII of the social security amendments of 1965 is the programme known as Medicare. This programme removed all financial barriers for hospital and physician services for all persons over age 65, regardless of their financial means. The expenditure of the programme was considerably higher than estimated in the first few years of operation. By mid 1970s, it had two parts:

Part A: Hospital insurance

Part B: Supplemental medical insurance

Both parts contain highly complex series of service benefit available and both require some payment by the patient. This programme was brought into being because the voluntary health insurance system was unable to provide adequately for persons over the age of 65. The dental segment of this programme is limited to those services requiring hospitalization for their treatment, usually surgical treatment for fractures and cancer.

b. Medicaid

Title XIX of the social security amendments of 1965 is the programme known as Medicaid. The original intent of the programme was to provide funds to meet the healthcare needs of all indigent and medically indigent persons. Expenditures for the programme grew at a more rapid rate than did the total expenditures for all healthcare. In order to qualify for the federal government’s share, the programme must cover at least these basic services.[1]

- Inpatient hospital care.
- Outpatient hospital care.
- Laboratory and X-ray services.
- Skilled nursing care facilities.
- Home health services for individuals aged 21 or older.

In addition it required early and periodic screening, diagnosis and treatment (EPSDT programme) for individual under 21, family planning services and physician services. The EPSDT programme was supported by ADA because for the first time a federal programme mandated dental care for indigent children.

Conclusion

Private fee for service is likely to remain the predominant method of financing dental care in the foreseeable future. The developing countries like India are in a transition period, during which alternative modes of delivery of services and financing of these services will evolve.

Dental professionals must and will adapt to this changing environment. Our responsi

bilities will not diminish; instead we must remain involved to ensure the public of the highest standards of care and professionalism.

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CHAPTER

17

Ethical Issues

Dentistry is treated by society as a learned profession, and therefore dental professionals have a responsibility to society. Society has conferred upon the professions a special status with unique rights and privileges. It is society's belief that professionals place the welfare of the patient above their own welfare, which helps support the independence of the professions in a regulated society. This covenant with society requires professionals to practice in an ethical manner, if society is to continue to accord these special privileges.

Definition

Ethics is defined as the part of philosophy that deals with moral conduct and judgement.

PRINCIPLES

There are several principles that healthcare professionals must be aware of in the practice of their profession. Knowing the names of these principles will not make us more ethical, but understanding the basis for certain behaviours may help us make more carefully reasoned decisions when confronted with ethical dilemmas. The major principles are[1]

1. ***To do no harm (non-maleficence)*:** This principle is attributed to Hippocrates and is considered to be the foundation of social morality.
2. ***To do good (beneficence)*:** It should be the role of dentists and dental hygienists 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 occur.
3. ***Autonomy*:** This principle dictates that healthcare professionals respect the patient's right to make decisions concerning the treatment plan. Patients should not be bystanders in their treatment but active participants. Informed consent both a legal and an ethical concept, is an essential component of a patient's right to autonomy. The following elements should be present.
    - Disclosure of appropriate information.
    - Comprehension of the information by the patient.
    - Voluntary consent.
    - Competence to consent.
4. ***Justice*:** It is described as fairness or equal treatment, giving to each his or her right or due.
5. ***Truthfulness*:** Lying fails to show respect for persons and their autonomy, violates explicit agreements and threatens relationships based on trust.
6. ***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. Confi-detiality must be maintained at all times.

Code of Ethics

All professional organizations have a published code to which members of the profession are expected to adhere. These codes have been developed over a long period of time, they reflect the customs and beliefs of current members of the profession and provide a historic link with the past. The Dental Council of India makes the following regulations for laying down standards of professional conduct.

Duties and Obligations of Dentists toward Patient and Public

1. Every dentist shall be mindful of the high character of his mission and the responsibilities he holds in the discharge of his professional duties and shall always remember that care of the patient and treatment of the disease depends upon the skill and prompt attention shown by him and always remembering that his personal reputation, professional ability and fidelity remain his best recommendation.
2. Treat the welfare of the patient as paramount to all other considerations and shall conserve it to the utmost of his ability.
3. Be courteous, sympathetic, friendly and helpful to and always ready to respond to the call of his patients, and should be polite and dignified.
4. Observe punctuality in fulfilling his appointment.
5. Deem it a point of honour to adhere with as much uniformity as the varying circumstances may admit, to the remuneration for professional services.
6. Not permit consideration of religion, nationality, race, caste and creed, party politics or social standing to intervene in his duties towards his patients.
7. Keep all the information of a personal nature which he comes to know about a patient directly or indirectly in the course of professional practice in utmost confidence. Dental hygienists and dental mechanics and other staff employed by him also observe this rule for the reason that knowledge or information of a patient gained during the course of examination and treatment is privileged, and a dentist is not bound to

disclose professional secret, except with the consent of the patient, or on being ordered to do so by a court of law.

Duties Toward Colleague

1. Cherish a proper pride in his colleagues and shall not disparage them either by actions, deeds or words.
2. On no account contemplate or do anything harmful to the interest of the members of the fraternity.
3. Honour mutual arrangements made regarding remuneration.
4. Retire in favour of the regular dentist, after the emergency is over.
5. Institute correct treatment at once with the least comment.
6. Regard it as a pleasure and privilege to render gratuitous service to another dentist, his wife and family members.

Unethical Practices[2]

1. Employment by a dentist in his professional practice of any professional assistant, not being a registered dental hygienist or a registered dental mechanic whose name is not registered in the state dentists register.
2. Styling by any dentist or a group of dentists his/their ‘dental clinic’ or chambers by the name of dental hospitals.
3. Any contravention of the drugs.
4. Signing under his name and authority any certificate which is untrue, misleading or improper, or giving false certificates or testimonials directly or indirectly concerning the supposed virtues of secret therapeutic agents or medicines.
5. Immorally involving abuse of professional relationship.
6. Aiding in any kind of illegal practice.
7. Promise of radical cure by the employment of secret methods of treatment.
8. Advertising, whether directly or indirectly, for the purpose of obtaining patients of promoting his own professional advantage.
9. Employing any agent or canvasser for the purpose of obtaining

patients.

10. Using of signboards larger than 0.9 metric by 0.6 metric and use of such words as teeth, painless extraction. Other than his name and qualifications as defined under Clause (i) of Section 2 of the Act.
11. Insertion of any paragraph and notice in the press.
12. Allowing the dentists name to be used to designate commercial articles such as toothpaste, toothbrush, tooth powder.
13. Mentioning after the dentists name any other abbreviation except those indicating dental qualifications as
    1. ***RDP*****:** Registered dental practitioner
    2. ***MIDA*****:** Member Indian Dental Association
    3. ***FICD*****:** Fellow of International College of Dentists
    4. ***MICD*****:** Master of International College of Dentists
    5. ***FACD*****:** Fellow of American College of Dentists
    6. ***MRSH*****:** Member of Royal Society of Hygiene and the like which are not academic qualifications.

Change of address and announcement relating thereto

1. A notice for the change of address shall be intimate to the concerned state dental council.
2. A dentist may issue a formal announcement in the press, one insertion per paper, regarding the following.
    a. On starting practice
    b. On change of type of practice
    c. On changing address
    d. On temporary absence from duty
    e. On resumption to practice.

Action of unethical conduct**:** When complaint or information is received by the state dental council, the concerned state dental council may call upon him to explain and after giving him a reasonable opportunity of being heard and after making such enquiries determine the action to be taken against the dentist under Section 41 of the Act.

Legal Vulnerability in Dental Practice

Legal vulnerability in dental practice may be divided into two broad categories (Fig. 17.1).[1]

a. Criminal

b. Civil

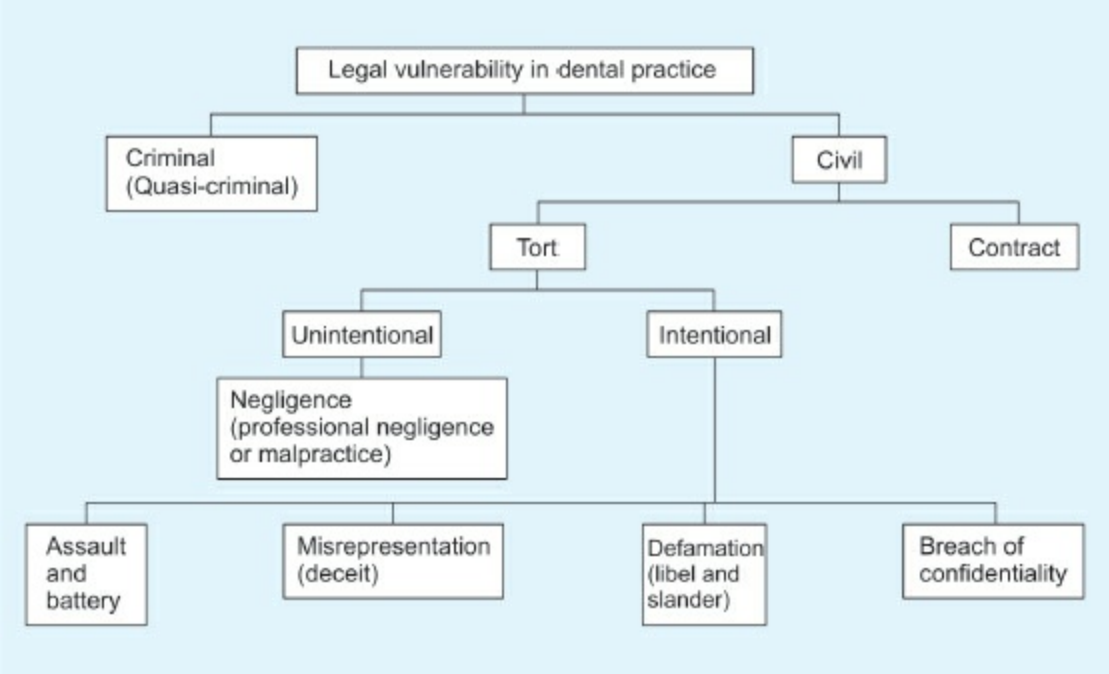


Fig. 17.1: Legal vulnerability in dental practice

a. Criminal

Violations of statutory law are termed crimes. They constitute acts that are deemed by the government to be against public interest.

***The penalties include*:**

- Loss or suspension of license
- Mandatory psychiatric counseling
- Drug rehabilitation
- Mandatory continuing education

- Fines
- Jail term

Violations of administrative laws (state board, state education department) are termed quasi crimes. The penalties include all actions under crimes except the jail term.

Contract

A contract is defined “as an agreement between parties” and can be either verbal or written. In law both are equally binding, but as the parties may have differing recollections of what was said, the advantages of a written agreement are apparent.

I. Doctor-patient contract

A written treatment plan and charge estimate, which is signed by the patient puts the legal foundation of doctor-patient relationship.

Duties owed by the doctor

1. Use reasonable care 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 provides for their proper supervision.
4. Maintain a level of knowledge in keeping with current advances in the profession.
5. Obtain informed consent from the patient before instituting an examination or treatment.
6. Charge a reasonable fee for services based on community standards.
7. Keep the patient informed of her or his progress.
8. Keep accurate records of the treatment rendered by the patient.
9. Maintain confidentiality of information.
10. Make appropriate referrals and request necessary consultations.
11. Comply with all laws regulating the practice of dentistry.

Duties owed by the Patient

In accepting the care, the patient should

1. Follow home care instructions.
2. Appointments will be kept.
3. Patient will co-operate in case.
4. Bills for services will be paid in a reasonable time.
5. That the patient will notify the dentist of a change in health status.

II. Dentist-staff contract

This should include a job description, pay, holiday entitlements, bonuses, loyalty and sickness allowances, disciplinary rules and termination procedures with details of notice required by each party.

Torts

A tort is a civil wrong or injury, independent of a contract, that results from a breach of a duty.

It is of 2 types

1. An unintentional tort is one in which harm was not intended as in the case in tort of negligence.
2. An intentional tort contains the element of intended harm.

If the negligence involves an act that is performed in a professional capacity, it is termed professional negligence or malpractice.

Professional Negligence

It is defined as a failure to exercise reasonable care in one's professional capacity.

Criminal Negligence

For criminal proceedings to be started the negligent action must be very serious and have some accentuating factors (e.g. dentist was drunk or drugged or disregarded well-known safety principles).

Contributory Negligence

When the actions of a patient have been partially (or completely) to blame for the damage that occurred (e.g. failure to follow postoperative instruction).

Vicarious Liability

An employer can be held responsible for any negligence by an employee. A dentist is responsible for the actions or omissions of his staff. A charge of negligence can be brought against both employee and employer.

Legal Remedy

There are many avenues of legal remedy when negligence occurs.

i. ***Criminal liability*****:** IPC Section 304A: Grossly rash or grossly negligent

Act, which is proximate, direct or substantive cause of patient's death.

ii. Civil liability: Indian Contract Act Section 73 and 74.

iii. Indian Medical/Dental Council Act 1948.

iv. Consumer Protection Act 1986.

Trespass to the Person (Assault and Battery)

It constitutes a threat to harm (assault) and unauthorized touching (battery). Traditionally, lack of informed consent to care was treated as assault and battery.

Misrepresentation (Deceit)

Patient must be kept informed of their treatment status. If information is withheld that places a patient's health in jeopardy of deprives the patient of the legal right to bring suit against the practitioner, a legal action (or) fraudulent concealment may result. The problems in dentistry most frequently associated with deceit and fraudulent concealment include the failure to inform the patient when an instrument breaks off in a root canal, when a root is fractured and the tip remains in the jaw, and when the dentist is aware that the services of the treatment will be compromised because of lack of co-operation by the patient.

Defamation

It is the publication of false statement which lowers the reputation of a man. Defamation can be statements with the intention of discrediting a person, expressing hatred contempt or ridicule.

Breach of Confidentiality

Information obtained from the patients in the course of diagnosis (or) treatment must remain confidential.

The patient's dental record is a legal document. It serves many purposes in the judicial process. It contains information about the patient's complaint, health history, and basis for the diagnosis, and it reports all treatment rendered, the patient's reaction to treatment, and the results of the treatment. Case law requires that health practitioners keep accurate records of the

diagnosis and treatment of their patients.

At one time, doctors had the exclusive right to the possession of the record and its contents. Today, the doctor is considered the custodian of the record and the patient has a property right in its contents. If the patient demands in writing to be sent a copy to the treatment record or demands that a copy be sent to another practitioner or to any other person or agency, you should comply with the request.

Consent

The general principle that a doctor who treats a patient without the patient's consent is guilty of unauthorized touching, for which the doctor can be held liable to the patient in damage.

Treatment without any consent is assault. Therefore to be valid, consent should be "informed".

Content of Consent

The patient must be informed of all the following:

1. Description of the proposed treatment
2. Material or foreseeable risks
3. Benefits and prognosis of proposed treatment
4. Alternatives to proposed treatment
5. Risks, benefits and prognosis of the alternative treatments.

All these factors must be described to the patient in language the patient understands and the patient must be given an opportunity to ask questions and have questions answered.

CONSUMER PROTECTION ACT

The Consumer Protection Act was passed by the Parliament in 1986.

***It was passed with a view to*:**

- Provide for the better protection of the interests of the consumers.
- Establish consumer councils to educate the public.
- Creation of authorities for the settlement of consumer disputes.
- Provide quicker and cheaper remedy, when there is deficiency in servicing and claims for damages.

The Act

***Section 2(1)(d)(ii) of the Act*:** "Consumer" means any person who hires or avails of any services for a consideration which has been paid or promised or partly paid and partly promised or under any system of deferred payment.

***Section 2(1)(o) of the Act*:** "Service" means service of any description which is made available to potential users. Healthcare services will be service, if they are obtained for consideration.

***Section 2(1)(o) of the Act*:** ... and that in the event of any deficiency in the performance of such services, the aggrieved party can invoke the remedies provided under the Act by filing a complaint before the consumer forum having jurisdiction.

Inclusion Criteria

- Services rendered by a medical practitioner or hospital by way of consultation, diagnosis and treatment on payment by all or some and free of charge to others falls within the Act.
- Services rendered to persons, whose charges are borne by an insurance company or employer as part of the conditions falls within the Act.

Exclusion Criteria

- Services rendered where no charge whatsoever is made from any person (rich or poor) availing services are given free service is outside the purview of Act.

The Consumer Forum

It consists of:

a. ***District forum*:** It consists of 3 persons.

One district judge

Two persons known for ability, integrity knowledge of economics, law, commerce, accounting, industry or administration, one of whom shall be a woman. The forum can entertain complaints where the compensation claimed does not exceed 5 lakhs.

b. ***State commission*:** It consists of 3 persons.

One judge of high court

Two persons known for ability, integrity knowledge of economics, law, commerce, accounting, industry or administration, one of whom shall be a woman.

The commission entertains complaints where the compensation claimed is between 5 lakhs and 20 lakhs and also appeals against the orders of the district forum.

c. ***National commission*:** It has five members.

Judge of supreme court

Four persons known for ability, integrity knowledge of economics, law, commerce, accounting, industry or administration, one of whom shall be a woman.

***Consumer protection councils*:** The objectives of the council is:

- Promotion and protection of the rights of consumers
- Consumer education.

Central consumer protection council is headed by minister in charge of the food and civil supplies.

State consumer protection council constituted in line with the central council and the members constituted by the state government.

Arguments for and Against

CPA is a piece of comprehensive legislation and recognizes 6 rights of the consumer. Right to safety, right to be informed, right to choose, right to be heard, right to seek redressal, right to education.

The medical community is fighting against the inclusion of medicare under CPA.

Arguments for CPA

1. Doctors are not above law.
2. Doctors are accountable for their actions.
3. Medical councils cannot give compensation.
4. Speedy Justice does not mean a summary trial. The procedures followed in civil courts are applicable to consumer forums.
5. Malpractice suits are decided by civil courts.
6. The composition of the forum is such that the decisions will be made on the basis of law, reasonableness, fairness and good faith.

Arguments Against CPA

1. Medical services cannot be compared to household appliances.
2. Medical services are personal in nature and not the type offered by manufacturers of consumer products.
3. The state medical councils are the authorities to hear complaints of such nature.
4. Doctors would be harassed, corruption will seep in.
5. Patient will be the loser, as doctors will not attend to patients with even slightly complicated ailments.
6. Doctors will practice defensive medicine.
7. Forum consists only of non-professional people, who cannot appreciate the complex issues in medical care.

8. If the complaint is dismissed, the reputation of the doctor is at stake.
9. Only the commission has a judicial background ground, in case of difference of opinion, majority will prevail.

***What to do and what not to do if you are used*:**

If a patient threatens you in writing with or suit, if you receive a letter threatening suit from an attorney representing a patient, or if you receive a summons, the following apply.

***Things to do*:**

1. At the earliest time after receiving the letter (or) summons, report it to your insurance carrier by telephone.
2. Make a copy of the papers and send the originals to your carrier, use certified mail, signed receipt request. Include a copy of any envelope that contained the papers.
3. Write a summary of the treatment of the patient using the treatment record to refresh your memory. Include all you recall, even if it is not on the record. Sign and date the summary.
4. Make a copy of the records, including radiographs, reports, and the summary, lock the originals in a safe place.
5. Tell your staff about the suit and instruct them not to talk to anyone asking questions about the case without obtaining your permission.
6. Co-operate with your insurance carrier and the attorney assigned by it to your case.

***Don't do the following*:**

1. Tell the patient or her or his representative that you are insured.
2. Agree to or offer a settlement
3. Agree to or offer to pay for a specialists services without first consulting with your carrier or the attorney assigned to your case
4. Alter your records in any way
5. Lose or misplace any of your records
6. Discuss the case, of the treatment of the patient, with anyone except representatives of your insurance company or the attorney assigned to

your case

7. Admit fault or guilt to anyone.
8. Contact any other practitioners about the case even if the practitioner has written a report.
9. Agree to or treat the patient—plaintiff during the course of the action.

FORENSIC DENTISTRY

Forensic dentists or odontologists, provide the dental component to determine the identity of a body when visual identification or methods such as DNA profiling and fingerprinting are inadequate or not possible. Forensic dentistry has a major role in the identification process of a diseased person of unknown identity.

Forensic Team

There are two types of dental identification team:

1. Traditional dental team which consists of chief forensic dentist and includes dentists, hygienists and dental assistants.
2. Disaster mortuary operational response team (DMORT) consists of a dental team, forensic pathology team, anthropology and laboratory support, photographic and communication support, logistics team and mortuary science team.

Dental Identification

Teeth are the most durable organs in the body, able to survive temperature of 1600 degree celsius and remain virtually intact long after other soft or skeletal tissues have decayed or been incinerated. Hence they are recognized as one of the most valuable individualizing features of the human body and so used for identification.

Dental identification process involves:

a. Post-mortem assessment (physical characteristics of the diseased)

The odontologists obtains post-mortem dental information which includes,

- Visual examination of the oral structure (endodontic treatment, implants, charting of existing restoration, tori, unusual anatomic features, etc.)
- Radiograph (full mouth, bitewing and panoramic)
- Photograph (facial and intraoral)
- Impressions

b. Ante-mortem assessment (physical characteristics made prior to death)

Ante-mortem dental information to be gathered includes

- Original radiographs.
- Original complete dental records
- Availability of dental models used for diagnostic purpose or for fabrication of prosthesis.

When all post-mortem and ante-mortem information is obtained and charted, the results can be compared and a conclusion reached with a high degree of reliability and simplicity.

Personal Identification

The teeth, jaws and orofacial characteristics are used for personal identification. The three types of personal identification system are:

1. ***Comparative dental identification*:** It involves the comparison of post-mortem and ante-mortem dental records to determine if the body is that of the person of interest.
2. ***Reconstrutive post-mortem dental profiling*:** It is used when there is no suspicion as to the identity of the decedent.
3. ***Dental DNA profiling*:** It is used when dental records are unavailable. It focuses on the application of modern forensic DNA profiling methods to oral tissues.

Conclusion

The increasing use of sealants and composite resins are challenging the reliability and accuracy of dental identification methods. Forensic dentistry will, however, remain an important tool for identifying a diseased person of unknown identity.

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2. Sathe. PV. Textbook of Community Dentistry. 2nd edition.

CHAPTER

18

Dentists Act and Association

The Dentist 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 the following chapters with their subsections as contents.

DENTIST ACT

Chapter I

Introductory

1a. Short title and extent.
2. Interpretation.
2a. Construction of reference to laws not in force in Jammu and Kashmir.

Chapter II

Dental Council of India

3. Constitution and composition of council.
4. Incorporation of council.
5. Mode of elections.
6. Term of office and casual vacancies.
7. President and vice president of council.
8. Staff, remuneration and allowances.
9. The executive committee.
10. Recognition of dental qualification.
11. Qualification of dental hygienist.
12. Qualification of dental mechanics.
13. Effect of recognition.
14. Power to acquire information as to courses of study and training and examination.
15. Inspections.

15a. Appointment of visitors.

16. Withdrawal of recognition.

16a. Withdrawal of recognition of recognized dental qualification.

17. Mode of declarations.

17a. Professional conduct.

18. The Indian register.
19. Information to be furnished.
20. Power to make regulations.

Chapter III

State Dental Council

21. Constitution and composition of state council.
22. Inter-state agreements.
23. Composition of joint state councils.
24. Incorporation of state councils.
25. President and vice president of state council.
26. Mode of elections.
27. Term of office and casual vacancies.
28. Staff, remuneration and allowances.
29. Executive committee.
30. Information to be furnished.

Chapter IV

31. Preparation and maintenance of register.
32. First preparation of register.
33. Qualification for entry on first preparation of register.
34. Qualification for subsequent registration.
35. Scrutiny of applications for registration.
35a. Special provision for amending the register, of dentists.
36. Register of dental hygienist and dental mechanics.
37. Qualification for registration as a dental hygienist.
38. Qualification for registration as a dental mechanic.
39. Renewal fees.
40. Entry of additional qualifications.
41. Removal from register.
42. Restoration to register.
43. Bar of jurisdiction.
44. Issue of duplicate certificate.
45. Printing of register.
46. Effect of registration.
46a. Transfer of registration.

Chapter V

Miscellaneous

47. Penalty for falsely claiming to be registered.
48. Misuse of titles.
49. Practice by unregistered persons.
50. Failure to surrender certification of registration.
51. Companies not to engage in dentistry.
52. Cognisance of offences.
53. Payment of part of fees to be council.
53a. Accounts and audit.
54. Appointment of commission of enquiry.
55. Power to make rules.

1. 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.

2. 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 anytime resign his membership and the seat of such member shall thereupon become vacant.

iii. Member of the council shall be eligible for re-election or re-nomination.

3. President and Vice President of Council

i. The president and vice president of the council shall be elected by the members, from among themselves.

ii. An elected president or vice president shall hold office for a term not exceeding five years. He shall be eligible for reelection.

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 consists of the president and vice president ex-officio and the director general of health services ex-officio and five others 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.

Functions and Responsibilities

The Dental Council of India is the 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 BDS degree.

b. Minimum physical requirements of a dental college.

c. Minimum staff pattern for undergraduate dental studies in colleges

with 40, 60 and 100 number of admissions.

d. Basic qualifications and teaching experience required to teach BDS and 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 exam for BDS and MDS.

h. ***Dental curriculum*****:** Time and subject specifications to clinical programme and field programme, syllabus, etc.

INDIAN DENTAL ASSOCIATION

The Indian Dental Association was formed in the year 1949 soon after the Dentists Act 1948 was passed in the Indian Parliament, before which, it was known as All India Dental Association. The association was registered in Delhi in 1967 with register number, S/265.

Objectives

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 improvement of public health and education in India.
3. The maintenance of the honour and dignity and the upholding of interests of the dental profession and co-operation between the members thereof.

Functions

The functions of IDA include:

1. Holding periodical meetings and conferences of the member of the association and of the dental profession in general.
2. Publishing and circulating a journal adopted to the needs of dental profession in India.
3. Encouraging the opening of libraries.
4. Publishing the papers from time to time related to dental researches.
5. Encouraging research in dental and allied sciences with grants out of funds of the association by the establishment of scholarships and maintain international contacts with foreign dental association.
6. Conducting an educational campaign in the matter of oral hygiene.
7. To consider and 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.
8. Protects public from unethical treatment from unqualified practitioners.
9. Trying to set exemption from custom duty for essential dental materials and instruments.

Structure of the Association

The association has got a registered office in India where the honorary general secretary resides. There are mainly 2 types of branches.

1. Local branches are situated either at district headquarters or in other places in the district.
2. State branches have their headquarters within their respective state and are made up of various local branches with the state.

Membership

Dental practitioners registered under Indian Dentist Act 1948 are eligible to become a member of the association.

a. ***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.

b. ***Ordinary members*:** Dental practitioners and other members of dental profession eligible to become a member of the association.

c. ***Direct members*:** Persons eligible for membership but who are not residing or practicing in the area of a local branch.

d. ***Student members*:** Undergraduate students of recognized dental institution are student members.

e. ***Affiliated members*:** Non-residential foreign dental practitioners having dental qualification according to schedule are eligible to become affiliated members. All affiliated members will be attached only to the head office.

f. ***Associate members*:** Persons registered with the Medical Council of India.

Privileges

1. All members 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 meeting, 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

For the proper management of the association, the following office bearers are elected.

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 head office, is located. Local branches also have office bearers of the same grade. Each of the office bearers has their own duties, powers and tenure.

Section

E

Preventive Dentistry

19. Prevention of Oral Diseases

20. Primary Preventive Services

21. Fluorides in Caries Prevention

CHAPTER

19

Prevention of Oral Diseases

Oral health problems arise mainly as a result of two oral diseases: Dental caries and periodontal disease. Although the prevalence of these two diseases is changing, it remains true that virtually every adult in the world has experience of either one disease or both.

Satisfactory oral health is difficult to achieve throughout the developing world not only because of increase in oral diseases but also because of lack of preventive programmes. This chapter looks into a preventive approach of dental diseases, which can be implemented at all levels of development.

Prevention

(Blackerby) It is defined as the efforts, which are made to maintain normal development, physiological function and to prevent diseases of the mouth and adjacent parts.

(Learell and Clark) It is defined as the interception of the disease process.

Preventive Dentistry

It encompasses all aspects of dentistry and those practices by dental professionals, individuals and communities that affect oral health. It has been conceptualized in a number of ways.

LEVELS OF PREVENTION (Table 19.1)

I. Primary Prevention

It is defined as the "action taken prior to the onset of disease, which removes the possibility that a disease will ever occur".[2]

The concept of primary prevention is now being applied to the prevention of chronic diseases such as coronary heart disease, hypertension, dental caries, periodontal disease based on elimination or modification of "risk factors" of disease. The WHO recommended the following approaches for the primary prevention of chronic diseases where the risk factors are established:

1. Primordial prevention
2. Population (mass) strategy
3. High risk strategy.

Table 19.1: Levels of prevention

Levels of prevention	*Primary*	*Secondary*	*Tertiary*
Priorities of prevention	Prevention of disease initiation	Prevention of disease progression and recurrence	Prevention of loss of function
Taxonomy of prevention	Prepathosis	Intervention	Replacement
Preventive services	Health promotion Specific protection	Early diagnosis and prompt treatment	Disability Limitation Rehabilitation

Primordial Prevention

This is primary prevention in its purest sense. In primordial prevention efforts are directed towards discouraging children from adopting harmful lifestyles (use of tobacco, eating patterns, adverse oral habits). The main intervention is through individual and mass education.[2]

Population (Mass) Strategy

This approach is directed at the whole population irrespective of individual

risk levels. For example, water fluoridation.

High Risk Strategy

The high risk strategy aims to bring preventive care to individuals at special risk. This requires detection of individuals at high risk.

Primary prevention is a desirable goal. To have an impact on the population, all the above three approaches should be implemented.

II. Secondary Prevention

It employs routine treatment methods to *terminate* a disease process and to *restore* tissues to as near normal as possible.

III. Tertiary Prevention

It employs measures necessary to *replace* lost tissues and to *rehabilitate* patients to the point that function is as near normal as possible after the failure of secondary prevention.

PREVENTIVE SERVICES

These are also the modes of intervention, which can be defined as any attempt to intervene or interrupt the usual sequence in the development of disease in man. The modes of intervention are

1. Health promotion
2. Specific protection
3. Early diagnosis and treatment
4. Disability limitation
5. Rehabilitation

Health Promotion

Health promotion 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 approaches. The well-known interventions in this area are:[2]

1. Health education
2. Environmental modifications
3. Nutritional interventions
4. Lifestyle and behavioural changes

Specific Protection

To avoid disease altogether is the ideal but this is possible only in a limited number of cases. The following are some of the currently available interventions aimed at specific protection.

1. Immunization.
2. Chemoprophylaxis.
3. Protection against occupational hazards, accidents, carcinogens.
4. Use of specific nutrients.

Early Diagnosis and Treatment

Early detection and treatment are the main interventions of disease control. The earlier a disease is diagnosed and treated the better it is from the point of view of prognosis and preventing the occurrence of further cases or any long-term disability.

Disability Limitation

When a patient reports late in a pathogenesis phase, the mode of intervention is disability limitation. The objective of this intervention is to prevent or halt the transition of the disease process from impairment to handicap. Disability is defined as any restriction or lack of ability to perform an activity in the manner or within the range considered normal for a human being.

Rehabilitation

Rehabilitation is defined as the combined and coordinated use of medical, social, educational, vocational measures for training and retraining the individual to the highest possible level of functional ability.

PREVENTION OF ORAL DISEASES

The global perspectives of preventive dentistry is based on the premise that every oral health activity implemented by the individual, the community or the dental professional is targeted towards the prevention of some aspects of the health-disease continuum. Coordinated efforts by the individual, community and the dental professional are needed to attain and maintain optimum oral health because of the complexity of disease etiology. A multitude of preventive dentistry services targeted towards dental caries, periodontal disease, oral cancer and oro-facial defects, malocclusion and accidents, are presented in the Tables 19.2–19.5.

Table 19.2: Prevention of dental caries[1]

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 sufficient fluoridated water. Appropriate use of fluoride prescriptions. Use of fluoride dentifrice. Oral hygiene practices	Self examination and referral, use of dental services	Use of dental services	Use of dental services
Services provided by the community	Dental health education programs, promotion of research and lobby efforts	Community or school water fluoridation, school fluoride mouth rinse, tablet and sealant 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, plaque control program, diet counselling, recall reinforcement, dental caries activity tests	Topical application of fluorides, fluoride supplements and rinses, pit and fissure sealant	Complete examination: Prompt treatment of incipient lesions, preventive resin restoration, simple restorative dentistry, pulp capping	Complex restorative dentistry, pulpotomy, root canal therapy, extractions	Removable and fixed prosthodontics minor tooth movements, implants

Table 19.3: Prevention of periodontal disease[1]

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	Oral hygiene practices	Self examination and referral, use of dental services	Use of dental services	Use of dental services
Services provided by the community	Dental health education programs, promotion of research and lobby efforts. 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, plaque control program, recall reinforcement	Correction of tooth mal-alignment, prophylaxis	Complete examination, scaling and curettage, corrective, restorative and occlusal services	Deep curettage, root planing, splinting, periodontal surgery, selective extraction	Removable and fixed prosthodontics minor tooth movement

Table 19.4: Prevention of oral cancer[1]

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, use of dental services	Use of dental services	Use of dental services
Services provided by the community	Dental health education programs, promotion of research and lobby efforts		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 in oral cavity	Complete examination, biopsy, oral cytology, complete excision	Chemotherapy, radiation therapy, surgery	Maxillofacial and removable prosthodontics plastic surgery, speech therapy, counselling

Table 19.5: Prevention of orofacial defects, malocclusion and accidents

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		Use of protective devices, habit control	Use of dental services	Use of dental services	Use of dental services
Services provided by the community	Dental health education programs; promotion of protective garb, lobby efforts	Mouth guard program, safety of children's toys, safety of school buildings and playgrounds	Provision of dental services	Provision of dental services	Provision of dental services
Services provided by the dental professional	Patient education	Caries control, space maintainers, genetic counseling prenatal care, parental counseling	Minor orthodontics	Major orthodontics, surgery	Maxillofacial fixed and removable prosthodontics plastic surgery, speech therapy, counselling

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2. Park K. Textbook of Preventive and Social Medicine. 16th edition.

CHAPTER

20

Primary Preventive Services

PLAQUE CONTROL

Plaque control is the removable of microbial plaque and the prevention of its accumulation on the teeth and adjacent gingival surfaces. Plaque control also retards the formation of calculus. Removal of microbial plaque leads to the resolution of gingival inflammation in its early stages.[2]

Plaque control is an effective way of treating and preventing gingivitis and is therefore a critical part of all the procedures involved in the prevention of periodontal diseases.

To date, the most dependable mode of controlling microbial plaque is still by mechanical cleansing with a toothbrush and other hygiene aids. Considerable progress has also been made with chemical inhibitors of plaque incorporated in mouthwashes or dentifrices.

Plaque control is one of the keystones of the practice dentistry.

Classification

I. Mechanical plaque control

1. Toothbrushes
    a. Manual toothbrushes
    b. Electric toothbrushes (powered tooth brushes)
2. Interdental oral hygiene aids
    a. Dental floss
    b. Dental floss holder
    c. Dental floss threader
    d. Knitting yarn
    e. Pipe cleaner
    f. Gauze strip
    g. Interdental tip stimulator
    h. Wedge stimulator
    i. Toothpick
    j. Toothpick holder
    k. Interdental brush and swab
    l. Tongue cleaner
    m. Metal pick instrument
3. Dentifrices

II. Chemical plaque control

1. Antibiotics
2. Phenols
3. Quaternary ammonium compounds
4. Bisbiguanides
5. Enzymes
6. Metallic salts
7. Oral Irrigation devices

I. Mechanical Plaque Control

Calculus formation is reduced significantly by proper plaque control. Bacterial plaque can be removed effectively by mechanical means. Mechanical plaque control is safe and effective. It permits the patients to assume responsibility for their own oral health.

1. Toothbrush (Manual)

A manual toothbrush is made up of handle, a head and bristles. When the bristles are bunched together, they are known as tufts. There is a constriction between handle and the head, termed the shank. The head is arbitrarily divided into the toe, which is at the extreme end of the head and the heel, which is closest to the handle. Toothbrushes are manufactured in three different sizes, large, medium and small to adapt to the oral anatomy of different individuals. Toothbrushes also differ in their defined hardness or stiffness, usually classified as hard, medium and soft (Fig. 20.1).[5]

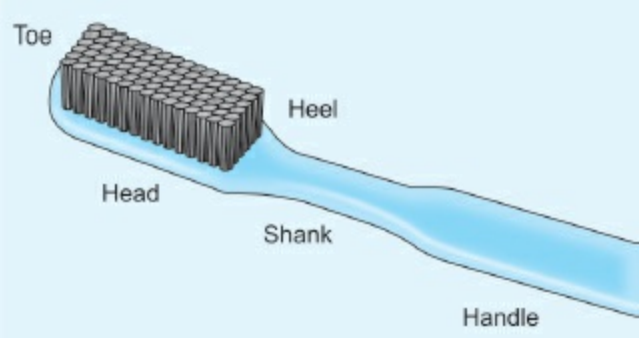


Fig. 20.1: Manual toothbrush

2. Electric Toothbrush

The head of the electric toothbrush is smaller than the manual toothbrush and is removable for replacements (Fig. 20.2). The three basic patterns that the head follows when the motor is started are:

1. ***Reciprocating*:** A back and forth movement.
2. ***Arcuate*:** Up and down movement
3. ***Elliptical*:** A combination of reciprocating and arcuate.



Fig. 20.2: Electric toothbrush

***Special uses of electric toothbrush*:**

1. Parental brushing of children's teeth.
2. For patients who are physically handicapped.
3. Mentally retarded patients.
4. Aged patients.
5. Patients with poor dexterity.

Table 20.1: Toothbrushing methods

Technique	*Bristles positioning*	*Brushing motion*	*Effect claimed*
Horizontal scrub	90 to tooth	Horizontal strokes	Supragingival cleansing
Fones	90 to tooth	Large circles over teeth and gingiva	Supragingival cleansing
Stillman	45 to apex; part on gingival margin, part on cervix of tooth	Vibratory pulsing	Gingival stimulation
Modified Stillman	45 to apex; part on gingival margin, part on cervix of tooth	Sweep occlusally	Supragingival cleansing
Charters	90 to tooth	Circular vibratory	Gingival stimulation, interproximal cleansing
Modified Charters	90 to tooth	Sweep occlusally	Supragingival cleansing
Bass	45 apex; in sulcus	Vibratory horizontal	Subgingival cleansing, gingival stimulation
Modified Bass	45 apex; in sulcus	Sweep occlusally	Supragingival cleansing

Toothbrushing methods and the brushing motions used in toothbrushing (Table 20.1):

Motions used	***Methods***
i. Horizontal reciprocating	Scrub
ii. Vibratory	Bass Stillman's Charters'
iii. Vertical sweeping	Rolling stroke Modified Bass Modified Stillman's Modified Charters'
iv. Rotary	Fones

*2. Interdental Oral Hygiene Aids (**Fig. 20.3**)*

Interdental oral hygiene aids are used to remove plaque and debris that are adherent to the teeth, restorations, orthodontic appliances, and gingiva in the interproximal embrasures. It polishes the surfaces as it removes the debris. They are used for massaging the interdental papillae and to reduce gingival bleeding. Interdental cleaning aids contribute to general oral sanitation and the control of halitosis.



Fig. 20.3: Flossing method

3. Dentifrices

Dentifrice is defined as a substance used with a toothbrush for the purpose of cleaning the accessible surfaces of the teeth. Dentifrices are available as tooth powders, toothpastes, liquids and gels. They are either cosmetic or therapeutic.[1]

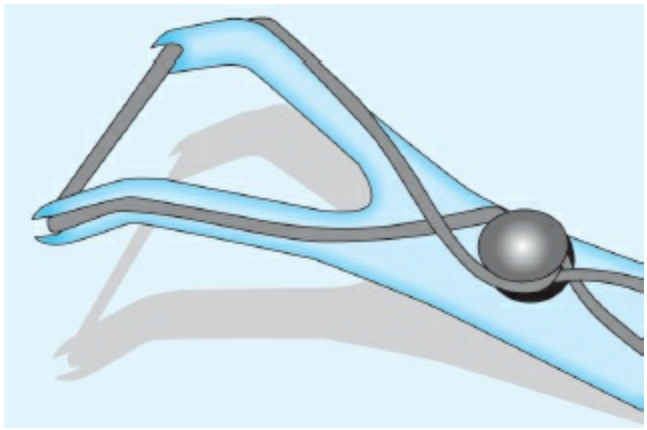


Fig. 20.4: Dental floss holder

Cosmetic Dentifrice

It must clean and polish the teeth.

Therapeutic Dentifrice

It must reduce some disease process in the mouth. Usually, to reduce caries

incidence, gingivitis, calculus formation, tooth sensitivity.

Dentifrice Ingredients

Abrasives	→	20–40%
Water	→	20–40%
Humectants	→	20–40%
Foaming agent	→	1–2%
Binding agent	→	2%
Flavouring agent	→	2%
Sweetening agent	→	2%
Therapeutic agent	→	2%
Colouring or preservative	→	1%

Abrasives

Calcium carbonate and calcium phosphates were previously the most common abrasives used. Now, silicon oxides, aluminium oxides and granular polyvinyl chlorides are used. Abrasives often dull the tooth luster. To compensate for this, polishing agents are usually added. Small-sized particles of aluminium, calcium, tin, magnesium or zirconium compounds are used as polishing agents.

Humectants

Humectants are added to maintain the moisture. Sorbitol, mannitol and propylene glycol are the most common humectants. It helps to maintain the consistency of the paste.

Foaming Agent: Soaps and Detergents

Sodium lauryl sulfate and sodium N-lauroyl-sarcosinate are probably the most used detergents. They are stable, possess some antibacterial properties, and have a low surface tension, which facilitates the flow of the dentifrice over the teeth.

Flavouring Agent

Flavour must be pleasant, provide an immediate taste sensation and have a relatively long-lasting flavour.

Sweetening Agent

Saccharin, sorbitol and mannitol serve as sweetening agents. Glycerine, which also serves as humectants, adds to the sweet taste.

Preservative

Benzoic acid is used as a preservative to prevent bacterial growth on binding agent.

II. Chemical Plaque Control (Table 20.2)

Chemical control of dental plaque may involve prevention of plaque formation, removal on dispersion of existing plaque, inhibition of calcification of existing plaque, or altering the pathogenicity of plaque. Chemicals interfere at various stages of development of plaque.[3]

1. Microorganisms responsible for plaque formation may be eliminated or reduced in number.
2. The formation of bacterial and salivary products which constitute the intermicrobial substance in plaque may be inhibited.
3. Established plaques may be dissolved.
4. Calcification of plaque may be counteracted.
5. Colonization of bacteria on the tooth surface may be inhibited.
6. Pathogenicity of plaque may be reduced by interference with the metabolism of plaque bacteria.

Table 20.2: Chemical plaque control

Antibiotics	*Enzymes*	*Bisbiguanides*
Penicillin	Protease	Chlorhexidine
Vancomycin	Lipase	Alexidine
Kanamycin	Nuclease	Octenidine
Erythromycin	Dextranase	
Niddamycin	Mutanase	
Spiromycin	Glucose oxidase Amyloglucosidase	

Quaternary ammonium compounds	*Phenolic compounds*
Cetypridinium chloride	Thymol
Benzalconium chloride	Eucalyptol 2-phenyl phenol 4-hexyl resorcinol

Fluoride	*Oxygenating agents*	*Natural products*	*Other antiseptics*
Sodium fluoride	Peroxide	Sanguinarine	Iodine
Sodium mono fluoro-phosphate			Povidone-iodine
Stannous fluoride			Chloramine T
Amine fluoride			Hexetidine triclosan

Antibiotics

Penicillin, vancomycin, erythromycin, nidda-mycin and kanamycin were tried as antiplaque agents. Vancomycin is a bacterial antibiotic and is poorly absorbed after oral dose. It was found to be quite effective in hospitalized patients for control of plaque formation.

Phenols

Antibacterial action of phenols depends on its ability to penetrate the lipid component of the cell walls of gram negative organisms. Listerine is a phenol, containing mouthwash that is widely used. It has been found to be an effective inhibitor of plaque formation when used as an adjunct to mechanical

methods.

Enzyme Preparations

Enzymes capable of breaking down the matrix of already formed plaque were considered for inhibition of plaque and calculus formation.

For example, mucinase, dehydrated pancreas, mutanase, dextranase, etc.

Quaternary Ammonium Compounds

These are cationic antiseptics and surface active charge, which reacts with the negatively charged cell membrane phosphates and the cell wall structure of microorganism is disrupted.

Cetylpyridinium and benzethonium chloride have been found to inhibit plaque.

Bisbiguanides

Chlorhexidine gluconate and alexidine are the most effective antiplaque agents. Chlorhexidine may bind to anionic acid groups on salivary glycoproteins thus reducing plaque formation. It reduces the gingival inflammation also.

0.2% Chlorhexidine solution used as mouth rinse twice daily is quite effective in total plaque inhibition.

Metallic Salts

Zinc sulphate and zinc citrate have been found to have inhibitory effect on plaque formation.

Therapeutic Dentifrice

A therapeutic dentifrice may be described as one that contains a drug substance that has been incorporated into the formulation in an effort to produce a beneficial effect upon the oral tissues.

The most commonly used active agent added to dentifrices is fluoride, which aids in control of caries.

Tetra sodium phosphate and disodium dihydrogen pyrophosphates are

used to significantly reduce the amount of calculus formed. The soluble pyrophosphates are crystal-growth inhibitors and retard the formation of calculus. The dentifrices with these agents are called anti-calculus dentifrices.

Dentifrices used in hypersensitivity are with active agents like potassium nitrate, strontium chloride, etc.

For example,

1. Dentifrices containing potassium nitrate: 5%.
2. Dentifrices containing potassium nitrate and sodium.
3. Dentifrices containing strontium chloride hexahydrate: 10%.
4. Dentifrices containing sodium fluoride-0.05%.
5. Dentifrices containing potassium chloride and sodium monofluoro phosphate.
6. Dentifrices containing potassium nitrate and sodium fluoride.

Therapeutic Mouth Rinse

A mouth rinse may be defined as a substance that is swished around the oral cavity and then expectorated in order to freshen the mouth and breath.

The therapeutic mouth rinse can be defined as a formulation containing a drug substance and used to transfer this drug substance to hard and soft tissues of the oral cavity. This drug substance then imparts a chemical, physiologic or pharmacologic action that is manifested clinically as a reduction in the incidence of plaque, caries, calculus and gingival disease.[4]

The first therapeutic, anticaries mouth rinse to be used extensively was 0.2% sodium fluoride rinse.

Chlorhexidine mouth rinse proved to be most effective anti-plaque agent that helps in controlling inflammation and subgingival plaque. It is safe, stable and effective in preventing plaque formation, in suppressing *Streptococcus mutans*, and in treating marginal gingivitis.

Oral Irrigation Devices

Mouth rinses provide a means to irrigate the entire mouth; irrigation devices provide a means to irrigate specific areas of the mouth. There are two types

of irrigation devices, the spray, which provides an aerosol and the irrigation device which provides a steady or pulsating stream of fluid.

Three situations in which an irrigating device are used:

1. To help remove accumulated debris from interdental areas where there is difficult access.
2. The aid in personal oral hygiene program of individuals with orthodontic devices, complex restorations, crowns and fixed bridges, splints.
3. To irrigate deeper gingival sulci.

***Types**:*

1. Home irrigation
    a. Supragingival home irrigation device
    b. Subgingival
    c. Marginal
2. Professional subgingival irrigation devices.

Conclusion

Plaque is formed so rapidly and its removal by the patient is so difficult that complete freedom from plaque over extended periods of time is an unrealistic goal.

Complete prevention of plaque formation is not possible by conventional mechanical means and not practical by current chemical means. Instead, the goal of clinical plaque control at present is periodic mechanical or chemical plaque removal at intervals spaced closely enough together to prevent recurrent plaque formation and any resulting significant pathological effects.

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DISCLOSING AGENTS

A disclosing agent is a preparation in liquid, tablet, or lozenge form that contains a dye or other coloring agent. In dentistry, a disclosing agent is used to identify bacterial plaque deposits for instruction, evaluation and research.[1]

Bacterial plaque is nearly colorless unless stained by foods, beverages or tobacco. After use of a disclosing agent, the soft deposits pick up the color of the agent, whereas the dye can be rinsed off readily from plaque-free surfaces.[2]

Purpose

1. Personalized patient instruction in the location of soft deposits and the techniques for removal.
2. Self-evaluation by the patient on a daily basis.
3. Continuing evaluation of the effectiveness of the instructions for the patient to determine the need for revisions of the plaque control procedures.
4. Preparation of plaque indices.
5. To gain new information about the incidence and formation of deposits on the teeth, effectiveness of specific devices for plaque control, antiplaque agents, etc.

Ideal Properties

1. ***Intensity of color*****:** A distinct staining of deposits should be evident. The color should contrast with normal colors of oral cavity.

2. ***Duration of intensity*****:** The color should not rinse off immediately with ordinary rinsing methods.

3. ***Taste*****:** The patient should not be made uncomfortable by an unpleasant or highly flavored substance. It should be pleasant and encourage co-operation of the patient.

4. ***Irritation to the mucous membrane*****:** It should produce no irritation or allergic reaction. Because of possibility of allergy, more than one type of disclosing agent should be available for use.

5. ***Diffusibility*****:** A solution should be thin enough so it can be applied readily to the exposed surfaces of the teeth.

Disclosing Agents

i. Iodine solution preparations.

a. Skinners solution.

Iodine crystals: 3 g

Potassium iodide: 1.0 g

Zinc iodide: 1.0 g

Water (distilled): 16 ml

Glycerin: 13 ml

b. Diluted tincture of iodine.

Tincture of iodine: 21.0 ml

Water (distilled): 15.0 ml

ii. Bismarck brown (Easlick's disclosing solution)

Bismarck brown: 3.0 g

Ethyl alcohol: 10.0 ml

Glycerine: 120.0 ml

Anise (flavouring): 1 drop

iii. Merbromin.

Merbromin. NF: 450.0 mg

Oil of peppermint: 1 drop

Distilled water to make: 100 ml

iv. Erythrosin

Concentrate for application by rinsing:

FD and C Red No. 3 or No. 28: 6.0 g

Water to make: 100.0 ml.

For direct topical application

Erythrosin: 0.8 g

Water distilled: 100.0 ml

Alcohol (95%): 10.0 ml

Oil of peppermint: 2 drops

Tablet:

FD and C red No. 3: 15.0 g

Sodium chloride: 0.747%

Sodium sucaryl: 0.747%

Calcium stearate: 0.995%

Soluble saccharin: 0.186%

White oil: 0.124%

Flavouring: 2.239%

Sorbitol to make 7 grain tablets

v. Fast green

FD and C Green No. 3: 5% or 2.5%

vi. Fluorescein

FD and C yellow No. 8 (used with a special UV light source to make the agent visible).

vii. Two-tone

FD and C Green No. 3

FD and C Red No. 3

Thicker (older) plaque stains blue

Thinner (newer) plaque stains red.

viii. Mercurochrome preparation.

a. Mercurochrome solution: 5%

Mercurochrome: 1.5 g

Water distilled to make 30.0 ml

Flavoured mercurochrome solution

Mercurochrome: 13.5 g

Water distilled: 3.0 ml

Oil of peppermint: 3 drops

Artificial non-cariogenic sweetner



Fig. 20.5: Disclosing solution kit

Method of Application

a. Dry the teeth with compressed air.

b. Retract check or tongue.

c. Use swab or small cotton pellet with cotton pliers to carry the solution to the teeth.

d. Apply solution to the crowns of the teeth only.

e. Direct the patient to spread the agent over all surfaces of the teeth with the tongue.

Method of application of rinses

a. A few drops of a concentrated preparation are placed in a paper cup.

b. Water is added for dilution.

c. Instruct the patient to rinse and swish the solution over all tooth surface.

Method of application of tablet or wafer

a. The patient chews the wafer.

b. Swishes it around for 30 to 60 seconds.

c. Rinses it completely.

Instructions to patients

1. Patients need to be informed about bacterial plaque composition and effect of plaque in the production of gingival and periodontal infections.
2. Patient should be shown about the location and distribution of plaque on lingual surfaces and posterior facial areas.
3. Techniques of daily plaque removal to be instructed to the patients.

Plaklite

This apparatus consists of a small mains operated lamp which gives light through a special dichroic filter. A bottle of a fluorescein-based solution is supplied and two drops of this are introduced into the mouth and the patient is instructed to swish it in the saliva all around the mouth. The indicator fluid has a special affinity for plaque but is relatively invisible until the light makes it appear with a greenish yellow glow. The effect is startling and dramatic and may well be responsible for an added keenness to remove the offending glow.[3]

Having demonstrated the presence of plaque the dentist's responsibility is of:

1. Removing it.
2. Ensuring that the patient can remove it and prevent its formation, on the mouth and teeth, where possible to discourage bacterial growth and retention.

PLAQUE TEST

Plaque test is a Fluorescein based disclosing agent which enables the invisible biofilm (plaque) on teeth visible.

Composition

Standard Composition (in % by Weight]

Glycerol	55.0
Distilled water	44.0
Fluorescein sodium, potassium dihydrogen phosphate, 4-hydroxybenzoic acid ethyl ester	1.0

Method of Application

Plaque test is generously applied to the surfaces of the teeth with the help of applicator brush and patients were instructed to rinse the mouth. It exposes plaque on teeth as a yellow colour and on gingiva as a green colour. The teeth appear blue and the gingival tissues dark blue under a blue light source. As a result, plaque can be clearly distinguished from the surrounding tissues (Fig. 20.6).



Fig. 20.6

Advantages Over other Plaque Disclosing Agents

1. Fluorescein only colours plaque; the gums, tongue natural teeth and restorations keep their own colour. In addition, fluorescein is not visible in daylight and, as a result, the use of the Plaque Test does not entail any esthetic impairment.
2. The taste of fluorescein is generally described as acceptable.
3. Fluorescein is better suited for digital quantification methods than erythrosine because the latter colours plaque in a red-purple colour and consequently does not create sufficient contrast to the red colour of the gingiva. Therefore, the Plaque Test is also suitable for the systematic

computer-based evaluation of plaque build-up, e.g. in the course of a clinical study.

A NEW SYSTEM FOR DISCLOSING PLAQUE IN THE HOME SETTING

PlaqPro: It is a Fluorescein based toothpaste and toothbrush/light system (Fig. 20.7).



Fig. 20.7

Composition

Apart from containing Fluorescein, the toothpaste is designed to a somewhat different formulation. It contains an elevated level of the sweetener, Xylitol, which is known to inhibit the growth of the plaque bacteria *Streptococcus mutans*. The Xylitol also stimulate the mouth to produce more saliva and at a higher pH, so increasing its potential to remineralise weak enamel. Conversely, the paste has none of the usual silica thickener found in most toothpastes. While this lowers the paste's viscosity, it also removes any tendency to dry the mouth. The 'hydrated' silica abrasive used is fine grade, which reduces the risk of 'toothbrush abrasion' and also contains sodium fluoride.

Steps 1 to 3 Illustrate the System in Use

Step 1: Patients are instructed to brush their teeth with Fluorescein toothpaste (Fig. 20.8).



Fig. 20.8

Step 2: After brushing, the toothbrush is turned around, the UV light engaged and the teeth inspected for the plaque which brushing has missed (Fig. 20.9).



Fig. 20.9

Step 3: The Fluorescein disclosant shows where brushing has been ineffective and plaque remains (Fig. 20.10).



Fig. 20.10

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CARIES ACTIVITY TEST

Caries is a multifactorial disease, the many contributing factors can be grouped into three categories: (1) Those microorganisms that constitute a challenge to the integrity of the tooth, (2) tooth and host resistance to the challenge, (3) remineralization capacity (repair). The objective of caries activity testing is to indentify some parameters related to the triad of challenge, defence and repair that will indicate impending or existent caries activity or inactivity. Such information can be used to help estimate the probability for caries but more importantly to formulate strategies for the prevention of disease.[1]

Criteria of Caries Activity Test[3]

1. The test should be reproducible.
2. The test should be valid.
3. The test should be simple and inexpensive to perform.
4. The test should be noninvasive, easy to evaluate and applicable to any clinical setting.
5. There should be a minimal occurrence of false responses.

Advantages of Caries Activity Tests[2]

1. Permits the identification of the individuals with higher probability of developing caries.
2. Institutes intensive effective primary-preventive measures designed to arrest and to reverse the disease process before the irreversible point of the caries has been reached.
3. Provides a patient an individual preventive program to be implemented before extensive dental restorative procedures are accomplished.
4. Helps to screen large segments of population such as schoolchildren.
5. To understand the caries process better.

Caries Activity Tests[1]

1. Lactobacilli Colony Count Test

The first microbiologic caries activity test that was used by practitioners was the lactobacilli colony count. The lactobacilli counts were performed by using serial dilutions of saliva that was collected by chewing 1 gm paraffin wafer. A 1 ml aliquot from each dilution was then placed in a series of petri dishes, to which was added approximately 10 ml of Ragosa's lactobacilli selective medium. After incubating 4 days the number of colonies was counted. Counts were often scored 1 to 4, depending on whether they fell with in the ranges of 0 to 1000, 1000 to10,000, 10,000 to 100,000 or 100,000 and up. When the score increased for a group of individuals, so did the caries score increase.

2. Snyder's Test

This calorimetric test is much easier for the private practitioner to use than the preceding lactobacilli counts. It is based on the assumption that the amount of acid produced in a medium is proportionate to the number of lactobacilli in the inoculum. The selective medium used for the test has a pH of approximately 5.0 which is optimum for lactobacilli growth. To evaluate visually the rapidity and extent of acid production, bromocresol green is incorporated into the medium to indicate pH change. The medium is blue at pH 5.0, green at 4.6, yellowish at 4.2, and yellow at 3.8. A standardized color chart is used as an aid in determining the colour changes. The medium is initially prepared by adding 1 litre of boiling water to 61 g of the powdered Snyder's medium and adjusting pH with glacial acetic acid. Approximately 5 ml of medium is placed in sterile test tubes that are stored in a refrigerator.

To perform the test a specimen of saliva is secured with paraffin stimulation. One tube from refrigerator is heated to 100 degree celsius to liquefy the agar. It is then cooled to 45 degree celsius before 0.1 ml of the saliva specimen is added and the tube shaken before being placed in the incubator for 72 hours at 37 degree celsius. At the end of 24 hours and again at 48 and 72 hours, the color of the medium is recorded as 1 to 4 on the basis of whether the color remains the same or changes to light green, a light yellow, or a definite yellow in 24 hours, the individual is considered as caries

resistant. In-between scores are less informative but can be used along with clinical judgement as an aid in evaluating caries status.

Snyder's test has the advantage of requiring only one tube of medium and no serial dilutions. Yet because of the need to use a controlled temperature to melt the agar before adding the saliva specimen, the test is still best accomplished in a laboratory environment. This discourages office use of the test.

The classical formula of Synder's agar per litre of purified water is,

Pancreatic digest of casein	13.5 g
Yeast extract	6.5 g
Dextrose	20.0 g
Sodium chloride	5.0 g
Agar	16.0 g
Bromocresol green	0.029 g

3. Alban's Test (Modified Snyder Test)

Arthur L. Alban modified the basic Snyder test to accomplish easily the caries activity test for routine dental office use. This modified Snyder test uses the same formula as Snyder's media, with the exception that less agar is added. This modification permits an easier permeation of bacterial metabolic end products throughout the agar column.

At the time of the test, a 5 ml tube of semisolid agar is removed from the refrigerator but it is not heated. The patient is asked to spit unstimulated saliva directly into the tube until there is thin layer of saliva covering the surface of green agar. The tube is then incubated for 4 days, with daily recordings is made to observe color changes produced by the acidogenic organisms in the salivary specimen. The color changes are scored from 0 to 4, with the score being based on the amount of color changes occuring from top to bottom in the tube.

A zero score indicates no color change.

A 1 + score indicates color change to yellow in the top ¼ of tube.

A 2+ score indicates color change to yellow in the ½ mark of tube.

A 3+ score indicates color change to yellow in the ¾ mark of tube.

A 4+ score indicates entire length of agar column has changed to yellow.

The Alban test is ideal for patient education. Favourable changes in diet intake and plaque control procedures are reflected within a few weeks by corresponding changes in the Alban test score.

Other tests include the following:

4. Salivary Buffer Capacity Test

5. Enamel Solubility Test (Susceptibility Test)

6. Salivary Reductase Test

7. Streptococcus mutans Level in Saliva

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PIT AND FISSURE SEALANTS

Definition

Pit and fissure sealants are defined as ‘a cement or a resin which is introduced into unprepared occlusal pits and fissures of caries susceptible teeth forming a mechanical and physical protective layer against the action of acid producing bacteria and their substrates’ (Fig. 20.11).[1]



Fig. 20.11: Placement of pit and fissure sealant

Indications

A deep occlusal fissure, fossa or a lingual pit.

Contraindications

Patient behaviour does not permit use of adequate dry – field technique throughout the procedure.

- Open occlusal carious lesion.
- Caries exist on other surfaces of the same tooth.
- A large occlusal restoration is already present (Fig. 20.12).

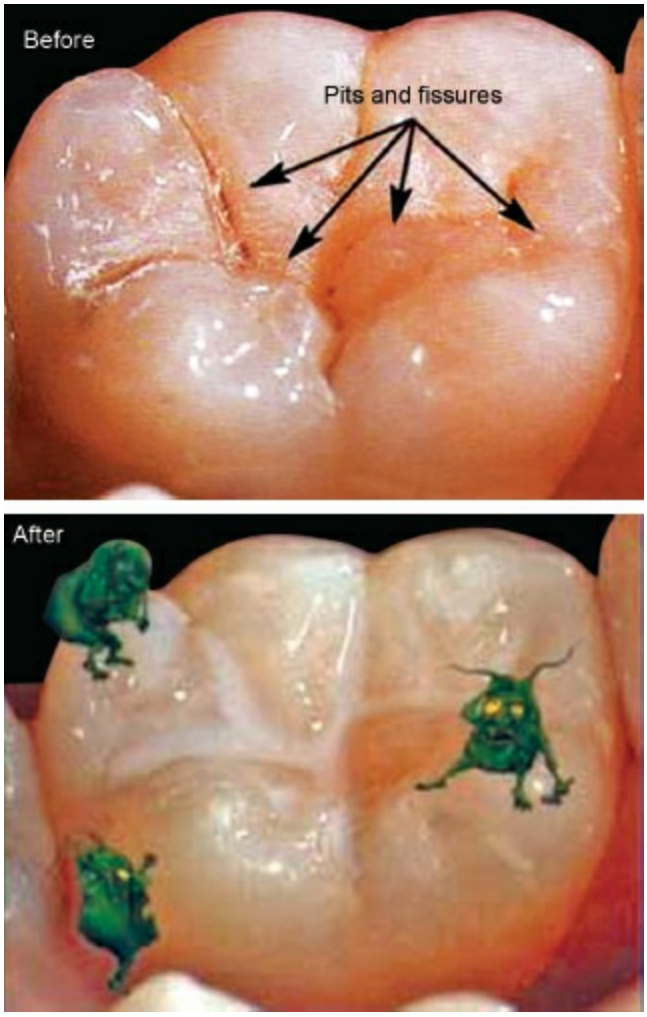


Fig. 20.12: Occlusal pits and fissures—A. before sealant application, B. after sealant application

Types

Three different kinds of plastics have been used as occlusal sealants:

a. Polyurethanes,

b. Cyanoacrylates and

c. Bisphenol A-glycidylmethylacrylate-(BIS–GMA)

1. ***Polyurethanes*:** They were among the first to appear on the commercial market. They proved to be too soft and totally disintegrated in the mouth after 2–3 months. Despite this problem, their use was continued for a period of time—not as a sealant but as a vehicle with which to apply fluoride to the teeth. This function has been superceded by the use of fluoride varnishes which are easier to apply.[3]

2. ***Cyanoacrylates*:** They have also been tried as sealants, but they too disintegrated after a slightly longer period of time. The ADA council on dental materials did not recommend the cyanoacrylates for routine use in dentistry because formaldehyde was formed as a part of their biodegradation in the oral fluids.[2]

3. ***BIS-GMA*:** Bisphenol-A glycidylmethyl-acrylate is now the sealant of choice. It is a mixture of BIS-GMA and methyl methacrylate. Some of the first commercial products:
    a. Concise brand white sealant (3M company)
    b. Delton, clear and tinted (Johnson and Johnson)
    c. Helioseal, white (vivadent)
    d. Nuvaseal

Lately, more effective second and third generation sealant have become available. Some of them contain fillers, which makes it desirable to classify the commercial products into filled and unfilled sealants.

In addition to the BIS-GMA, the filled sealant contains microscopic glass beads, quartz rods and other fillers used in composite restorations. The filler makes the sealant more resistant to abrasion. The fillers are coated with products such as silane, to facilitate their combination with BIS-GMA.

Polymerizing of the Sealants

The liquid plastic is called the monomer. When the monomer is acted upon by the catalyst, repeating chemical bonds begin to form, increasing in number and complexity as the hardening process (polymerization) proceeds. Finally the resultant hard product is known as a polymer.

Two methods have been employed to catalyze polymerization:

1. Light curing by use of either an ultraviolet or visible blue light (photocure, photoactivation, light activation).
2. Self curing where a monomer and a catalyst are mixed together (cold cure, autopolymerization, chemical activation).

With the autopolymerising sealants, the catalyst is incorporated with the monomer—in addition, another bottle contains an initiator—usually benzoyl peroxide. While the monomer and the initiator are mixed, polymerisation begins.

The High-Intensity Light Source

The light emitting device consists of a high-intensity white light, a blue filter to produce the desired blue color usually between 400 nm and 500 nm and light conducting rod. There are two types of lights, one is a hand-held model with a short conducting rod, the other desk top model with a fiber glass cable to conduct the light to the light rod. The time required for polymerization is set by the manufacturer and is usually around 20–30 seconds.

Photocured Sealants

Advantages

- Operator can initiate polymerization at any suitable time.
- Polymerization time is shorter.
- Higher compressive strength and smoother finish.

Disadvantage

Expensive.

Self-cured Sealants

Advantage

Does not require expensive light source.

Disadvantage

Polymerization process cannot be controlled.

Requisites for Sealant Retention

1. The surface of a tooth should have a maximum surface area.
2. The tooth should have deep, irregular pits and fissures.
3. The tooth should be clean.
4. The tooth should be absolutely dry at the time of sealant placement.
5. The tooth surface should be uncontaminated with saliva residues.

Increasing the Surface Area

To increase the surface area, which in turn increases the adhesive potential, tooth conditioners also called etchants which are composed of 30 to 50% of concentration of phosphoric acid are placed on the occlusal surface prior to the placement of the sealant. The etchant may be either in liquid or gel form. Deep irregular pits and fissures offer a much more favourable surface contour for sealant retention compared to broad, shallow fossae.[4]

Procedure of Pit and Fissure Sealant Application

1. Surface cleanliness of the tooth.
2. Dryness of the tooth surface.
3. Preparing the tooth for sealant application.
4. Application of the sealant.

1. Surface Cleanliness of the Tooth

Usually the acid etching alone is sufficient for surface cleaning. Pumice and water slurry are used to the occlusal surface. Slurry must be non-fluoride, oil free mixture to avoid contamination of the tooth surface. Hydrogen peroxide also been tried as a cleaning agent but, it has the disadvantage that it produces a precipitate on the enamel surface. All heavy stains, deposits, and debris should be off the occlusal surface before applying the sealant.

2. Dryness of the Tooth Surface

The teeth must be dry at the time of sealant placement. A dry field can be maintained by several ways, such as by the use of rubber dam, applying cotton rolls, bibulous pads over the opening of the parotid duct. Isolation of a tooth are done mainly by using cotton rolls.

3. Preparing the Tooth for Sealant Application

After the selected teeth are isolated, they are thoroughly dried for approximately 10 seconds. The liquid etchant is then placed on the tooth with a small plastic sponge or cotton pledget held with cotton pliers. The etching solution is gently daubed, not rubbed, on the surface for 1 minute for permanent teeth and 1% minute for deciduous teeth.

Alternatively, acid gels are applied with a supplied syringe. At the end of the etching period, for 10 seconds the water is flowed over the occlusal surface. Following the water flush, the tooth surface is dried for 10 seconds. The dried tooth surface should have a white, dull, frosty appearance. This is due to the fact that the etching has removed approximately 5 to 10 micrometer of the original surface.

4. Application of the Sealant

When the plastic sealant flows over the prepared surface, it penetrates the finger like depressions created by the etching solution. The projections of plastic into the etched areas are called tags. These tags are essential for retention. With either the photo cured or the auto polymerized sealants, the material should be first placed in the fissures where there is the maximum depth. The sealant should not only fill the fissures but should have some bulk over the fissure. Following the polymerization, the sealant should be examined carefully for voids. If there are any voids, additional sealants can be added without the need for any additional etching. The hardened sealant has an oily residue on the surface. This is the un-reacted monomer that can be wiped off with a gauze sponge.

Table 20.3: Sealant versus amalgams[1]

Sealant	***Amalgam***
1. Sealants are used to prevent the occlusal lesions	1. Amalgam are used to treat the lesions
2. Common cause of sealant replacement is loss	2. Common cause of replacement is marginal decay of material
3. Time taken for sealant is less	3. Time taken for amalgam is more
4. It is highly technique sensitive	4. It is less technique sensitive
5. Painless to apply and aesthetic	5. Need to cut tooth structure and not aesthetic

Retention of Sealants

Plastic sealants are retained better on recently erupted teeth.

It is better on first molars than on second molars.

It is better retained on mandibular than on the maxillary teeth.

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CARIES VACCINE

There exists the possibility of preventing dental caries by stimulating the defense mechanism of the mouth. Mobilization or augmentation of the defense systems of the body is perhaps the most attractive approach to the prevention of infectious disease, as it involves working with natural functions rather than cutting across them. The protection against caries by caries vaccine has generated hopes and a significant progress has been made in this field.[3]

Mechanism of Action

Protection against dental caries by immunization could be achieved by immune components from serum, by IgA antibodies in salivary secretions or by a combined effect of serum and salivary components.[2]

IgA antibodies from serum reach the oral cavity through the gingival crevicular fluid. When the teeth erupt local inflammation is common, and during this time, serum antibodies may stimulate opsonization and phagocytosis of bacterial cells. Serum antibodies have shown to have an inhibitory effect both on glucosyltransferase and on acid production. Such antibodies could inhibit the establishment and metabolic activity of *S. mutans* on teeth. This may explain experimental results in which a lower number of *S. mutans* and less dental caries in immunized animals than controls.[1]

Thus parental immunization directed to *S. mutans* could favour the early establishment of a non-cariogenic microflora on the teeth which in turn could prevent or delay the colonization of pathogenic *S. mutans* and thereby reduction in dental caries.

In the saliva, secretory IgA antibodies dominate and in the rodent model, specific IgA antibodies have been found to protect animals against *S. mutans* infection and dental caries[1] (Fig. 20.13).

Summary

The development of an oral vaccine is an age old dream. Animal studies have shown that immunization against *Streptococcus mutans* is feasible and yet to date a successful vaccine for use in humans has not been developed.

Purified antigens can be expensive to produce which in turn will make immunization less attractive for use on a public health basis. This however would appear not to be an insurmountable problem because developing technologies should make it possible to isolate economically the relevant antigens in highly purified form. On the other hand, by using whole cells in an encapsulated form via an oral route one is simulating a phenomenon which occurs naturally, more or less continuously, and does not run the risk of omitting several potentially important antigens.

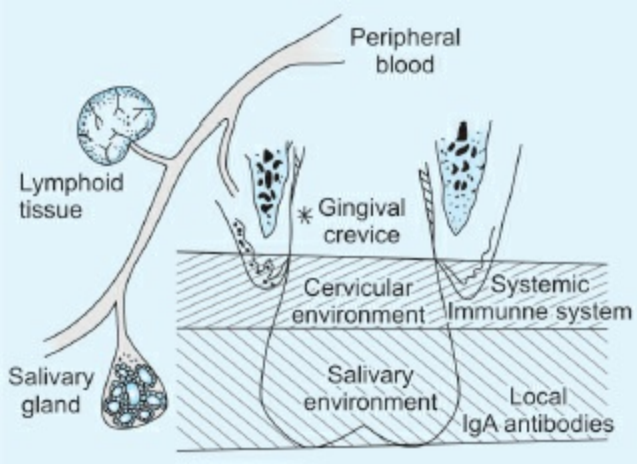


Fig. 20.13: Diagrammatic illustration of the two main immunological mechanisms involved in protecting the host against dental caries by immunization. The first mechanism involves the production of secretory IgA secreted in the saliva. The second mechanism involves the systemic immune system and the production of antibodies that travel through the gingival epithelium into circular fluid that bathes tooth and plaque (modified after Lehner, 1978)

It is possible that a vaccine will not be widely accepted by the general population, nevertheless, it is highly probable that a vaccine can and will be developed if it is developed, its value will presumably be found primarily in

those subjects who appear to be particularly susceptible to caries and those who for medical reasons such as hemophiliacs should be totally protected from caries.

Perhaps, a vaccine may be developed in the years to come but for now people have recourse to the good old standbys brushing, flossing, regular dental checkups and water fluoridation.

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MINIMAL INTERVENTION DENTISTRY

Introduction

The ideal aim of preventive dentistry is to avoid disease altogether, but this is not possible in all cases. However, we can aim for both an early diagnosis and a minimally invasive therapy to ensure the existing early carious lesion is treated and the progress arrested.

The minimally invasive approach in treating dental caries incorporates the dental science of detecting, diagnosing, intercepting and treating dental caries at microscopic level.[1]

Principles of Minimal Intervention Dentistry[2]

The four core principles can be summarized as follows:

1. ***Recognition*:** To identify and assess any potential caries risk factors early, through lifestyle analysis, saliva testing and using plaque diagnostic tests.
2. ***Reduction*:** To eliminate or minimize caries risk factors, through altering fluid balance, reducing the intake of dietary cariogenic foods, addressing lifestyle habits such as smoking, and increasing the pH of the oral environment.
3. ***Regeneration*:** To arrest and reverse incipient lesions, regenerating enamel subsurface lesions and arresting root surface lesions using appropriate topical agents including fluorides and casein phosphopeptides-amorphous calcium phosphates (CPP-ACP).
4. ***Repair*:** When cavitation is present and surgical intervention is required, as much as possible of the tooth structure is maintained by using conservative approaches to caries removal. Bioactive materials are used to restore the tooth and promote internal healing of the dentine, particularly in cases of deep dentine caries where the risk of iatrogenic pulpal injury is high.

MODALITIES

Remineralising Agents

***CPP-ACP (Casein phosphopeptide-amorphous calcium phosphate)*:** CPP-ACP is a rather new way of remineralizing tooth surfaces by keeping high levels of calcium and phosphorus ions in the proximity of the enamel. Casein phosphopeptides bind the calcium and phosphate ions forming CPP-ACP-complexes (casein phosphopeptide stabilized amorphous calcium phosphate) which release calcium and phosphorus ions at pH values below 7.[3] CPP-ACP binds readily to the surface of the tooth, under acidic conditions, this localized CPP-ACP buffers the free calcium and phosphate ions, substantially increases the level of calcium phosphate in plaque and, therefore, maintains a state of supersaturation that inhibits enamel demineralisation and enhances remineralisation.[1]

CPP-ACP is available commercially as:

a. Tooth mousse
b. Tooth mousse plus (CPP-ACP+sodiumfluoride)
c. MI paste
d. MI paste plus (CPP-ACP + sodium fluoride)
e. GC MI varnish (CPP-ACP + sodium fluoride)

Titanium Tetrafluoride[4]

McCann suggested an additional mechanism for fluoride fixation in enamel in which the fluoride is bound to a polyvalent metal ion in the form of a strong complex. He discovered that both fluoride uptake and retention could be enhanced when the tooth is pretreated with any polyvalent metal capable of forming strong fluoride complexes while simultaneously binding to the apatite crystals. Titanium ion pre-treatment showed the maximum uptake and retention, followed by aluminium (among various metals such as Al, Ti, Zr, La, Fe, Be, Sn, Mg, Zn).

When compared with other topically used fluorides, the use of TiF_4 seems to have great advantages. Higher uptake and greater penetration of fluoride and lower acid solubility of the tissues has been seen with TiF_4 when compared to NaF. It was observed that in addition to increasing the fluoride content, topical application of TiF_4 may also change the surface morphology of enamel.

The marked protective effect of TiF_4 is attributed to the following:

1. Chemically decreasing enamel solubility by increasing the fluoride content and
2. Physically providing a protective glaze resistant to any acid penetration.

Enamelon[1]

Enamelon consists of unstabilized calcium and phosphate salts with sodium fluoride. The calcium salts are separated from the phosphate salts and sodium fluoride by a plastic divider in the centre of the toothpaste tube. An inherent technical issue with Enamelon™ is that calcium and phosphate are not stabilized, allowing the two ions to combine into insoluble precipitates before they come into contact with saliva or enamel.

Silver Diamine Fluoride (SDF)

Topical application of silver diamine fluoride (SDF) has been receiving more and more attention due to its low cost and simplicity in treatment. The advantages of caries treatment with SDF include its attributes of pain and infection control, ease of use, low material costs, non-invasive nature of the treatment procedure, and minimal requirement for personnel time and training. A recent systematic review[5] concluded that SDF treatment may fulfil the World Health Organization (WHO) millennium goals and the United States Institute of Medicine's criteria for 21st century medical care. SDF treatment can potentially increase access to care, improve oral health, and reduce the need for emergency care and treatment[5].

The exact mechanism of SDF is not understood. Yamaga and his co-workers[6] suggest that both fluoride ions and silver ions contribute to its mechanism of action. They propose that fluoride ions act mainly on tooth structure while silver ions act mainly on cariogenic bacteria. SDF reacts with hydroxyapatite [$Ca_{10}(PO_4)_6$ $(OH)_2$] in an alkaline environment to form calcium fluoride (CaF_2) and silver phosphate (Ag_3 PO_4) as major reaction products. CaF_2 provides sufficient fluoride for the formation of fluoroapatite [$Ca_{10}(PO_4)_6$ F_2], which is less soluble than hydroxyl apatite in an acidic environment.

A literature review on SDF concluded that arresting caries treatment with SDF can be a method to prevent caries from progression.[7]

RESIN BASED SYSTEMS

Resin Infiltration

The resin infiltration technique prevents further progression of the carious lesion using a low-viscosity resin with a high penetration coefficient, filling the enamel intercrystalline spaces.[8,9]

The pores within the lesion body of enamel caries provide diffusion pathways for acids and dissolved minerals. Therefore, an alternative approach to superficial sealing might be to arrest caries lesions by infiltration and occlusion of these pores with light curing resins, thus creating a diffusion barrier within the lesion without establishing any material on the enamel surface. Driven by capillary forces, the infiltrant is soaked into the lesion body where it is subsequently light-cured. The infiltrant occludes the lesion porosities and thus blocks diffusion pathways for cariogenic acids.

Resin infiltration system is commercially available as DMG icon.

CHEMICAL AND MECHANICAL METHODS

Chemico-Mechanical Caries Removal

The principal on which chemico-mechanical method for caries removal work are based on studies by Goldman and Kronman working in New Jersey, US in the early 1970s. This new method of treatment involves the chemical softening of carious tissue followed by its removal by gentle excavation.

After certain trials the first product launched into the market was known as, “Caridex”.

Caridex[10]

It received FDA approval for use in the USA in 1984 and was marketed in the 1980s. It is developed from a formula made of N-monochloroglycine and amino butyric acid. The system was granted in the form of two bottles, solution I having sodium hypochlorite and solution II having glycine, aminobutyric acid, sodium chloride and sodium hydroxide. The system involves the chlorination and disruption of the partially degraded collagen fibres in carious dentine. The carious dentine then becomes easier to remove by excavation using the modified needle tip.

Carisolv[10]

Medi team in Sweden continued to work on the Caridex system and resulted in the launch of chemico-mechanical caries removal reagent known as Carisolv in January 1998. The fundamental dissmilarity between Carisolv and other products already in the market was the use of three amino acids—lysine, leucine and glutamic acid—instead of the amino butyric acid.

***The entity is retailed in the form of two syringes*:**

- Syringe I—containing 0.5% sodium hypochlorite solution
- Syringe II—gel consisting of three amino acids.

Papacarie[10]

In 2003, a research project in Brazil led to the development of a new formula to globalize the use of chemico-mechanical method for caries removal and promote its use in public health. Papacarie is intrinsically formed of papain gel, chloramines, toludine blue, salts, thickening agent which altogether idiosyncranise to its antibacterial and anti-inflammatory features. It is commercially available as a gel syringes that have 3 ml of solution.

Air Abrasion[1]

Air abrasion was originally developed by Robert Black in 1945 as an alternative pseudomechanical method for dental tissue removal and the first air abrasion unit marketed was called the Airdent by SS White. This technique involves bombarding the tooth surface with high velocity aluminium oxide particles (Alumina) carried in a stream of air. This method of cutting is relatively painless, however, the total loss of tactile sensation, and the ability of alumina particles to remove sound tooth structure rather than the carious substrate in addition to the potential risk of inhalation problem should also be considered at the time of selection.

The abrasive units currently being marketed

1. The three KCP series (KCP 1000 Whisperjet, KCP 2000 and KCP 2000 Plus) (American Dental Technologies),
2. The MicroPrep (Sunrise Technologies) and
3. The Kreativ (Kreative Inc.).

Contraindications

It should be avoided in cases involving severe dust allergy, asthma, chronic obstructive lung disease, recent extraction or other oral surgery, open wounds, advanced periodontal disease, recent placement of orthodontic appliances and oral abrasions, or subgingival caries removal. Many of these conditions increase the risk of air embolism in the oral soft tissues.

Ozone[1]

During the last few years, reversal of caries using ozone has also been suggested based on the fact that the remineralised tooth tissues are known to be more resistant to decay than sound tooth structure. Ozone therapy causes remineralisation of incipient caries lesion.

Ozone readily penetrates through decayed tissue, eliminating the ecological niche of cariogenic microorganisms as well as priming the carious tissue for remineralisation. As ozone readily penetrates through decayed tissue, eliminating any bacteria, fungi and viral contamination, it would be expected that this ‘clean’ lesion would remineralise. The remineralisation process will then take place with the aid of a topically applied remineralising solution and the recommended patient’s maintenance kit.

Laser Irradiation[11,12]

One of the potentially effective preventive measures is the use of lasers. As early as 1966, Stern and Sognnaes, using an Nd:YAG (Neodymium-doped: Yttrium Aluminium Garnet) laser, showed that irradiated enamel specimens were resistant to acid demineralization. Highly absorbed wavelengths can modify the tissue composition and structure by thermal action, and promote an increased acid resistance. One of the most absorbed laser wavelength by the enamel are Erbium wavelengths (2.94 μm @ Er:YAG and 2.79 μm @ Er,Cr:YSGG), for which the primary absorption occurs for water and hydroxiapatite.

The widely accepted explanation for the increased acid resistance of the enamel postirradiation with lasers is that bound carbonate is released when dental enamel is heated.

Conclusion

These non-invasive and minimally invasive modalities point to a direction of potential consistent benefit in prevention, slowing the progression or reversing early carious lesions.

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ATRAUMATIC RESTORATIVE TREATMENT (ART)

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.

Atraumatic restorative treatment (ART) approach was developed to suit the needs of the developing countries. ART includes both prevention and treatment of dental caries. This procedure is based on excavating and removing caries using hand instruments only and restoring the tooth with an adhesive filling material such as glass ionomer.[3]

Unlike the conventional methods ART is non-threatening, not painful, therefore does not need anaesthesia, does not use expensive electrically driven equipment and can be provided at low cost. This technique is simple enough to train non-dental personnel or primary healthcare workers. All one needs are a flat surface for the patient to lie, a stool for the operator and the necessary instruments and materials for ART which can easily be carried in a small bag. ART therefore is suited for people residing in remote areas and for field practise and can be carried out in schools, village halls or in health centers with minimum equipment and resources. ART is a perfect alternative treatment approach for dental caries in the developing countries, whereas mentioned earlier quite often carious teeth go untreated and eventually have to be extracted.[1]

The two main principles of ART are:

- Removing carious tooth tissue using hand instruments only
- Restoring the cavity with a glass ionomer
- The reasons for using hand instruments rather than electric driven handpieces are:
    - It makes restorative care accessible to all population groups.
    - 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 anaesthesia to a minimum and reduces psychological trauma to patients.
- Simplified infection control; hand instruments can be easily cleaned and sterilized after every patient.

Community Field Studies with ART

The ART approach was pioneered in Tanzania in the mid 1980s which was then followed by several community field trials conducted in Thailand, Zimbabwe and Pakistan in 1991, 1993 and 1995 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.[2]

Glass-Ionomer as a Restorative Material in ART

They are available as a powder and liquid that has to be mixed together. Since they chemically (not mechanically) bind to the teeth, the need to cut sound tooth tissue to prepare the cavity is reduced. These materials continue to release fluoride after setting which has the added advantage of arresting and preventing caries around the restorations. Glass-ionomers are harmless to dentine and pulp tissues. However, compared with other materials, glass-ionomers are not strong enough and are currently being improved by the manufacturers.[1]

Instruments and Materials Essential for Art

Only hand instruments are needed to perform ART. These are—mouth minors, explorers, pair of tweezers, spoon excavators, hatchets or hoes and carvers. A mixing-pad and spatula are also necessary to mix the filling material. Only a few other materials are needed—cotton wool rolls and pellets, petroleum jelly to protect the setting glass-ionomer filling, plastic strips to shape the restorations and wedges to hold the plastic strips to the teeth (Figs 20.14 and 20.26)[1].

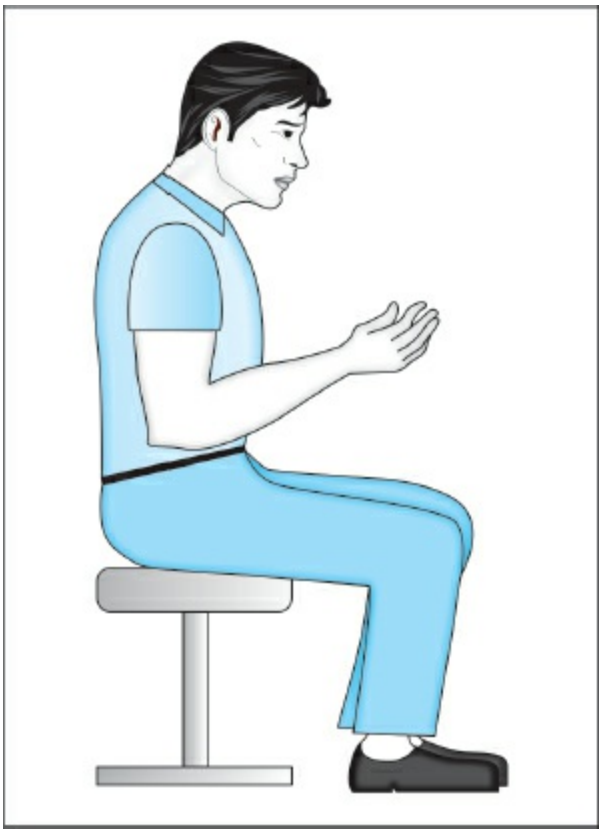


Fig. 20.14: Recommended work posture and position for the operator



Fig. 20.15: Recommended position for the operator and the assistant



Fig. 20.16: Recommendation position for the operator and assistant. The patient lies on a flat surface



Fig. 20.17: Hand instruments needed for ART



Fig. 20.18: Removal of caries using excavator

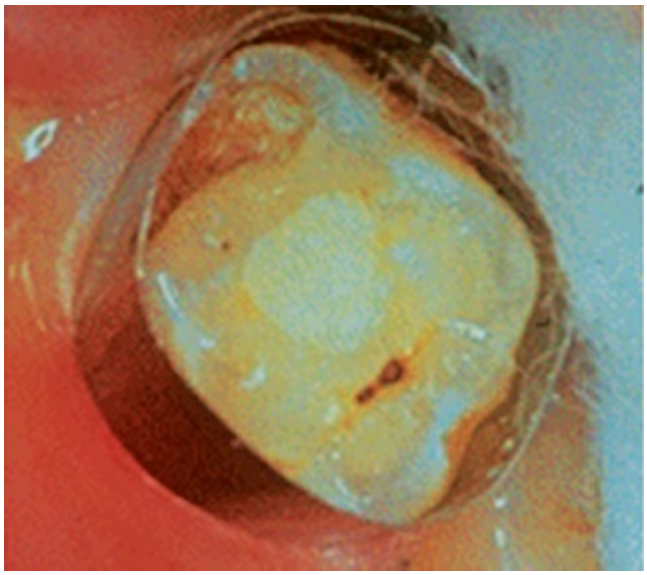


Fig. 20.19: Isolation with cotton rolls

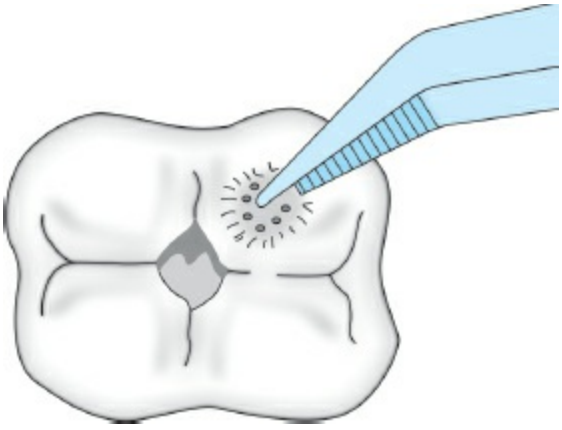


Fig. 20.20: Application of dentin conditions on the cavity

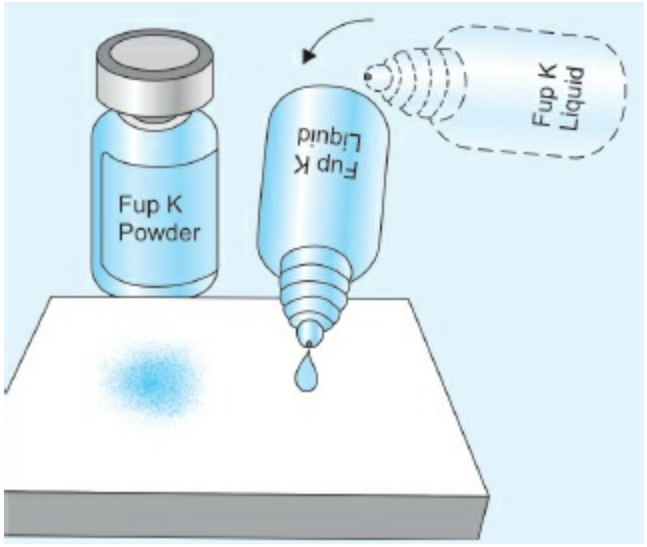


Fig. 20.21: Glass ionomer consists of powder and liquid

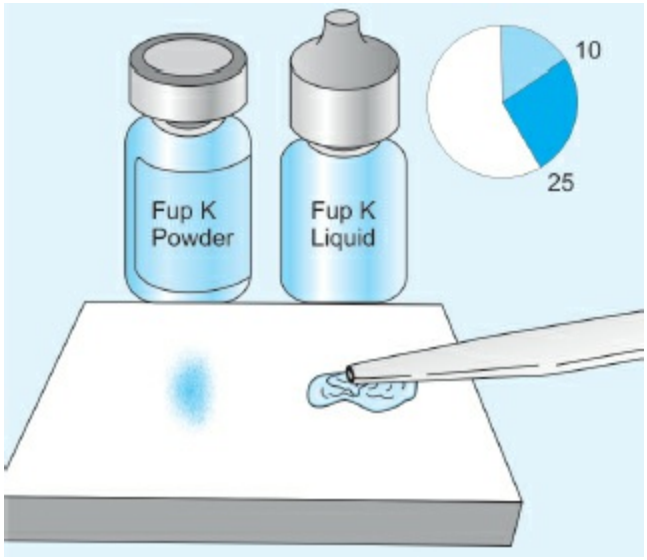


Fig. 20.22: Mixing of glass ionomer on the mixing pad

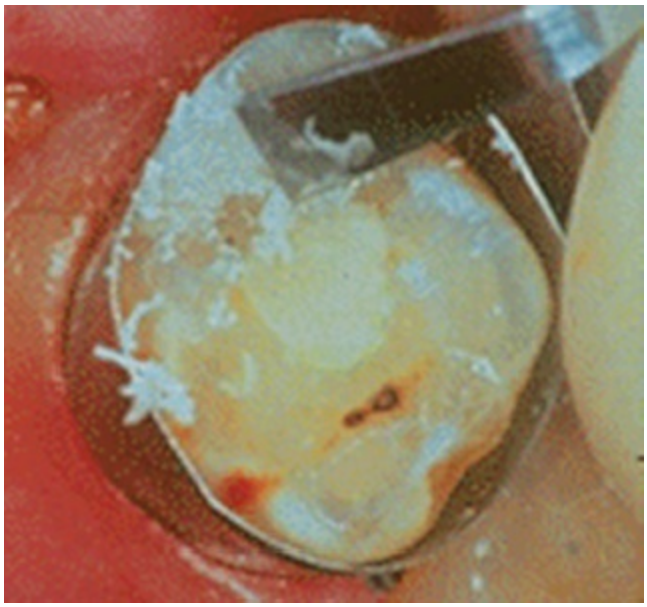


Fig. 20.23: The mixture is inserted into the cavity with a flat end of a carve

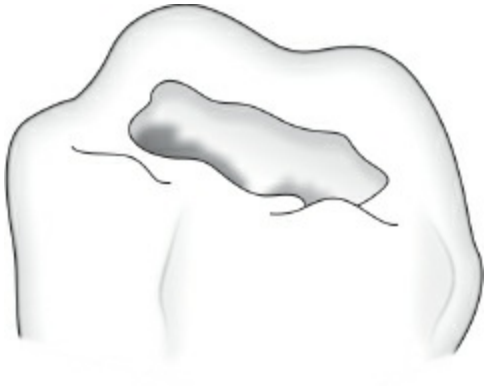


Fig. 20.24: The cavity is over filled

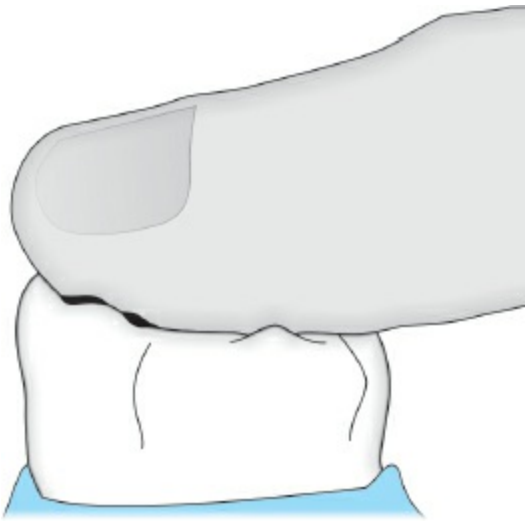


Fig. 20.25: Petroleum jelly is applied on the gloved finger and the filling material is pressed firmly by the index finger on the tooth



Fig. 20.26: Excess material is removed with a carver

Future Applications of Art

As ART is based on modern concepts of cavity preparation where minimal intervention and invasion is emphasised, this approach is applicable also in the industrialized countries for special groups such as the physically and mentally handicapped and the elderly. ART is a friendly procedure where no electric drills or anaesthetic injections are necessary that it can be used for children and fearful adults.

Indications and Contraindications for ART

In general ART is carried out only in the cavities (involving dentine) and in those that are accessible to hand instruments.

ART is not used when

There is an abscess (swelling) near the carious tooth. The pulp of the tooth is exposed. Carious cavity not reachable with hand instruments.

Conclusions

ART is NOT a compromise but a perfect alternative treatment approach for developing countries and special groups in the industrialized world.

ART is a biological approach which requires minimal cavity preparation that conserves sound tooth tissues and causes less trauma to teeth.

As ART is painless the need for local anaesthetics 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 practised in remote areas and in the field.

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.

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CHAPTER

21

Fluorides in Caries Prevention

Fluorides play a pivotal role in the prevention of dental caries. It is the most effective and most extensively tested of current anti-caries agents. The natural occurrence, metabolism, mechanism of action and toxicology has been thoroughly studied as any other element. It is one of the best armamentariums used in the prevention and control of dental caries.[6]

NATURAL OCCURRENCE OF FLUORIDE

Fluorides in Minerals and Earth's Crust

Fluoride is an extremely reactive member of the halogen group of elements. Fluoride is widely distributed in the earth's crust. It is the 13th most prevalent element and is found in both igneous and sedimentary rocks.

In nature, fluorine occurs most abundantly in association with the elements calcium, as fluorite or fluorspar, CaF_2; calcium and phosphorus, as fluoroapatite, $Ca_{10}(PO_4)_6F_2$; and aluminium as in cryolite Na_3AIF_6. Fluorides occur in certain silicate minerals (topaz and lepidolite) as a result of isomorphous replacement of the hydroxyl by fluoride ion, which is about the same size and bears the same charge.

Fluorides in Water

By virtue of dissolution, fluorides occur in most springs, wells, seawaters, and plants. The ubiquitous presence of fluorides in nature makes it an inevitable component of human diet. Fluorides are present in trace quantities in all surface and underground waters. The concentration of fluorides is negligible in rainwater and high in some lakes and wells. The fluorides contained in drinking water is commonly the largest single contributor to the daily fluoride intake.[5]

Fluorides in Food

The fluorides in the soil are absorbed by plants to a degree determined mostly by the type of plant and secondarily by the fluoride compounds in soil and the moisture conditions. Plants are selective in the amount of fluoride they absorb.

Seafood

Sardines, salmon, mackerel and other fish contain about 20 ppm of fluoride on a dry weight basis. Seafood is rich in fluorine since the oceans contain about 1 ppm of fluorine. The high fluoride level in fish is attributed to the fluoride in the skins and in bones, which become edible during canning.

Shellfish, or the flesh from large fish, contains only about 1 ppm of fluoride.[6]

Rock Salt

The fluorine content of rock salt ranges between 40 and 200 ppm. In India, this form of salt may be consumed at maximum intake of 20 g daily. These source alone could supply between 1 and 4 mg fluoride to the daily diet and this may contribute to the endemic fluorosis in some parts of India.

Tea

The tea plant family theaceae, including tea and camellias, stores fluoride. Dried tea leaves contain about 100–400 ppm fluoride. An average infusion of tea contains between 1.4 and 3.6 ppm fluorides.

Leafy Plants

The normal levels of fluoride in plants other than in tea family is about 2–20 microgram/gram of dry weight. Leafy vegetables, such as cabbage and lettuce, contain about 11–26 microgram fluoride.[5]

Plants grown in acidic soils have a higher fluoride content than those grown in lime-containing basic soils.

Airborne Fluoride Emissions

Fluoride emissions are heaviest in the vicinity of industries involved in the production of aluminium from cryolite or phosphate fertilizers. Airborne fluoride in such areas occurs as particulate dusts, as hydrofluoric acid or gaseous fluorine.

Fluorides in Drinks

Fresh fruit juices have a low fluoride content of 0.1 to 0.3 mg/litre. Human breast milk has a low fluoride content, less than 0.02 mg/litre. The fluoride content in soft drinks and mineral water reflects the same level as the water from which it is produced.

Beer is normally low in fluorides ranging from 0.3 to 0.8 mg/litre, in contrast to wine that can have fluoride levels of the order of 6–8 mg/litre.

Fluorides in Pharmaceutical Products

An increasing number of pharmaceutical products contain fluorides in organic and inorganic form. The products such as sodium fluoride tablets, vitamin pills, fluoride dentifrice, fluoride gels and solution are widely used for caries prevention.

Metabolism of Fluoride (Fig. 21.1)

The significance of fluoride in nutrition is related to its regular presence in small amounts in foods and in all tissues of the body. The advent of water fluoridation as a public health measure for partial reduction of caries and the continued and increasing use of other fluoride formulations makes it essential that its metabolism be known. By understanding the fate of ingested fluoride it is possible to quantitate safe and unsafe levels of ingestion from air, water and foods.[6]

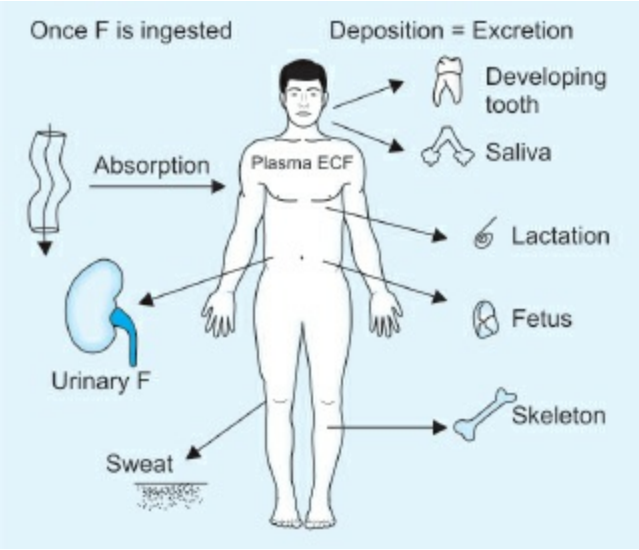


Fig. 21.1: Metabolism of fluoride[2]

Estimated Daily Intake of Fluoride

Several estimates have been made of the daily intake of fluoride from food and water. The variation reflects different dietary patterns between races and countries. Two factors that contribute most to the daily intake are fluoridated water and fluoride-rich foods such as fish. The average daily intake of fluoride by adults from dry food substances is in the range of 0.2–1.8 mg and the average daily intake from water containing 1.0 ppm fluoride is about 1.5 mg.The total daily intake for adults being in the 1.7–3.3 mg range.[5]

Absorption of Fluoride

Most fluorides are absorbed rapidly and transported in the body and subsequently excreted as the fluoride ion. About 86–97% of ingested fluoride is absorbed. The main factors influencing absorption are species variation, concentration of fluorides ingested, solubility and degree of ionization of the compounds, and other dietary constituents, such as calcium, which may form insoluble salts with fluoride. The rate of absorption increases with starvation and presence of fats. The presence of calcium, magnesium and aluminium decrease absorption. A comparison of rates of absorption of fluoride in milk and water indicates a significant reduction in fluoride absorption from milk during the first hour, but thereafter absorption continued at higher levels for longer periods of time.

Fluoride in Blood Plasma

There is evidence that plasma fluoride levels increase slightly with age. Plasma fluoride levels also increase in the presence of renal failure.

Human blood contains fluorine in both organically bound and inorganic forms. It has been suggested that the former originates from the environment and that it does not seem to be related to the inorganic fluoride content. Almost all fluoride in plasma is in ionic form and is not bound to any macromolecules. The plasma half-life of fluoride is reported to be 4–10 hours.

Blood plasma fluoride levels begin to rise about 10 minutes after ingestion and reach maximum levels within 60 minutes. Dose level and frequency of intake determine the steady state level of fluoride in plasma.

Excretion of Fluorides

Excretion by the gut and sweat glands

Fluorides are excreted through the kidney, the gut and the skin. Fluorides have low solubility and therefore, low absorption is excreted via the gut. Sweat and insensible perspiration may account for an appreciable loss of fluorine from the body. The concentration of fluoride in sweat is in the range of 0.067–0.5 ppm under normal conditions of intake.

Renal Clearance of Fluoride

The normal kidney will efficiently eliminate about 50% of fluoride, which is presented to it by glomerular filtration. It does not have access to all the fluoride to which an individual has been exposed.

Fluoride in Osseous Tissue

Fluoride ions have an affinity for skeletal mineral and can be incorporated in it during growth of the skeleton. Even in the absence of growth, it is ultimately incorporated by replacement of hydroxyl ions in the mineral of bone, hydroxyapatite.

Fluoride concentrations in bone tissue depend upon the amount of fluoride ingested in food and water, and to a lesser extent, the amount inhaled in air and on the length of time the individual has ingested fluoride. The fluoride can be deposited in either the (1) adsorbed layer of the bone (2) crystal structure (3) possibly bone matrix. The amount of fluoride that is not stored in bone is rapidly excreted through kidneys.

Distribution and Deposition of Fluoride in NonOsseous Tissues

Fluoride in blood is rapidly transferred, at rates of 30–40 %/minute to the extracellular fluid component. Approximately 96% of the fluoride retained in the animal body are found in bones and teeth, leaving a small quantity in soft tissues. Fluoride is a bone seeker and accumulates in other tissues that contain calcium. The ingestion of water containing negligible concentration to 4.0 ppm fluoride does not result in the accumulation of fluoride in the

heart, liver, lung or spleen.

Fluoride Transfer by Placenta

The presence of fluoride in primary teeth that develop during the intrauterine phase and the rapid increase in fluoride level of fetal blood when medications containing fluoride are administered to pregnant women indicate that fluorides readily cross the placenta. The skeletal fluoride increases with fetal age in areas that have water supplies of 0.1, 0.5 and 1.0 ppm.

HISTORICAL BACKGROUND

Colorado Stain

The man who had the greatest impact on the early history of water fluoridation was Dr Frederick McKay who arrived in Colorado Springs, Colorado in 1901. 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’. 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 colour of a china dish.[4]

McKay approached one of America’s foremost authorities on dental enamel, Dr Greene Vardiman Black, Dean of the North Western University Dental School in Chicago. At first, Black thought that McKay was mistaking the stain for something else. Black asked that some of the mottled teeth be sent to him for examination and also agreed to attend the Colorado State Dental Association meeting in July 1909.

In preparation for this visit, and as a first step in mapping out the entire endemic area, McKay and a fellow townsman, Dr Isaac Binton, examined the children in the public schools of Colorado Springs. In all, they inspected 2945 children and discovered to their complete astonishment that 87.5 percent of the children native to the area had mottled teeth.

This new information was given to Black when he arrived in Denver in June 1909. Black addressed the State Dental Association meeting and Black’s histological findings were published in a paper. “An endemic imperfection of the enamel of the teeth heretofore unknown in the literature of dentistry”.

In 1912 McKay discovered that people from parts of Naples in Italy also had stained teeth. He came across an article written in 1902 by Dr JM Eager, a United States Marine Hospital Service Surgeon stationed in Italy, who reported that a high proportion of certain Italian emigrants embarking at Naples had a dental peculiarity known locally as denti di chiaie (Eager 1902).

McKay requested a young doctor, Dr JF McCounell from Colorado Springs, to examine some Naples children and report back. The doctor was

familiar with the stain in Colorado Springs and wrote back, from Naples that there was no doubt that the mottled teeth in Naples were the same as those being investigated by McKay.

Mottled Enamel—Aetiological Factors

In the forefront of McKay's mind all the time was the desire to determine the cause of mottled enamel.

Further evidence supporting the water supply hypothesis came from a dentist, Dr OE Martin, practicing in Britton, South Dakota. On reading McKay's 1916 article in Dental Cosmos, he felt that McKay's description of mottling sounded suspiciously like the blemishes he had seen in certain local children and asked for McKay's advice. McKay visited Britton in October 1916. He discovered that in 1898 Britton had changed its water supply from individual shallow wells to a deep-drilled artesian well. Without exception, McKay found that all those who had passed through childhood prior to the changing of the water supply had normal teeth, while natives who had grown up in Britton since 1898 had mottling. He concluded that some mysterious element in the water supply was responsible (McKay 1918).

A similar occurrence was reported in the town of Bauxite. The first domestic water supply to Bauxite came from shallow wells and springs, but in 1909 deep well water was obtained. They found that no mottling occurred in people who grew up on Bauxite water prior to 1909, but all native Bauxite children who used the deep well water after that date had mottled teeth. Another piece of evidence had been gathered, but McKay seemed no closer to the solution.

Mottled Enamel and Fluoride Concentration in the Drinking Water

In New Kensington, Pennsylvania, the Chief Chemist of ALCOA, Mr HV Churchill, read McKay's paper and was greatly disturbed. He asked McKay to send samples of water from other endemic areas with a "minimum of publicity". The results showed that in all these areas the fluoride levels were very high.

The sustained work of McKay was then rewarded in 1931 when "fluorine" the element in drinking water which had evaded him for thirty years was thus established to be the cause of enamel mottling.

Trendley H Dean was assigned the job to continue McKay's work and to find out the extent of geographical distribution of mottled enamel in the United States (Shoe Leather Survey) Dean established that concentration of fluoride in drinking water was directly correlated with severity of fluorosed enamel. Thus Dean also developed a standard classification of mottling—mottling index. Dean in 1936 presented additional evidence to show that fluoride up to 1 ppm in drinking water was not hazardous to public health.

Dean also observed that in children taking 0.6 and 1.5 ppm, only 4–5 % were caries free while those who used 1.7–2.5 ppm 22% were caries free. He concluded that there is possibility in controlling dental caries through domestic water supplies containing fluoride.

A series of studies conducted in the USA revealed that in areas with water supplies containing no fluoride, DMFT ranged from 6–10 and in those areas containing 1 ppm of fluoride, the DMFT ranged between 2 and 3.

Thus the above series of findings contributed factual information on the beneficial role of fluorides on dental caries which paved the way towards implementation of water fluoridation as a public health measure globally.[4]

Administration of Fluoride

a. ***Systemic***

1. Water fluoridation
    a. Community
    b. School
2. Milk fluoridation
3. Salt fluoridation
4. Fluoride drops
5. Fluoride tablets
6. Fluoride lozenges

b. ***Topical***

1. Sodium fluoride
2. Stannous fluoride
3. Acidulated phosphate fluoride
4. Fluoride varnish
5. Fluoride dentifrice
6. Fluoride mouth rinse

SYSTEMIC FLUORIDES

Water Fluoridation

Definition

Fluoridation is “the upward adjustment of the fluoride ion content of a domestic water supply to the optimum physiologic concentration that will provide maximum protection against dental caries and enhance the appearance of the teeth with a minimum possibility of producing objectionable enamel fluorosis”.[1]

Optimum levels

The optimum fluoride level for water in temperate climate is 1 ppm. For warmer and colder climates the amount can be adjusted from approximately 0.7 ppm to 1.2 ppm, adapted in accord with the amount of water consumed. A concentration of 1 part per million (ppm) amount to 1 mg of fluoride per litre (1 mg/litre).[9]

Historical juncture

A great forward stride in the era of preventive dentistry was ushered with the epidemiologic studies of the 1930s sponsored by the United States Public Health Service and directed by Dr TH Dean.

The evidence regarding the safety of water fluoridation was so convincing that the US Public Health Service took the major step in artificially water fluoridating the water supply of Grand Rapids at 1 ppm on 25th January 1945. Muskegon town was kept as a control town. The town was to serve as a control town for 15 years. It did not. After 6 years the caries experience in Grand Rapids was half that of Muskegon and it ceased to be a control town.

The other communities that fluoridated their water supplies are as follows.[7]

Date	*Fluoridation*	*Control city*
May 1945	Newburgh,	Kingston,

	New York	New York
June 1945	Brantford, Ontario	Sarnin, Ontario
Feb. 1947	Evanston, Illinois	Oak park, Illinois

Equipment and chemicals for fluoridation

The choice of equipment and of fluorides to be used will depend on

1. Costs and installation
2. Maintenance
3. Surveillance

The following general characteristics of the system need to be considered:

- The equipment must be adapted to local conditions and needs of water network.
- Equipment must be efficacious, safe and precise.
- Should have well defined precision limits.

Types of equipment

a. Saturator system
b. Dry feeder
c. Solution feeder
d. Venturi fluoridator system
e. Saturation-suspension cone

Fluorides used

a. *Sodium fluoride (NaF):*
    1. Used in saturator system to avoid obstruction of gravel bed.
    2. Used in granular form.
    3. Available in 45 kg bags.
    4. Expensive.
b. *Sodium silico fluoride*:
    1. Available in 45 kg bags.
    2. Cheapest.

c. *Hydroflurosilicic acid*:

1. Delivered by tanker lorry with a capacity of 19,000 litres.
2. More expensive than sodium silico fluoride on account of transporting liquids.

Benefits of water fluoridation

1. ***Appearance of teeth*:** Teeth exposed to an optimum or slightly higher level of fluoride frequently are clear, white, shining, opaque and without blemishes (Fig. 21.2).

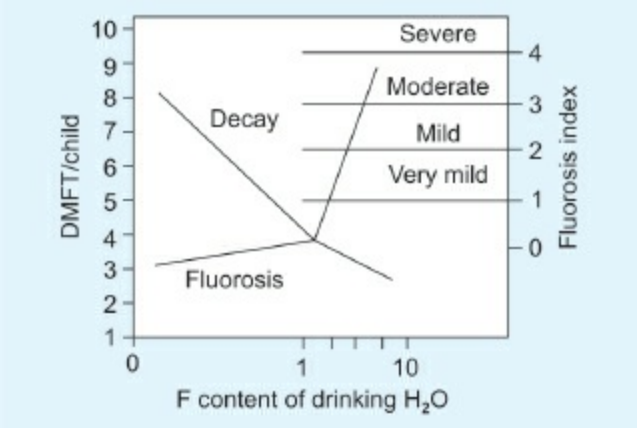


Fig. 21.2: As the fluoride content of water increases beyond 1 ppm, the index of fluorosis accelerates more rapidly than the DMF decreases

2. ***Dental caries reduction in primary and permanent teeth*:** The reduction for caries for primary teeth was between 40 and 50% and the reduction for permanent teeth was between 50 and 60 % (Fig. 21.3).

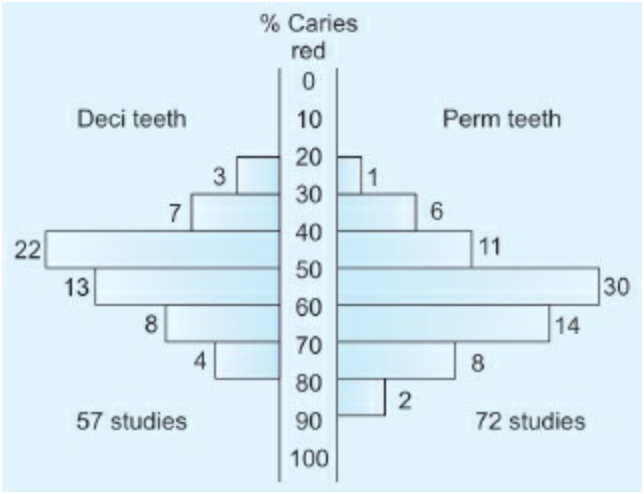


Fig. 21.3: Study reported by Murray JJ and Rugg-Gunn of 94 community fluoridation studies in 20 countries

3. ***Root caries*:** A report by Stamm and Banting shows that life long consumption of fluoridated water reduces the incidence of root caries by approximately 50%.
4. ***Tooth loss*:** According to Arnold FA, there is a 75% reduction in the prevalence of extracted first molars in fluoridated areas compared with those that are non-fluoridated.
5. ***Malocclusion*:** According to Salzman, orthodontic problems are approximately 20% less prevalent among children 6–14 years of age living in a fluoride area compared to those living in areas without the benefits of fluorides. This difference is possibly due to fact that the loss of first permanent molars is minimal in fluoride area.
6. ***Interproximal and coronal caries*:** There is about 95% less prevalence of interproximal dental caries and a reduction of 60% coronal caries in fluoridated communities compared to those of non-fluoridated.
7. ***Economy*:** Among other means of fluoride usage—fluoride tablets, school dentifrices, prescription fluorides, water fluoridation is most economical in reducing the cost of public health expenditure.

Feasibility

Water fluoridation procedure is feasible 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 rainwater tanks.
3. Suitable equipment is present.
4. Supply of fluoride is assured.
5. Workers available in the water treatment plant to maintain the system and keep records.
6. Money should be available for initial installation and running costs.

Fluoridation is feasible but is not implemented for political reasons. In view of the good results achieved in those countries where it has been used extensively for many years, water fluoridation must always be considered as a public health measure. Not only it is safe, but water fluoridation is also by far the most effective and efficient method of bringing the benefits of a continuous low concentration of fluoride to a whole community.

The reasons for rejecting a proven benefit could be

1. Ignorance and confusion on the part of the public about the dental health benefits.
2. Ambivalence of the public towards science and its by-products.
3. Misrepresentation of the scientific and technical information involved.

School water fluoridation: It was first initiated as a pilot study in 1954 at St. Thomas Virgin Islands, United States. One of several effective alternatives for prevention of dental caries in children of communities where water fluoridation is not feasible is the fluoridation of the school water supply. It can be used only if the surrounding areas from which the students come have a low fluoride content. Consolidated schools are ideal since all grades are housed in the same building.[7]

The concentration of fluoride in the school water system is 4.5 ppm in contrast to 1 ppm of community water supply. This upward adjustment is to compensate for the reduced water intake since the school day and year is shorter, hence the time spent at school.

The greatest advantage of school water fluoridation is that no effort is required by the recipient. A reduction in DMFT of about 40% was observed in children who drank fluoridated water containing 5 ppm.

Problems

1. Any effort to fluoridate the school system is subject to possible confrontation by antifluoridation groups.
2. The cost of the installation, supplies and maintenance competes with other needs of the school budget.
3. Custodial and back up personnel must be trained and used for continual operation, maintenance and monitoring of the unit.
4. The major concern however is by age 6 all teeth except 3rd molars are in an advanced stage of mineralization, thus reducing the pre-eruptive benefits of fluoride.

Salt Fluoridation

Salt fluoridation appears to be the most effective method to deliver fluoride to a target population where water fluoridation is not possible, and avoiding the firestorm of anti-fluoridationist opposition.[6]

This program was first introduced in Switzerland in 1955, with 5 mg of potassium iodine and 90 mg of sodium fluoride per kg.

Method of preparation

Type 1: Fluoride is added to salt by spraying concentrated solutions of sodium fluoride and potassium fluoride on salt on a conveyor belt.

***Type 2*:** Sodium fluoride and calcium fluoride are first mixed with slightly moist salt or mixed with a flow conditioner such as tricalcium phosphate and these premixed granules are added to the dry salt.

Advantages

1. The possibility of fluorosis is minimal.
2. It is safe.
3. Low cost.
4. Individual monitoring not required.
5. Freely available.
6. Distribution can be easily monitored.

7. Supply can be effectively controlled.
8. Readily accepted—as the addition of fluoride does not alter colour.

Disadvantages

1. There is no precise control, as the salt intake varies greatly among people.
2. There is now international efforts to reduce sodium intake to help control hypertension.

Milk Fluoridation

Milk is a reasonable vehicle for fluoride since it is a food used universally by infants, pregnant women and children. Milk is an excellent source of calcium and phosphorous and when fortified with vitamin D, contains all essentials for the development of bones and teeth (Figs 21.4 and 21.5).



Fig. 21.4: Distribution of fluoridated milk



Fig. 21.5: Drinking fluoridated milk

Fluoridation of milk was first mentioned by Ziegler in 1956. The rate of absorption of fluoride from milk and water indicates a significant reduction in fluoride absorption from milk during the first hour, but thereafter absorption continues at higher levels for longer periods of time. When milk is fluoridated, most of the fluoride persists in the ionized form for the first 4 hours, thereafter, about one-fifth is bound to calcium and protein.[9]

Advantage

- Staple food for children and infants.

Disadvantages

- Cost of fluoridated milk would be considerably higher.
- Centralized milk supply should exist.
- Variation in intake and quantity of milk.

Fluoride Tablets

Fluoride tablets provide systemic effect before mineralization of primary and permanent dentition and a topical effect thereafter.

***Effect on deciduous teeth*:** When fluoride administration in the form of tablets was started before 2 years of age and continued for a minimum of 3–4 years, caries reductions in the range of 50–80% have been reported.[3]

***Effect on permanent teeth*:** Majority of the studies showed from no marginal reduction to 20–40% caries reduction. Fluoride must be ingested systemically in order to exert maximum cariostatic effects during the mineralization of the surface of a crown.

***Availability*:** Fluoride tablets are commercially available as NaF tablets of 2.2 mg, 1.1 mg and 0.55 mg yielding 1 mg, 0.5 mg and 0.25 mg fluoride respectively (Fig. 21.6).



Fig. 21.6: Commercially available fluoride tablets

Sodium fluoride tablets with vitamin combinations are also available. For best topical effect, fluoride tablets should be first chewed and then swallowed.

***Swish and swallow technique*:** With the use of tablets, it seemed logical that if a child would chew the tablets, then swish the saliva between the teeth for a minute before swallowing, both a topical and a systemic dosage of fluoride would be achieved. This swish and swallow method is advocated whenever tablets are used.

***Recommended dose*:** The daily recommended dose of fluoride for child below 2 years is 0.5.mg, between 2 and 3 years is 0.5–0.7 mg and above 3 years is 1.0–1.5 mg.

Fluoride tablets are commercially available as NaF tablets of 2.2. 1.1 and 0.5 mg respectively yielding 1, 0.5, and 0.25 mg fluoride respectively.

Advantages

1. Ready for use.
2. Requires a little time to dispense.
3. Some tablets have a flavour that enhances child motivation to participate in the daily ingestion of fluoride tablet.

Fluoride Drops

Fluoride drops are used to supplement fluoride intake until a child is old enough to swallow fluoride tablets.

Drops are usually administered by use of a plastic dropper bottle, where 10 drops equal 1 mg of fluoride. When 10 drops are placed in a litre of water containing no fluoride, there is a resultant concentration of 1 ppm of fluoride (1 mg/ml).

The use of drops can be expected to produce a caries reduction on the order of 40%. Parents should be cautioned to use the prescribed number of drops and not to assume that just because one drop is effective, two will be better.

MECHANISM OF ACTION OF SYSTEMIC FLUORIDES

The cariostatic mechanism of systemic fluorides can be explained under the following headings:

1. Rendering enamel more resistant to acid dissolution
2. Inhibition of bacterial enzyme systems—enzymatic action
3. By reducing tendency of the enamel surfaces to absorb proteins.
4. Modification in the size and shape of teeth.

Rendering Enamel More Resistant to Acid Dissolution

Enamel contains millions of rods that run from dentino enamel junction to the tooth surface. Each rod is made up of crystals which are hexagonal in shape which is flattened on two opposite sides. Each crystal has three axis. The cental position is occupied by the hydroxyl ion surrounded by calcium and peripherally by phosphate ions. This model shows the steric configuration. According to the laws of chemistry, in order to maintain symmetry, hydroxyl ions must be located on side of the calcium plane as often as on the other. Moreover, neutron diffraction studies have shown that two adjacent calcium ions planes cannot have two hydroxyls between them. When such an orientation of hydroxyl groups occurs, a steric interference occurs. To avoid this steric interference one of the hydroxyl ions gets exterminated creating a void or reversal points. Presence of such voids in crystal structure leads to greater chemical reactivity making it highly reactive, thereby increases its solubility.[6]

Fluoride incorporates into the voids forming fluoroapatite as per the following formula.

$Ca_{10}\ (PO_4)\ OH2 + F_2^-$

$Ca_{16}\ (PO_4)\ F_2 + 2OH^-$

The other mechanisms which have been postulated in rendering decreased enamel solubility in addition to void replacement are:

1. Under the influence of fluoride, large crystals are formed with fewer imperfections, thus stabilizing the lattice and presenting a smaller surface area/unit volume for dissolution.
2. Enamel which mineralizes under the influence of fluoride has a lower carbonate content, thus giving a reduced solubility.
3. Fluoride brings about remineralization of the enamel at 1 ppm in early carious lesions.

Enzymatic Action

Fluoride is found in two forms, bound and ionic. The bound fluoride represents a fluoride reservoir in that it can dissociate when acid is produced by plaque organisms to make available much more ionic fluoride.

Fluoride has several different modes of action on bacterial metabolism:

1. The concentration of fluoride above 2 ppm in solution progressively decreases transport or uptake of glucose or glucose analogues into cells of oral streptococci.
2. When plaque has been depleted of its exogenous sugar supply, fluoride inhibits metabolism of iodophilic polysaccharides by the microorganisms present in plaque and also by salivary bacteria, thus indirectly interfering with acid production.

Effects Mediated by Surface Absorption

According to this hypothesis, fluoride incorporated in enamel by substitution of hydroxyl ions altered the surface charge or free energy and thus indirectly alters the deposition of pellicle and subsequent plaque formation.

Effects Mediated by Tooth Morphology

Fluoride is believed to alter the tooth morphology, i.e. reduction in the cusp height, fissure depth and increase in the fissure width, thus making teeth less susceptible to caries.

TOPICAL FLUORIDES

Definition

Topical fluoride therapy refers to the use of systems containing relatively large, concentrations of fluoride that are applied locally, or topically, to erupted tooth surfaces to prevent the formation of dental caries.[8]

Classification

i. Operator administered
   Fluoride solutions
      Sodium fluoride 2%
      Stannous fluoride 8%
   Fluoride gels
      Acidulated phosphate fluoride 1.23%
      Fluoride varnishes
         Duraphat
         Fluorprotector.

ii. Self-administered
   Fluoride dentifrices
   Sodium fluoride
      Fluoride mouth rinses
      Dentifrices containing monofluoro-phosphate.

Sodium Fluoride: 2%

Method of preparation

Sodium fluoride solution can be prepared by dissolving 20 gm of sodium fluoride powder in 1 litre of distilled water in a plastic bottle. If stored in glass containers, the fluoride ion of solution can react with silica of glass forming SiF_2, thus reducing the availability of free active fluoride for anticaries action.

Method of application (Knutson technique)

1. Initially, cleaning and polishing of the teeth is done.
2. An upper and opposing lower quadrant are isolated with cotton rolls.
3. Teeth are dried thoroughly.
4. 2% NaF is applied with cotton applicators and is permitted to dry in the teeth for about 4 minutes.
5. Procedure is repeated for the remaining quadrants.
6. After completion, patient is instructed to avoid eating, drinking or rinsing for 30 minutes.
7. Second, third and fourth applications are done at weekly intervals.

Recommended ages

Full series of four treatments is recommended at ages 3, 7, 11 and 13.

Mechanism of action of sodium fluoride

When sodium fluoride is applied topically, it reacts with hydroxyapatite crystals to form calcium fluoride which is the dominant product of reaction. This is due to high concentration of fluoride (9,000 ppm) in 2% sodium fluoride due to which the solubility product of calcium fluoride get exceeded fast and this initial rapid reaction is followed by drastic reduction in its rate and the phenomenon is called choking off.

Once 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. Further calcium fluoride reacts with hydroxyapatite to form

fluoridated hydroxyapatite which increases the concentration of surface fluoride, thus making the tooth structure more stable, less susceptible to dissolution by acids, interferes with plaque metabolism through antienzymatic action and also helps in remineralization of the initial decalcified areas, thus showing its manifold anticaries effect.

Advantages

1. Accepted taste.
2. Stable if stored in plastic containers.

Disadvantage

Four visits relatively at short period of time.

Stannous Fluoride – 8%

Method of preparation (Muhler's solution) Stannous fluoride solution has to be freshly prepared before use each time as it has no shelf life. 0.8 gm of stannous fluoride is dissolved in 10 ml of distilled water in a plastic container and the solution thus prepared is shaken briefly. The solution is then applied immediately to the teeth. The 10 ml of solution should be sufficient to treat the whole mouth of a single patient. If any remains, it should be discarded and not used again.[7]

Method of application

1. Each tooth surface must be cleaned and polished.
2. Teeth are isolated with cotton rolls and dried with compressed air.
3. Either a quadrant or half of the mouth can be treated at one time.
4. Freshly prepared 8% solution of SnF_2 is applied continuously to the teeth with cotton applicators.
5. Teeth are kept moist with solution for 4 minutes.
6. Re-application of solution to tooth is done every 15–30 seconds.

Recommended frequency

The recommended frequency of 8% SnF_2 applications is once per year.

Mechanism of action

When stannous fluoride reacts with hydroxyapatite, in addition to fluoride, the tin of stannous fluoride also reacts with enamel and new crystalline product stannous tin trifluoro-phosphate which is more resistant to decay than enamel is formed. It is due to this reason that always a freshly prepared stannous fluoride solution should be used and the capsule of SnF_2 should be kept in air tight containers, otherwise the stannous form of tin gets oxidised to stannic form, thus making the SnF_2 inactive for anticaries action.

Stannous fluoride with hydroxyapatite shows mainly four end products.

1. Tin hydroxyphosphate
2. Tin trifluorophosphate

3. Calcium trifluorostannate
4. Calcium fluoride

Calcium fluoride so formed, further reacts with hydroxyapatite and small fractions of flour—hydroxyapatite also gets formed. The other end product, tin hydroxyphosphate gets dissolved in oral fluids and is responsible for the metallic taste after topical application of stannous fluoride.

The main end product tin trifluorophos-phate is responsible for making the tooth structure more stable and less susceptible to decay.

Advantage

Application required only once per year.

Disadvantages

1. Has to be prepared freshly each time before use.
2. Metallic taste.

Acidulated Phosphate Fluoride—1.23%

Method of preparation (Brudevolds solution)

It is prepared by dissolving 20 gm of sodium fluoride in 1 litre of 0.1 M phosphoric acid. To this added is 50 percent hydrofluoride acid to adjust the pH at 3.0 and fluoride-concentration at 1.23 percent.[4]

APF gel (Fig. 21.9)

For the preparation of APF gel, a gelling agent methyl cellulose or hydroxyethyl cellulose is to be added to the solution and the pH is to be adjusted between 4 and 5.

Another form of APF for topical applications, namely thixotropic gels, is also available. The term thixotropic denotes a solution that sets in a gel-like state but is not a true gel. With application of pressure, thixotropic gels behave like solutions; it has been suggested that these preparations are more easily forced into the interproximal spaces than conventional APF gels.

A foam form of APF is also available. Laborartory studies indicate that the amount of fluoride uptake in enamel after applications using the foam is comparable to that observed with conventional APF gels and solutions.[7]

Method of application

1. Oral prophylaxis.
2. Teeth are isolated with cotton rolls on both lingual and buccal sides.
3. Teeth are dried.
4. APF solution is continuously and repeatedly applied with cotton applicators.
5. Teeth are kept moist for four minutes.

Recommended frequency

The recommended frequency of APF topical application is twice a year.



Fig. 21.7: Commercially available fluoride gel



Fig. 21.8: Gel loaded on the tray for application



Fig. 21.9: Placement of gels

Mechanism of action

When APF is applied on the teeth, it initially leads to dehydration and shrinkage in the volume of hydroxyapatite crystals which further on hydrolysis forms an intermediate product called dicalcium phosphate dihydrate (DCPD).

This DCPD is highly reactive with fluoride and starts forming immediately when APF is applied and fluoride penetrate into the crystals more deeply through the openings produced by shrinkage and leads to formation of fluorapatite.

Advantages

1. No staining of tooth structure.

2. Stable when kept in polyethylene bottle.
3. In case of gel, self-application is possible.

Disadvantages

1. Sour and bitter in taste.
2. Repeated applications necessitates the use of suction, thereby minimising its use in the field.

Fluoride Varnish (Figs 21.10 and 21.11)

The two most commonly used varnishes are:

- Duraphat (NaF varnish)
- Fluorprotector (silane fluoride)

Composition

Fluorprotector is a colourless, polyurethane lacquer. The fluoride compound is a difluorosilane-ethyl-difluorohydroxy, silane. The active fluoride available is 7000 ppm. Duraphat is a sodium fluoride in varnish form containing 22.6 mg F/ml suspended in an alcoholic solution of natural organic varnishes. It is available in bottles of 30 ml suspension containing 50 mg NaF/ml. The active fluoride available is 22,600 ppm[3].



Fig. 21.10: Commercially available fluoride varnish

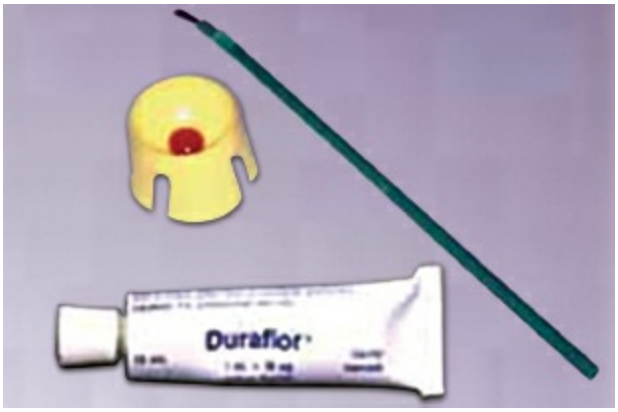


Fig. 21.11: Dispensing of varnish solution

Method of varnish application *(Figs 21.12 to 21.17)*

1. Oral prophylaxis.
2. Teeth are dried.
3. Teeth are not isolated with cotton rolls as varnish being sticky has a tendency to stick to cotton.
4. The application is done first on lower arch as saliva collects more rapidly around it, and then on the upper arch.
5. Application of varnish is done with single tufted small brush.
6. After application, patient is made to sit with mouth open for four minutes.
7. Patient is instructed not to rinse or drink anything at all for one hour and not to eat anything solids but take liquids and semisolids only till next morning.
8. Contact between varnish and tooth surfaces are needed to be maintained for 18 hours for prolonged interaction between fluoride and enamel.

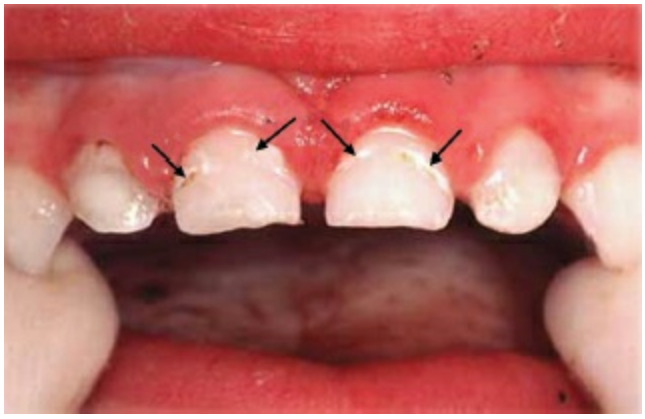


Fig. 21.12: Incipient caries lesion indicated for varnish application



Fig. 21.13: Drying the tooth surface with gauze



Fig. 21.14: Varnish application



Fig. 21.15: Varnish application using unitufted brush



Fig. 21.16: Allow to dry after application



Fig. 21.17: Three months after application

Mechanism of action

When varnish is applied topically under controlled conditions, a reservoir of fluoride ions gets build up around the enamel of teeth. Fluoride keeps on slowly releasing and continuously reacting with the hydroxyapatite crystals of enamel over a long period of time leading to deeper penetration of fluoride and formation of fluorapatite.

Recommended dose

The recommended dose of 0.5 ml of duraphat for single application contains 11.3 mg F, and 0.5 ml of fluorprotector contains 3.1 mg F.

MI Varnish

MI varnish is a 5% sodium fluoride varnish that has a desensitizing action when applied to tooth surfaces. MI varnish also contains RECALDENT™ (CPP-ACP): Casein phosphopeptide-amorphous calcium phosphate. The application leaves a film of varnish on tooth surfaces (Fig. 21.18).



Fig. 21.18: MI varnish

Fluoride Dentifrices

The term dentifrice is derived from a latin word (dens – tooth, fricare – to rub). The most commonly used fluoride dentifrices are sodium mono fluorophosphates and sodium fluoride.

Mono fluorophosphates dentifrices are considered to be more advantageous than NaF and SnF_2 because it has

1. Neutral pH.
2. Greater stability to oxidation and hydrolysis.
3. Greater shelf life.
4. Increased availability of fluoride.
5. No staining of teeth.

Indications

1. *Dental caries prevention*: Recommended for each patient as part of the complete prevention program.
2. ***Caries – risk patients*:** Patients with moderate to rampant dental caries should be advised to brush several times each day with fluoride – containing dentifrice.
3. ***Desensitization*:** Certain dentifrices containing fluoride have desensitizing properties.

Mechanism of action

There are two possible modes of action regarding caries inhibitory mechanism of mono fluorophosphates. According to Erricsson, 1963, mono fluorophosphates is deposited in the crystalline lattice and in subsequent intracrystalline transposition, fluoride is released and replaces the hydroxyl group to form fluorapatite.

The second mode of action attributes the anticariogenic activity due to mono fluorophosphates as such and it may exchange with the phosphate groups in the apatite crystals and this reaction is not competitive of fluoride.

Preparations

Fluoride dentifrices are available as gels or pastes. Sodium fluoride and sodium mono-fluorophosphates dentifrices are approved currently.

Recommended procedures

1. Select an approved fluoride containing dentifrice.
2. Place a small amount of dentifrice on the toothbrush tips.
   Use only a small amount, the size of a pea.
3. Spread dentifrice over the teeth with a light touch of the brush.
4. Proceed with correct brushing for sulcular removal of bacterial plaque.
5. Keep dentifrice container out of reach of children.

Safety

Fluoride toothpaste generally contains around 800 to 1000 ppm of fluoride and the free available fluoride is approximately 500 to 600 ppm, i.e. about 30 mg fluoride in a tube of 50 gm.

Recommendations for use of fluoride

1. *For children below 4 years*: Fluoride toothpaste is not recommended.
2. ***For children 4–6 years*:** Brushing once daily with fluoride toothpaste and other two times without a paste.
3. ***For children 6–10 years*:** Brushing twice daily with fluoride toothpaste and once without paste.
4. ***For children above 10 years*:** Brushing three times with fluoride toothpaste.

Amine Fluoride Dentifrices (Fig. 21.19)

A special category of topical fluorides are organic fluorides in the form of amine fluorides (AmF).

- Amine fluoride 297 (OLAFLUR) contains 1000 ppmF.
- Amine fluoride 242 (HETAFLUR) contains 250 ppmF.



Fig. 21.19: Amine fluoride dentifrice

Fluoride Mouth Rinses (Table 21.1)

Mouth rinsing is a practical and effective means for self-application of fluoride. The only persons excluded from the practice of this method are children under 6 years of age and those of any age who cannot rinse because of oral-facial musculature problems or other handicap.[3]

Table 21.1: Composition and frequency of approved fluoride rinses[7]

Source of fluoride	*Fluoride content*		*Recommended frequency*
	Percent	*ppm*	
Sodium fluoride	0.20	900	Weekly
Sodium fluoride	0.02	100	Twice daily
Sodium fluoride	0.05	225	Daily
APF	0.02	200	Daily
Stannous fluoride	0.10	243	Daily

Method of preparation

The procedure of making a rinse everyday in home is by dissolving 200 mg NaF tablet (10 mg NaF and rest the filler as lactose) in 5 teaspoons of fresh clean water (25 ml approx.) which is sufficient for daily mouth rinse of a family of about four members.

Method of use

1. Rinse daily with 1 teaspoonful (5 ml) after brushing before bed.
2. Swish between teeth with lips tightly closed for 60 seconds; expectorate.

Fluoride rinses can be used as daily mouth rinse by community and fortnightly in schools.

Advantage

30–40% average reduction in dental caries incidence.

Disadvantage

Requires community participation.

Multiple Fluoride Therapy

Multiple fluoride therapy describes fluoride combination programs.This program included the application of fluoride in the dental office in the form of both fluoride containing prophylactic paste and a topically applied fluoride solution, in addition to self-care using an approved fluoride dentifrice. In addition, some form of systemic fluoride, preferably community water fluoridation was included.[7]

Recent Advances in Fluoride Release

Controlled Release Fluoride

Observations have suggested that the sustained release of fluoride from an intraoral device could be an approach for the control of dental caries in special groups. Such a device has now been developed which consists of a central depot of sodium fluoride intimately mixed with a plastic copolymer and surrounded by a rate-controlling membrane. Fluoride diffuses out at a rate that is controlled by the thickness of the membrane and the exposed surface area of the device. Device can release fluoride at a rate of from 0.02 to 1 mg/day for up to six months.[2]

All the available evidence shows slow release techniques could play a major role in the prevention of dental caries. The devices could be incorporated into space maintainers, orthodontic appliances, partial dentures, crown and bridge work and of course directly on to the tooth surfaces. Patients most likely to benefit from the use of these devices include those who have salivary gland malfunction as a result of disease on radiation therapy. The handicapped who are unable to carry out normal oral hygiene procedures are also likely to be beneficiaries.

Types of Intraoral Fluoride-Releasing Devices (Fig. 21.20)[10]

The various types of intraoral fluoridereleasing devices are:

- Copolymer membrane device
- Glass device containing fluoride.
- Hydroxyapatite-Eudragit ₹ 100 diffusion controlled fluoride system
- Slow-fluoride release tablets for intrabuccal use.



Fig. 21.20: Glass device and bracket attached to upper first permanent molar teeth

TOXICITY OF FLUORIDE

The term toxicity refers to the symptoms manifested as a result of over dosage or excessive administration.

Acute: Due to single ingestion of large amounts of fluoride.

Chronic: Due to long-term ingestion of smaller amounts.

Concentration	***Medium***	***Effect***
2 parts per million	Air	Injury to vegetation
1 ppm	Water	Dental caries reduction
2 ppm or more	Water	Mottled enamel
8 ppm	Water	10% osteosclerosis
20–80 mg/day or more	Water/air	Crippling fluorosis
50 ppm	Food/water	Thyroid changes
100 ppm	Food/water	Growth retardation
<125 ppm	Food/water	Kidney changes
2.5–5.0 g	Acute dose	Death

Acute Fluoride Toxicity

The acute lethal dose of fluoride for man is probably 5 g. The probable range is 2–10 g. Acute fluoride intoxication is rare and is not well described as the chronic intoxication. Acute fluoride poisoning have been recorded

- As a result of accidents.
- Deliberate attempts to suicide.

Certainly Lethal Dose (OLD)

A lethal dose is the amount of drug likely to cause death.

Adult lethal dose = 34–64 mg F/kg body wt.

Safely Tolerated Dose (STD)

STD = ¼ certainly lethal dose (CLD)

Symptoms

1. Vomiting, nausea, diarrhoea
2. Pain abdomen extremities
3. Difficulty in speech
4. Thirst
5. Perspiration
6. Weak pulse
7. Coma
8. Convulsions
9. Cardiac arrhythmia → death.

Death will occur within 4 hours. If the patient survives for 24 hours, the prognosis is good.

Pathological Changes

1. Corrosive changes
    - Mouth

- Throat
- Oesophagus
- Stomach

2. Haemorrhagic stomach contents
3. Changes in
    - Duodenum
    - Small intestine
    - Large intestine

Treatment

1. Milk or egg can be given: This serves 2 purposes:
    a. Protects upper gastrointestinal tract from chemical burns
    b. Provides calcium that acts as a binder for fluoride.
2. Lime water
3. Aluminium hydroxide gels
4. Vomiting

Majority of ingested fluoride is expelled.

In an hospital

1. Cardiac monitoring.
2. Gastric lavage.
3. Oral or IV calcium gluconate (10 ml of 10%).
4. Urine output to be maintained.
5. General supportive measures.

Chronic Fluoride Toxicity

On Enamel

The influence of chronic fluorine intoxication is on the structure of enamel in the development of mottled enamel.

"Characterised by minute white flecks, yellow or brown spot areas, scattered irregularly over the tooth surface".

- Thicker the enamel, higher the severity.
- Fluorosis occurs symmetrically with in dental arches.
- Premolar is the most affected.
- Permanent teeth are particularly affected although occasional mottling of primary teeth may also be seen.

Treatment of Mottled Teeth

1. Milder forms diminish with time.
2. Removing minor blemished stains by grinding or polishing and etching by acid.
3. Bleaching with H_2O_2.
4. Use of composite.
5. Use of veneers.

Skeletal System

It has been reported in Madras (1937), Punjab (1962), Ceylon, and China.

Clinical features

Vague pains in small joints of hand and feet, knee joints, joints in the spine.

- Stiffness of spine
- Difficulty in walking
- Rigidity of thoracic cage (dyspnoea)

Radiographic Features

***Stage 1*:** Spinal column and pelvis show roughening and blurring of trabecule.

***Stage 2*:** Trabecule merge together and bone has a diffuse structure less appearance.

***Stage 3*:** Bone appears as marble white shadows.

On Thyroid

Used in the treatment of Graves, disease.

On Kidney

May aggravate renal disease.

DEFLUORIDATION

The need to fluoridate water supplies to reduce dental caries is balanced by a similar need to remove excessive amounts of fluorides from naturally fluoridated waters. Defluoridation of water is more than 10 times as expensive as fluoridation.

Methods

The ideal method to defluoridate an area is to blend the water from the well with the excess amount of fluoride with another water supply deficient in fluoride.

This method is being used at Myrtle Beach, South Carolina.

Advantage

The only expenditure is the connecting pipes.

Disadvantage

It can be used only in areas where extremes in concentration exists.

Hence alternative chemical methods need to be used.

Additive Methods

In this method chemicals are added to precipitate the fluoride and then the fluoride is passed through mixing basins, flocculation units, setting basins and filtering beds.[9]

Chemicals used

- Lime (calcium oxide)
- Magnesium compounds (dolomite)
- Aluminium sulfate (alum)

Adsorption Method

The water rich in fluoride is run over contact beds, where the fluoride is removed by ion exchange.

Chemicals used

1. Synthetic hydroxyapatite → Abandoned now due to high cost
2. Ion exchange resin → Too expensive
3. Activated alumina

4. Polystyrene → Fluoride removal capacity is lost on prolonged use,unacceptable taste in water, and costly.
5. Defluoron – 1 → Attritional loss
6. Magnesia → High initial cost, large concentration required.

Indian Perspective

The deflouridation techniques required skilled operations and the chemicals were expensive. Hence Nawlakhe in 1974 introduced the Nalgonda technique.

Method

The chemicals lime, bleaching powder and filter alum is added in sequence to the fluoride water. The water is then passed through the flocculation, sedimentation and filtration chambers.

Chemicals

1. Lime or sodium aluminates → hastens settlement of precipitate.
2. Bleaching powder → disinfection.

FLUORIDE BELTS

In our country, the states having some circumscribed areas of high fluoride levels (endemic fluoride belts with F content in groundwater above 4.00 ppm) include Punjab, Haryana, Rajasthan, Gujarat, Madhya Pradesh, Andhra Pradesh, and Tamil Nadu.

In the north, areas with high fluoride content in natural waters constitute a long endemic fluoride belt with fluoride content 1.1–21.0 ppm starting from north west Delhi to Sirsa and Hissar in Haryana, a part of Sangrur district including Barnala, almost whole of Bhatinda districts in Punjab and Rajasthan.

The high fluoride areas in Gujarat are Kutch and western Jamnagar districts (F levels in groundwater between 4 and 8.0 ppm).

The areas in Tamil Nadu with fluoride levels between 1.5 and 5.0 ppm are Coimbatore, Dharmapuri, North Arcot, Salem, Tiruchirapalli, Madurai, etc.

The arid and semi-arid belts of western India have a few villages with water fluoride levels as high as 9.5, 8.5, 8.5 and 19.0 ppm respectively.

Usually, without the scientific background of realistic data on the fluoride content of drinking water, a casual remark is often made that India already has a high concentration of fluoride in drinking water. Only about 5% of population lives in high fluoride areas or known endemic fluoride belts.

For example,

Biharsharif area in Bihar,

Bhatinda belt in Punjab,

Etawah area in Uttar Pradesh.

Anantpur and Guntakal areas in

Andhra Pradesh

FLUORIDE ALTERNATIVES

In recent years, alternatives to fluoride such as theobromine, nano hydroxyapatite (HA) casein phosphopeptide (CPP), etc. have been proposed for their anti-cariogenic properties.

Theobromine Containing Dentifrices (Fig. 21.21)

Theobromine is an active ingredient in chocolate cocoa beans which are main constituent of chocolate; contain some polyphenols which exhibit anti-glucosyltransferase activity. The odent classic is a non-toxic and revolutionary alternative to fluoride; ideal as a daily dentifrice replacement to traditional toxic fluoride therapies.



Fig. 21.21: Theodent toothpaste

Casein Phosphopeptide-Amorphous Calcium Phosphate (CPP-ACP) (Fig. 21.22)

A water based, sugar free dental topical creme containing Recaldent™ CPP-ACP (Casein Phosphopeptide-Amorphous Calcium Phosphate). The first product for professional use that contains Recaldent™ technology is GC tooth mousse.



Fig. 21.22: GC tooth mousse

Bioactive Glass Containing Dentifrice (Novamin Technology) (Fig. 21.23)

Novamin is a calcium sodium phosphosilicate that belongs to a class of bioactive glasses that react when exposed to aqueous media, providing calcium and phosphate ions. Novamin have been used for preventing demineralization and enhancing remineralization. Examples of novamin powered technology include oravive, a product from natural health organics, which is a non-fluoridated, non-prescription dentifrice containing 5% novamin.



Fig. 21.23: BAG conataining dentifrice

Chlorhexidine Varnish (The Cervitec Plus Varnish System) (Fig. 21.24)

Chlorhexidine varnish was developed to prolong the contact of the chlorhexidine with the teeth and to provide sustained release of the antimicrobial agent for increased effectiveness.[11]



Fig. 21.24: Chlorhexidine varnish

Chocolate Mouthrinse

Cocoa bean husk extract which is a waste material generated in chocolate industry having anti-glucosyltransferase activity, incorporated into mouth rinses and named it chocolate mouth rinse. It is seen to be acceptable to children with a significant decrease in mutans streptococci counts and plaque scores.[12]

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Section

F

Health Statistics

22. Applied Biostatistics and Research Methodology

CHAPTER

22

Applied Biostatistics and Research Methodology

INTRODUCTION

The increasing amount of research in the dental field and the active participation of students in research have deemed the need to understand basic statistics and research methodology principles. The goal of this chapter is to give the reader a conceptual understanding of the basic statistical procedures used in the health sciences. Emphasis is given to the rationales, applications, and interpretations of the most commonly used statistical techniques rather than on their advanced mathematical, computational and theoretical aspects.

TERMINOLOGIES[1,2]

Statistics

Statistics can be defined as the science of collecting, summarizing, presenting, analyzing and interpreting the data.

Biostatistics

Biostatistics deals with the statistical methodologies involved in biological sciences. As medicine is a branch of biology, medical statistics is a branch of biostatistics.

Statistical Inference

Statistical inference makes use of information from a sample to draw conclusions (inferences) about the population from which the sample was taken.

Experiment

An experiment is any process or study which results in the collection of data, the outcome of which is unknown. In statistics, the term is usually restricted to situations in which the researcher has control over some of the conditions under which the experiment takes place.

Population

A population is any entire collection of people, animals, plants or things from which we may collect data. It is the entire group we are interested in, which we wish to describe or draw conclusions about.

Sample

A sample is a group of units selected from a larger group (the population). By studying the sample, it is hoped to draw valid conclusions about the larger group.

Sampling Unit

A unit is a person, animal, plant or thing which is actually studied by a researcher; the basic objects upon which the study or experiment is carried out. For example, a person; a monkey; a sample of soil; a pot of seedlings; a postcode area; a doctor's practice.

Sampling Distribution

The sampling distribution describes probabilities associated with a statistic when a random sample is drawn from a population. The sampling distribution is the *probability distribution* or *probability density function* of the statistic.

Parameter

A parameter is a value, usually unknown (and which, therefore, has to be estimated), used to represent a certain population characteristic. For example, the population mean is a parameter that is often used to indicate the average value of a quantity. Within a population, a parameter is a fixed value which does not vary. Each sample drawn from the population has its own value of any statistic that is used to estimate this parameter. For example, the mean of the data in a sample is used to give information about the overall mean in the population from which that sample was drawn.

Statistic

A statistic is a quantity that is calculated from a sample of data. It is used to give information about unknown values in the corresponding population. For example, the average of the data in a sample is used to give information about the overall average in the population from which that sample was drawn.

Estimate

An estimate is an indication of the value of an unknown quantity based on observed data. More formally, an estimate is the particular value of an estimator that is obtained from a particular sample of data and used to indicate the value of a parameter.

Uses of statistics[3]

1. To measure the state of health of community and to identify its health problems, their nature, etc.

2. For comparing health status of one country with that of another and for comparing the present status with that of the past.
3. For planning and administration of dental health services.
4. For prediction of health trends.
5. To evaluate progress and development of disease.
6. Statistics helps the dentist to think quantitatively and to be able to assess probabilities.
7. It helps in estimating the future needs of the community and to fix suitable targets for achievement.

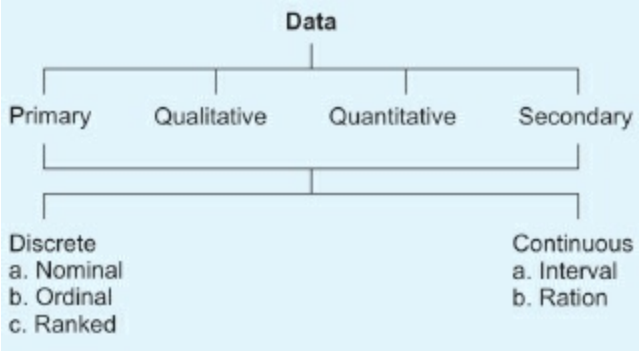
DATA[3,4]

Data are a set of values of one or more variables recorded on one or more individuals. Data consist of discrete observations of attributes or events that carry little meaning when considered alone. Data need to be transformed into information by reducing, summarizing and adjusting them for variations in the age and sex composition of the population so that comparisons over time and place are possible.

Table 22.1: Types of data[3,4]

Data type		*Description*	*Example*
Primary data		Obtained directly from individual	Surveys, investigations
Secondary data		Obtained from outside sources	School register, hospital records
Qualitative data (e.g. level of oral hygiene, gender)	Nominal	Classified into groups with no particular order or severity	Type of restoration, marital status, religious faith, speciality in dentistry
Quantitative data (e.g. age, height, weight)	Ordinal	Ranked in specific order but no consistent level of magnitude between groups	Loe and Silness index scores, Miller's classification of root exposure, oral cancer staging
	Ranked	Ranks are determined by sorting the data into order and replacing each value by its relative position in the order	
	Interval	Data are ranked in specific order with constant change in magnitude with zero point arbitrary	Fahrenheit scale, IQ scores
	Ratio	Like interval scale but with an arbitrary zero	Heart rate, blood pressure, diastema, length of root canal, treatment cost

Types of Data[4]



VARIABLE[3,4]

A variable is any characteristic of an object that can be measured or categorized. An object can be a patient, a laboratory animal, a periapical lesion, or dental or medical equipment.

Types of Variable

1. ***Numerical discrete*:** A discrete variable is a random variable that can take on a finite number of values or a countably infinite number of values.

   For example, the number of teeth with restorations, the number of patients with premalignant lesions, the number of patients requiring ART.

2. ***Numerical continuous*:** A continuous variable is a random variable that can take on a range of values on a continuum; that is, its range is uncountably infinite.

   For example, treatment time, pocket depth, amount of new bone deposition.

METHODS OF COLLECTION OF DATA[5]

1. Questionnaires
2. Surveys
3. Records
4. Interviews
5. Observational studies
6. Biophysiological methods

Data Collection Plan[5]

1. Determination of data to be gathered.
2. Prioritize the order in which it should be gathered.
3. Type of instrument for each variable.
4. Analyze the skills, resources, validity and reliability issues of the instrument.
5. Ethical issues in the data collection process.
6. Develop data collection forms, protocols, and data management procedures.
7. Training and calibration of examiners.
8. Pretest entire data collection package.
9. Proceed to data collection.

PRESENTATION OF DATA[3,4]

The variables distributed in a population or a sample can be of interest for various reasons. Statistical data once collected must be arranged purposively, in order to bring out the important points clearly and strikingly. Therefore, the manner in which statistical data is presented is of utmost importance. There are several methods of presenting data.

I. Tabulation
   - Simple tables
   - Frequency distribution table

II. Charts and diagrams
   - Bar charts
     a. Simple bar chart
     b. Multiple bar chart
     c. Component bar chart
   - Histograms
     a. Frequency polygon
     b. Frequency curve
     c. Pie chart Pictogram

III. Line diagrams

IV. Statistical maps

Tabulation

Tables are devices for presenting data. Tabulation is the first step before the data is used for analysis or interpretation. There are general principles that should be borne in mind before designing tables.

1. The tables should be numbered, e.g. Tables 22.1 to 22.3, etc.
2. A title must be given to each table. The title must be brief and self-explanatory.
3. The headings of columns and rows should be clear and concise.
4. The data must be presented according to size or importance chronologically, alphabetically or geographically.
5. If percentage or average are to be compared, they should be placed as close as possible.
6. No table should be too large.
7. Foot notes may be given, where necessary, providing explanatory notes or additional information.

Simple tables[3]

Students ina primary school	
Classes (standard)	***Number of students***
I	68
II	65
III	63
IV	62
V	60

Frequency distribution table[3]

The first step in summarizing data is to organize the data in some meaningful fashion. The most convenient and commonly used method is a **frequency distribution**, in which raw data are organized in table form by class and

frequency. For nominal and ordinal data, a frequency distribution consists of categories and the number of observations that correspond to each category.

Points to remember in formulating a frequency distribution table:

1. Select the number of non-overlapping intervals. The groups should not be too broad or too narrow. For example, grouping of age should neither be yearly or 30 yearly but have 5 or 3 yearly and the interval should be uniform throughout.
2. The number of classes should neither be too many nor too low. It can generally be anywhere between 6 and 16 depending on requisites of study and the proposed sample size.
3. The actual number and percentages can be mentioned simultaneously using parenthesis.
4. Groups should be tabulated in ascending or descending order, from the lowest value in range to highest, such as height in centimetres 141–150, 151–160, 161–170.
5. If certain data are to be omitted or excluded from the table, the reason for the same should be mentioned in foot note.
6. The headings must be clear with measurement units, e.g. age in years, rate in per cent or per thousand, etc.

Example of a frequency distribution table: Age and gender-wise distribution of dental students.

Age (years)	***Gender***	
	Male n (%)	***Female n (%)***
18–22	10 (23.2)	12(25.5)
23–27	13(30.2)	10(21.2)
28–32	20(46.6)	25(53.2)
Total	**43(47.7)**	**47(52.3)**

Charts and Diagrams[6]

Although frequency distribution is an effective way to organize and present data. Charts and diagrams can convey the same information more interestingly.

Advantages

1. Diagrams are better retained in the memory than statistical tables.
2. If the diagrams are drawn simple, the impact on the reader is much higher.

Disadvantages

Lots of details of the original data may be lost in charts and diagrams.

Presentation of Qualitative Data

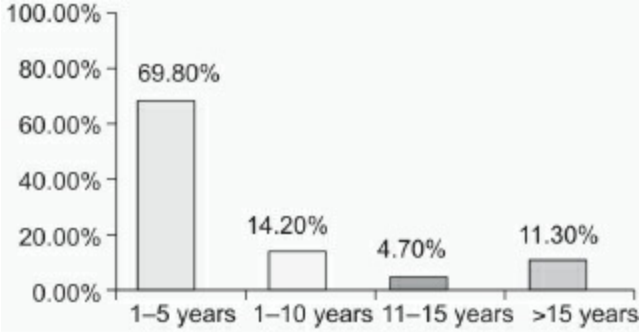
Bar charts[6]

In a **bar graph** categories into which observations are tallied appear on the abscissa (X-axis) and the corresponding frequencies on the ordinate (Y-axis). The height of a vertical bar represents the number of observations that fall into a category (or a class). When two sets of data with an unequal number of observations are being compared, the height of a vertical bar should represent proportions or percentages.

Types of bar chart[3,4]

1. *Simple bar chart*

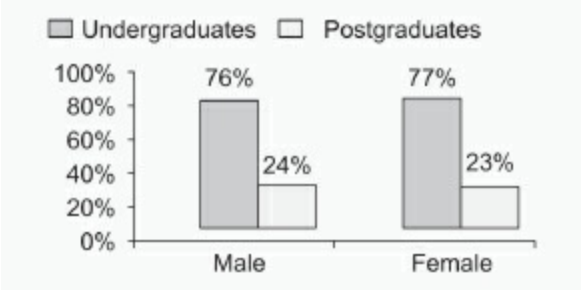
Example: Age-wise distribution of students in a school.



2. *Multiple bar chart*

When there are two sets of similar information they can be contrasted by displaying both sets on the same graph, by using multiple bars. Similar to bar diagram except that for each category of the variable we have set of bars of the same width corresponding to the different sections without any gap in between the width and length corresponds to the frequency.

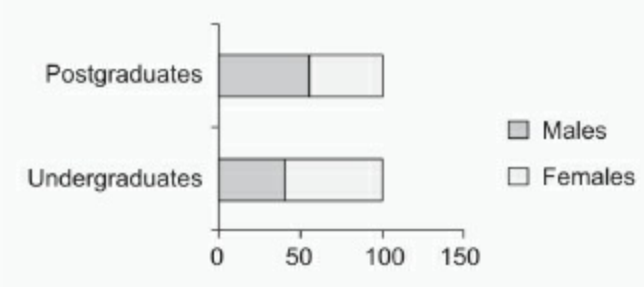
Example: Distribution of students according to gender and level of graduation.



3. *Percentage component bar chart*

This can be used in a similar way as multiple bar chart. When it is desired to compare only the proportion of subgroups between different major groups of observations, then bars are drawn for each group with same length, either as 1 or 100%. These are then divided according to the subgroup proportion in each major group.

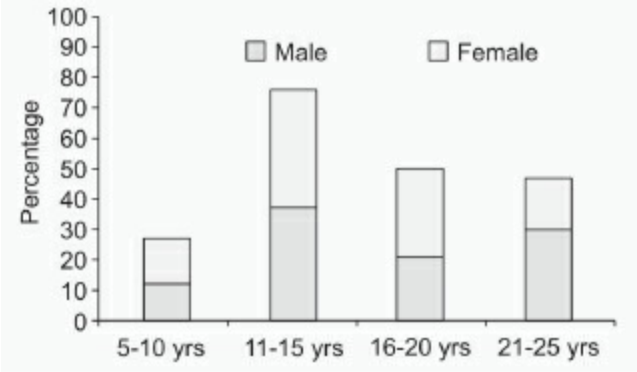
Example: Distribution of students according to gender and level of graduation.



4. *Component bar chart*

When it is desired to represent both, the number of cases in major groups as well as the subgroups at the same time, we use the component bar diagram. First, we draw rectangles proportional to the number of cases of the major group. Then, each rectangle is divided according to the numbers in subgroups.

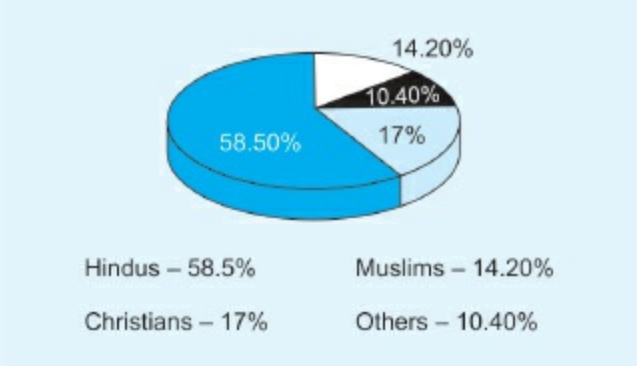
Example: Prevalence of dental caries age- and gender-wise.



5. *Pie or sector diagram*[6]

It is a simple circle divided into pie-shaped pieces that are proportional in size to the corresponding frequencies or percentages. Categorical data are often presented graphically as a pie chart. The variable for pie charts can be nominal or ordinal measurement scale. To construct a pie chart, the frequency for each category is converted into a percentage. Then, because a complete circle corresponds to 360 degrees, the central angles of the pieces are obtained by multiplying the percentages by 3.6.

Example: Distribution of study subjects according to religion in a state.



6. *Pictogram or picture diagram*

It is a most preferred method when research data is to be projected to a common man, such as mortality rates in case of a recent epidemic. The reduction in number of road traffic accidents before and after making helmets compulsory for two wheelers.

Example: Approximate number of people who live in selected cities are:

London: 6 million

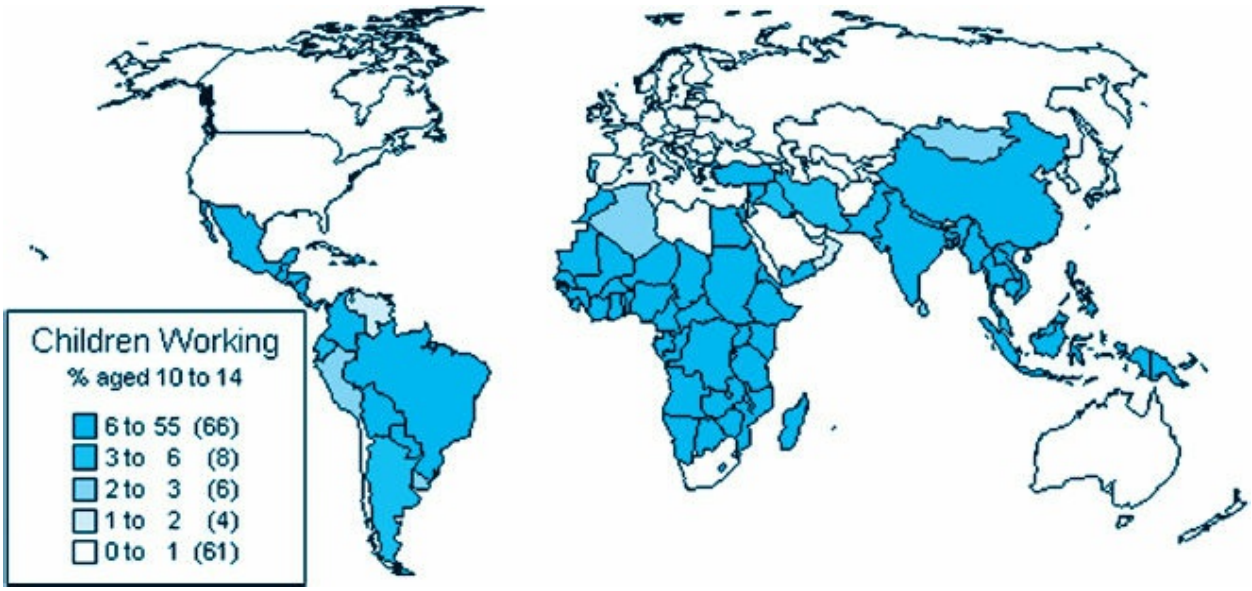
Paris: 2½ million

Berlin: 3 million

Rome: 2¼ million

Moscow: 8 million.

This data may be presented as a pictogram.



7. *Map diagram or spot map*

The geographical distribution of a characteristic or a frequency can be represented by using this method. Scenarios like fluoride belts in the country, primary health centres in the country can be denoted using map diagram or spot map.

Example: Worldwide distribution of child labour aged 10 to 14 years (**Picture courtesy:** The Washington post).



Presentation of Quantitative Data

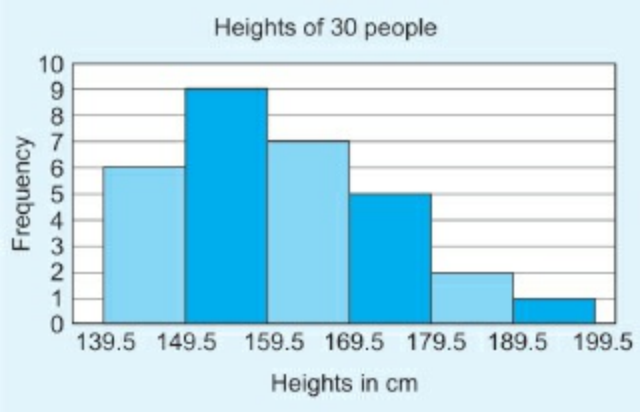
1. *Histogram*

A histogram is similar to bar graph except it uses interval or ratio variables and is used to represent quantitative data. The variables under consideration are grouped into intervals of equal width. Like a bar graph, rectangles are drawn above each interval, and the height of the interval represents the number of observations in the interval.

Points to be noted in histograms[6]

- Histograms serve as a quick and easy check of the shape of a distribution of the data.
- The construction of the graphs is subjective.
- The shape of the histograms depends on the width and the number of class intervals.
- Histograms could be misleading. Histograms display grouped data. Individual measurements are not shown in the graphs.
- Histograms can adequately handle data sets that are widely dispersed.
- The subjective nature of the histogram suggests that we must be cautious about how we use histograms and not be enamoured with their use.
- Histograms should not be constructed with open class intervals. When the width of the class intervals is not equal, special care should be exercised.

Example: Distribution of study subjects according to height in cm.



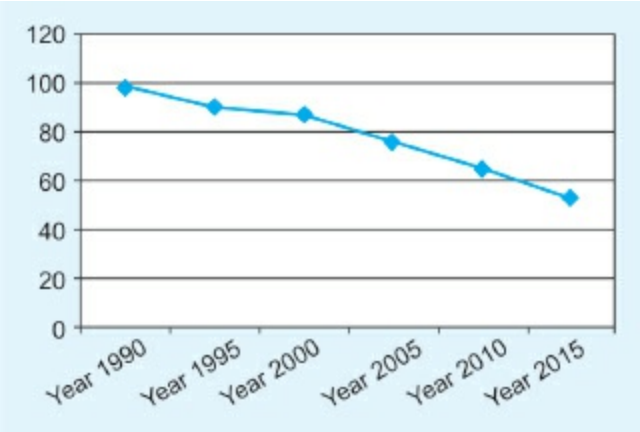
2. *Frequency polygon (a figure with many angels)*

It is a diagram of frequency distribution drawn over a histogram. The midpoints of class intervals at the height of frequencies are joined by straight lines. It gives a polygon. Most commonly used when multiple sets of data are to be represented in the same graph. For example, birth of heterozygous and homozygous twins. When the number of observations is very large and group interval is reduced, the frequency polygon tends to loose its angulation giving place to a smooth curve known as frequency curve.

3. *Line chart or graph*

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, years is represented and the value of any quantity data is represented along the Y axis.

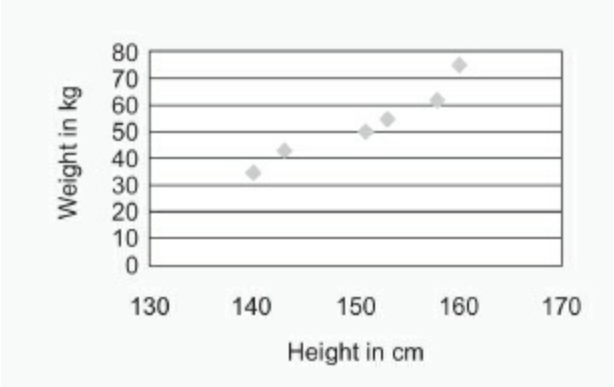
Example: Change in trend of dental caries over past 25 years.



4. *Scatter or dot diagram*

It is prepared after tabulation in which frequencies of at least two variables have been cross classified. It is a graphic presentation, made to show the nature of correlation between two variable characters X and Y in the same person or group such as height and weight in men aged 20 years, hence it is also called correlation diagram. The characters are read on the base and the vertical axes and the perpendiculars drawn from these readings meet to give one scatter point. Varying frequencies of the characters give a number of such points that show a scatter. A line is drawn to show the nature of correlation.

Example: Correlation between height and weight in 6 individuals.



MEASURES OF CENTRAL TENDENCY[3,4]

For overall comparison of the distributions, the entire mass of data may be summarized using a single value which is known as the parameter and one such parameter is the measure of central tendency.

The **main objective** of measure of central tendency is:

a. To condense the entire mass of data.

b. To facilitate comparison.

Requisites of a good measure of central tendency:

1. It should be rigidly defined.
2. It should be simple to understand and easy to calculate.
3. It should be based upon all values of given data.
4. It should be capable of further mathematical treatment.
5. It should have sampling stability.
6. It should not be unduly affected by extreme values.

The most commonly used measures are as follows.

Mean

This measure implies the arithmetic average or arithmetic mean. It is obtained by summing up all the observations and dividing the total by number of observations.

For example, the following denotes the number of decayed teeth in 10 children.

No. of children	1	2	3	4	5	6	7	8	9	10
No. of decay	5	6	4	0	2	2	3	7	4	3

Total = 36

Mean = 36/10 = 3.6 (mean decay in 10 children)

Mean is denoted by the sign $\bar{X}$ (X bar)

Merits of Mean

1. It is rigidly defined.
2. It is easy to understand and easy to calculate.
3. It is based upon all values of the given data.
4. It is capable of further mathematical treatment.
5. It is not much affected by sampling fluctuations.

Demerits of Mean

1. It cannot be calculated, if any observations are missing.
2. It cannot be calculated for the data with open end classes.
3. It is affected by extreme values.
4. It cannot be located graphically.
5. It may be number which is not present in the data.
6. It can be calculated for the data representing qualitative characteristics.

Median

In median, the data are arranged in an ascending or descending order of magnitude and the value of middle observation is located.

For example, number of decayed teeth in ten children.

No. of children	1	2	3	4	5	6	7	8	9	10
No. of decay	5	6	4	0	2	2	3	7	4	3

Arrange them in ascending or descending order.

0, 2, 2, 3, 3, 4, 4, 5, 6, 7

$$\text{Median} = \frac{3+4}{2} = 3$$

If there are only 9 observations excluding the 0 then median = 4.

Merits of Median

1. It is rigidly defined.
2. It is easy to understand and easy to calculate.
3. It is not affected by extreme values.
4. Even if extreme values are not known, median can be calculated.
5. It can be located just by inspection in many cases.
6. It can be located graphically.
7. It is not much affected by sampling fluctuations.
8. It can be calculated for data based on ordinal scale.

Demerits of Median

1. It is not based upon all values of the given data.
2. For larger data size, the arrangement of data in the increasing order is difficult process.
3. It is not capable of further mathematical treatment.
4. It is insensitive to some changes in the data values.

Mode

The mode is the most frequent data value. Mode is the value of the variable which is predominant in the given data series. Thus in case of discrete frequency distribution, mode is the value corresponding to maximum frequency. Sometimes there may be no single mode, if no one value appears more than any other. There may also be two modes (bimodal), three modes (trimodal), or more than three modes (multimodal).

For example, number of decayed teeth in children are as follows:

1. 0, 2, 3, 4, 4, 5, 6, 7

Here the mode is 4 (unimodal)

2. 0, 2, 3, 3, 4, 4, 5, 6, 7

Here the mode is 3, 4 (bimodal).

Merits of Mode

1. It is easy to understand and easy to calculate.
2. It is not affected by extreme values or sampling fluctuations.
3. Even if extreme values are not known, mode can be calculated.
4. It can be located just by inspection in many cases.
5. It is always present within the data.
6. It can be located graphically.
7. It is applicable for both qualitative and quantitative data.

Demerits of Mode

1. It is not rigidly defined.
2. It is not based upon all values of the given data.
3. It is not capable of further mathematical treatment.

MEASURES OF DISPERSION[3,4]

The scatteredness or variation of observations from their average is called the dispersion. There are different measures of dispersion like range, quartile deviation, mean deviation and standard deviation.

Main objective of measures of dispersion:

1. To study the variability of data.
2. Accounting the variability in data.

***Requisites of a good measure of dispersion*:** It carries the same requisites as for measures of central tendency.

The most commonly used measure of dispersion is as follows.

The 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. This measure is simple to calculate.

For example, the plaque index score of 5 individuals is as follows: 1, 0, 0, 2, 3

Range = Xmax – Xmin

Range = 3 – 0 = 3

Range coefficient

$$= X_{max} – X_{min}/X_{max} + X_{min}$$

3 – 0/3 + 0 = 1

Merits of Range

- Simple
- Easy to understand
- Quickly calculated

Demerits of Range

- Its value fluctuates with size of observation.
- It is unstable in repeated sampling.
- It is very rough measures of dispersion and not suitable for precise and accurate studies.

It is of no practical importance because it does not indicate anything about the dispersion of values between the two extreme values.

Quartile Deviation

The quartiles are the values which divide the whole distribution into four equal parts. We can delete the values below the first quartile and above the third quartile. This quantity is known as quartile deviation.

$$QD \text{ —(Q3 —Q1)/2}$$

Merits of Quartile Deviation

- The quartile deviation is more stable than range.
- This is not affected by two extreme values.

Demerits of Quartile Deviation

- It fails to take all the values of deviation into account.

Mean Deviation

It is the average of the deviation from the arithmetic mean. The mean deviation is one way of measuring how closely the individual scores in the data set cluster around the mean. This is done by (x—X bar).

Merits

- The mean deviation takes all the values into consideration.
- It is fairly stable compared to range or quartile deviation.

Demerits

- It is not stable like standard deviation.
- Mean deviation ignores signs of deviation.
- It is not possible to use it for further statistical analysis.

Standard Deviation (SD)

The standard deviation is the most frequently used measure of deviation. In simple terms, it is defined as root mean square deviation. It is denoted by the Greek letter Sigma or by the initials SD. It is an improvement over mean deviation as a measure of dispersion and is used most commonly in statistical analyses.

It is calculated in the following way; first the mean is calculated. Then the difference of observations from the mean is made. This value is then squared and the squared values are added to get the sum of squares. This sum is divided by the number of observations minus one to get the mean square deviation (variance). Find the square root of this variance to get the root mean squared deviation, called standard deviation. Having squared the original, reverse the step of taking square root.

$$SD = \sqrt{\frac{(x-\bar{x})^2}{n}}$$

(For samples more than 30)

(For samples more than 30)

For smaller samples, the above formula tends to underestimate the SD and, therefore, needs correction which is done by substitution the denominator (n —1) for n.

The modified formula is

$$= \sqrt{\frac{(x-\bar{x})^2}{n-1}}$$

Standard Error (SE)

It is the standard deviation of the population mean. It is an indication of the reliability of the mean. A small SE is an indication that the sample mean is a more accurate reflection of the actual population mean. A larger sample size will normally result in a smaller SE (while SD is not directly affected by sample size).

SD vs SE

Many researchers fail to understand the distinction between standard deviation and standard error, even though they are commonly included in data analysis. While the actual calculations for standard deviation and standard error looks very similar, they represent two very different, but complementary measures. SD tells us about the shape of our distribution, how close the individual data values are from the mean value. SE tells us how close our sample mean is to the true mean of overall population. Together, they help to provide a more complete picture than the mean alone can tell us.

Merits of Standard Deviation

1. It is rightly defined.
2. It is based on all the observations of the series and hence it is representative.
3. It is amenable to further algebraic treatment.
4. It is least affected by the fluctuations of sampling.

Demerits of Standard Deviation

1. It is more affected by extreme items.
2. It cannot be exactly calculated for a distribution with open-ended classes.
3. It is relatively difficult to calculate and understand.

NORMAL DISTRIBUTION[4]

When a large number of observations of any variable characteristic such as height, blood pressure and pulse rate are taken at random to make them a representative sample, a frequency distribution table is prepared. It will be seen that:

1. Some observations are above the mean, and others are below the mean.
2. If they are arranged in order (plus or minus side of mean) maximum number of frequencies will be seen in the middle around the mean and fewer at the extremes, decreasing smoothly on both sides.
3. Normally almost half the observations lie above and half below the mean and all observations are symmetrically distributed on each side of mean.

A distribution of this nature or shape is called normal distribution or Gaussian distribution.

It is useful to note at this stage that in a normal curve:

a. The area between one standard deviation on either side of mean ($\bar{x} \pm 1$ *SD)* will include approximately 68% of the values in the distribution.

b. The area between two standard deviations, on either side of mean ($\bar{x} \pm 2$ *SD*) will include approximately 95 per cent values

c. The area between three standard deviation on either side of mean ($\bar{x} \pm 3$ *SD*) will include 99.7% of values.

These limits on either side of the mean are called confidence limits.

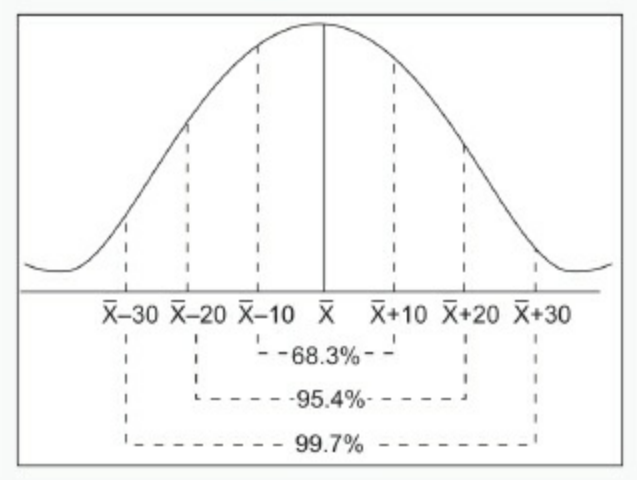


Fig. 22.1: Normal curve

Characteristics of a Normal Curve[4]

1. It is a smooth, symmetrical bell-shaped curve.
2. The total area of the curve is 1. Its mean zero and standard deviation 1.
3. The parameters mean, median and mode coincide at the centre
4. A maximum number of observations are at the centre and gradually decrease towards the extremities on either side.

CONFIDENCE[4,6]

The confidence interval is the plus-or-minus figure usually reported in newspaper or television opinion poll results. For example, if you use a confidence interval of 4 and 47% of your sample picks an answer you can be "sure" that if you had asked the question of the entire relevant population between 43% (47 – 4) and 51% (47 + 4) would have picked that answer.

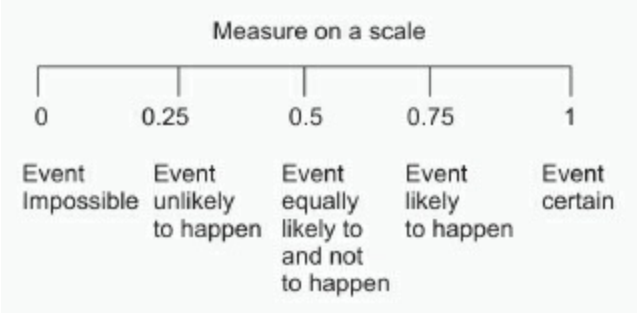
The confidence level tells you how sure you can be. It is expressed as a percentage and represents how often the true percentage of the population who would pick an answer lies within the confidence interval. The 95% confidence level means you can be 95% certain; the 99% confidence level means you can be 99% certain. Most researchers use the 95% confidence level.

When you put the confidence level and the confidence interval together, you can say that you are 95% sure that the true percentage of the population is between 43% and 51%. The wider the confidence interval you are willing to accept, the more certain you can be that the whole population answers would be within that range. For example, if you asked a sample of 1000 people in a city which brand of cola they preferred, and 60% said Brand A, you can be very certain that between 40 and 80% of all the people in the city actually do prefer that brand, but you cannot be so sure that between 59 and 61% of the people in the city prefer the brand.

PROBABILITY[4]

This topic has fascinated philosophers, mathematicians and gamblers for hundreds of years. Probability is defined as possible or probable chances of occurrence of an event or happening. Probability is a proportion. Its value must, therefore, be between 0 and 1 or 0% and 100%.

In other words, it denotes the elative frequency of odds with which an event is expected to occur on an average or in the long run. The main purpose of selecting a representative sample is to know the probability of occurrence of single or group of observations in a normal distribution of any biological variable. To know the occurrence by chance in sample is to compare with the population.



In tossing a coin, the only possible outcome is a head or a tail. Probability of a head is 0.5 and tail is 0.5 and the sum is 1.

1. An impossible event has probability 0.
2. An event which must occur has probability 1.

The above 2 rules show that probability of any event is measured on a scale from 0 to 1. There are a large number of theoretical probability distributions. Among the most common is the normal distribution/normal curve. In any test, a quantity P is found out which gives the probability that the difference between the two groups is because of sampling variation. If this probability is more than 0.05, the difference is called insignificant and if it is less than or equal to 0.05, the difference is called as significant. This value of P is obtained by calculating various tests of significance.

$P < 0.001$: Very highly significant.

$P < 0.01$: Highly significant.

$P < 0.05$: Significant.

$P > 0.05$: Not significant.

Formula for calculating P: P = Number of events occurring/Total number of trials

Laws of Probability

- Addition law of probability.
- Multiplication law of probability.
- Binomial law of probability distribution.
- Probability from shape of normal distribution or normal curve.
- Probability of calculated values from tables.

TEST OF SIGNIFICANCE[7,8]

Two questions arise about any hypothesized relationship between two variables:

1. What is the probability that the relationship exists?
2. If it does, how strong is the relationship?

There are two types of tools that are used to address these questions; the first is by tests for statistical significance; and the second is addressed by measures of association. Tests for statistical significance are used to address the following questions:

1. What is the probability that we think is a relationship between two variables is really just a chance of occurrence?
2. If we selected many samples from the same population, would we still find the same relationship between these two variables in every sample?
3. If we would do a census of the population, would we also find that this relationship exists in the population from which the sample was drawn? Or is our finding due only to random chance?

Statistical significance is not the same as practical significance. We can have a statistically significant finding, but the implications of that finding may have no practical application. The researcher must always examine both the statistical and the practical significance of any research finding.

Steps in Testing for Statistical Significance[9]

1. State the research hypothesis
2. State the null hypothesis
3. Select a probability of error level (alpha level)
4. Select and compute the test for statistical significance
5. Reporting tests of statistical significance

1. State the Research Hypothesis

A research hypothesis states the expected relationship between two variables. It may be stated in general terms, or it may include dimensions of direction and magnitude. For example,

General: The length of the job training programme is related to the rate of job placement of trainees.

Direction: The longer the training programme, the higher the rate of job placement of trainees.

Magnitude: Longer training programmes will place twice as many trainees into jobs as shorter programmes.

2. State the Null Hypothesis

A null hypothesis usually states that there is no relationship between the two variables. For example, there is no relationship between the length of the job training programme and the rate of job placement of trainees.

A null hypothesis may also state that the relationship proposed in the research hypothesis is not true. For example, longer training programmes will place the same number or fewer trainees into jobs as shorter programmes.

Researchers use a null hypothesis in research because it is easier to disprove a null hypothesis than it is to prove a research hypothesis. It is easier to show that something is false once than to show that something is always true. It is easier to find disconfirming evidence against the null hypothesis than to find confirming evidence for the research hypothesis.

3. Type I and Type II Errors

Even in the best research project, there is always a possibility (hopefully a small one) that the researcher will make a mistake regarding the relationship between the two variables. There are two possible mistakes or errors. The first is called a Type I error. This occurs when the researcher assumes that a relationship exists when in fact the evidence is that it does not. In a Type I error, the researcher should accept the null hypothesis and reject the research hypothesis, but the opposite occurs. The probability of committing a Type I error is called alpha.

The second is called a Type II error. This occurs when the researcher assumes that a relationship does not exist when in fact the evidence is that it does. In a Type II error, the researcher should reject the null hypothesis and accept the research hypothesis, but the opposite occurs. The probability of committing a Type II error is called beta.

Generally, reducing the possibility of committing a Type I error increases the possibility of committing a Type II error and vice versa, reducing the possibility of committing a Type II error increases the possibility of committing a Type I error. Researchers generally try to minimize Type I errors, because when a researcher assumes a relationship exists when one really does not, things may be worse off than before. In Type II errors, the researcher misses an opportunity to confirm that a relationship exists, but is no worse off than before.

Example: At a dental check up, the dentist tries to discriminate between the hypothesis that your teeth are fine, and the hypothesis that you have one or more cavities, on the basis of the data collected by clinical examination and other investigations. These measurements are subject to certain level of uncertainties. As a result, the dentist can make two kinds of errors—concluding you have a cavity when you don't or vice versa.

Null hypothesis: You don't have a cavity.

Alternate hypothesis: You have one or more cavities.

Type I error: It occurs if the dentist concludes you have a cavity, but you do not.

Type II error: It occurs, if the dentist concludes you don't have a cavity, when you really have one or more.

***Select a probability of error level (alpha level)*:**

Researchers generally specify the probability of committing a Type I error that they are willing to accept, i.e. the value of alpha. In the social sciences, most researchers select an alpha = .05. This means that they are willing to accept a probability of 5% of making a Type I error, of assuming a relationship between two variables exists when it really does not. In research involving public health, however, an alpha of .01 is not unusual. Researchers do not want to have a probability of being wrong more than 0.1% of the time, or one time in a thousand.

If the relationship between the two variables is strong (as assessed by a Measure of Association), and the level chosen for alpha is .05, then moderate or small sample sizes will detect it. As relationships get weaker, however, and/or as the level of alpha gets smaller, larger sample sizes will be needed for the research to reach statistical significance.

4. Select and Compute the Test for Statistical Significance[7,8]

See Table 22.2 on next page.

Table 22.2: Selection and computation of test for statistical significance [7,8]

Goal	Types of data			
	Measurement (from Gaussian population)	*Rank, score, or measurement (non-Gaussian population)*	*Binomial (two possible outcomes)*	*Survival time*
Describe one group	Mean, SD	Median, interquartile range	Proportion	Kaplan Meier survival curve
Compare one group to a hypothetical value	One sample t test	Wilcoxon test	Chi square or binomial test	
Compare two unpaired groups	Unpaired t test	Mann-Whitney test	Fishers test (Chi square for large samples)	Log rank test or Mantel Haenszel
Compare two paired groups	Paired t test	Wilcoxon test	Mcnemar's test	Conditional proportional hazards regression
Compare three or more unmatched groups	One way ANOVA	Kruskal-Wallis test	Chi square test	Cox proportional hazards regression
Compare three or more matched groups	Repeated measures ANOVA	Friedman test	Cochrane Q	Conditional proportional hazards regression
Quantify association between two variables	Pearson correlation	Spearman correlation coefficients	Contigency	—
Predict value from another measured variable	Simple linear regression or non-linear regression	Non-parametric regression	Simple logistic regression	Cox proportional hazards regression
Predict value from several measured or binomial variables	Multiple linear or multiple non-linear regression	—	Multiple logistic regression	Cox proportional hazards regression

Parametric vs non-parametric tests

Choosing the right test to compare measurements is a bit tricky, as you must choose between two families of tests—parametric and non-parametric. Many statistical tests are blased upon the assumption that the data are sampled from a Gaussian distribution. These tests are referred to as parametric tests. Tests that do not make assumptions about the population distribution are referred to as non-parametric tests. These tests usually rank the outcome variable from low to high and then analyze the ranks.

How to choose

1. Choose a parametric test if you are sure that your data are sampled from a population that follows Gaussian distribution.
2. The outcome is a rank or a score and the population is clearly not

Gaussian. For example, VAS scale, Apgar scale for new born babies, then use non-parametric test.

3. Some values are too high or too low to measure, even if the population is Gaussian, it is not advisable to use parametric test since we do not know all values.

Significance of Choosing Parametric vs Non-Parametric

What happens when a parametric test is used for non-Gaussian distribution?

Parametric tests are robust to the deviations from Gaussian distribution, so as long as the samples are large the effect might be camaflouged. *What happens when non-parametric test is used for a data from Gaussian population?*

The p values tend to be a bit too large, but the discrepancy is small, in other words, non-parametric tests are only slightly less powerful than parametric tests with large samples. In case of small samples when the same parametric test is used for non-Gaussian population, the p value becomes inaccurate.

P Value (one-/two-sided)

With many tests you must choose whether you wish to calculate one- or two-sided P value. A one-sided P value is appropriate when you can state with certainty that there will be no difference between the means or that the difference will go in a direction you can specify in advance. If you cannot specify the direction of any difference before collecting data, then a two-sided P value is more appropriate. “If in doubt, select a two-sided P value”.

Paired or unpaired test

When comparing two groups, you need to decide whether to use a paired test. When comparing three or more groups, the term paired is not apt and the term repeated measures is used instead. Use an unpaired test to compare groups when the individual values are not paired or matched with one another. Select a paired or repeated measures test when values represent repeated measurements on one subject or measurements on matched subjects. The paired or repeated measures tests are also appropriate for repeated laboratory experiments run at different times, each with its own control.

You should select a paired test when values in one group are more closely correlated with a specific value in the other group than with random values in

the other group. It is only appropriate to select a paired test when the subjects were matched or paired before the data were collected.

1. *Standard error test for large samples*: A sample is considered to be large when it has more than thirty observations. When the difference between any two large sample in terms of means or proportion need to be tested the formulas used are:

a. *Standard error of difference between two means*

$$SE(\bar{d}) = \frac{S_1^2 + S_2^2}{n_1 n_2}$$

where S_1 and S_2 are standard deviation of 2 samples and n_1 and n_2 are the respective sample sizes.

b. *Standard error of difference between 2 proportions*

It is given by the formula

$$SE(\bar{d}) \text{ of 2 proportions} = \sqrt{\frac{P_1 Q_1}{n_1} + \frac{P_2 Q_2}{n_2}}$$

where P and Q are the proportion of 2 groups and n_1 and n_2 are the respective sample sizes.

Chi square test

It is an alternate method of testing the significance of difference between two proportions.

a. ***Test the null hypothesis*:** Set up a null hypothesis that "there is no difference between the two" and then proceed to test the hypothesis.

b. *Applying the X^2 test:*

$$X^2 = \frac{\Sigma (O - E)^2}{E}$$

where O is the observed value and E is the expected value.

c. *Finding the degree of freedom*: It depends on the number of columns and rows and given by the formula

$$df = (c - 1)\,(r - 1)$$

where *c* = number of columns and

r = number of rows

e. *Probability tables*: Depending upon the value of "P" the conclusion is drawn.

2. *Standard error test for small samples*: A sample is considered to be small, if it has less than 30 observations. The test applied is called the '*t*' test.

When the investigation is in terms comparing the observations carried out on the same individuals say before and after certain experiment, such comparisons are called as paired comparisons, when the observations are carried out in two independent samples and their values are compared, it is known as unpaired comparison.[1]

t-test for paired comparison

a. First the null hypothesis that the two sets of observations are not different is set up.

b. The difference between the before and after experimentation readings are calculated for each individual.

c. The mean and standard deviation(s) of these differences are calculated.

d. The standard error of this mean difference is calculated by the formula *S* A/n.

e. *t* is calculated by the formula:

$$t = \frac{\text{Mean difference}}{\text{Standard error of the mean difference}}$$

f. The degrees of freedom *(df)* for this calculation t is $n - 1$ where n is the number of pairs of observation.

g. From t-distribution table, *p* is noted down corresponding to (n – 1) *df* and then calculated value of *t*.

h. If *p* is more than 0.05, the mean difference is insignificant and if *p* is less than 0.05 the mean difference is significant.

The unpaired't' test

a. Set up the null hypothesis that the difference in two means is zero.

b. Calculate the means and standard deviations for the two groups separately.

c. Calculate the standard error of difference of means.

d. The standard error of the difference between the two means is calculated by the formula:

$$smd = \sqrt{\frac{(n_1+n_2)}{n_1 n_2} \times \frac{(n_1-1)S_1^2+(n_2-1)S_2^2}{n_1+n_2-2}}$$

where s_1 and s_2 are the standard deviations of the two groups and n_1 and n_2 are the respective numbers of observations in the two groups.

e. Calculate *'t'* by the formula: *t* = difference between the means of two samplesA standard error of the difference between the two means.

f. Compute the pooled degrees of freedom as $n_1 + n_2 - \mathbf{2}$.

g. Refer to the table of "t distribution" and find out the probability level *P* corresponding to the above degrees of freedom and the calculated 't'.

h. Conclusions are made on the basis of this P.

Correlation

In order to find out whether there is significant association or not between two variables (e.g. height and weight), we calculate the coefficient of correlation which is represented by the symbol V and is calculated by the formula

$$r = \frac{\Sigma(x-\bar{x})(y-\bar{y})}{\Sigma(x-\bar{x})^2\,\Sigma(y-\bar{y})^2}$$

where *x* and *y* are the two variables and we have 'n' individuals with one reading of × and one reading of y. The correlation coefficient *r* tends to lie between –1.0 and +1.0. If *r* is near +1, it indicates a strong positive association between × and y, i.e. when one variable increases the other variable also increases. A value near –1 indicates a strong negative association, i.e. when one variable increases the other decreases. If *r* = 0 it indicates there is no association between *X* and *Y*.

5. Reporting tests of statistical significance[9]

In research reports, tests of statistical significance are reported in three ways.

First, the results of the test may be reported in the textual discussion of the results. Include:

1. The hypothesis
2. The test statistic used and its value
3. The degrees of freedom
4. The value for alpha (p-value)

A second method of reporting the results of tests for statistical significance is to report the test and its value, the degrees of freedom, and the *p*-value at the bottom of the contingency table or printout showing the data on which the calculations were based.

The third way to report tests of statistical significance is to include them in tables showing the results of an extended analysis of the data, including a number of variables.

RESEARCH METHODOLOGY[10]

Research can be referred to as a careful investigation or inquiry specially through search for new facts in any branch of knowledge. Redman and Mory define research as “systematic effort to gain new knowledge. According to Clifford Woody, research comprises defining and redefining problems, formulating hypothesis or suggested solutions; collecting, organising and evaluating data; making deductions and reaching conclusions; and at last carefully testing the conclusions to determine whether they fit the formulating hypothesis.

Objectives of Research

The purpose of research is to discover answers to questions through the application of scientific procedures. The main aim of research is to find out the truth which is hidden and which has not been discovered as yet.

1. To gain familiarity with a phenomenon or to achieve new insights into it (Exploratory or formulative research studies).
2. To portray accurately the characteristics of a particular individual, situation or a group (Descriptive research studies).
3. To determine the frequency with which something occurs or with which it is associated with something else (Diagnostic research).
4. To tort a hypothesis of a causal relationship between variables (Hypothesis-testing research).

Types of Research[10]

1. *Descriptive vs. analytical research*: Descriptive research includes surveys and fact-finding enquiries of different kinds. The major purpose of descriptive research is description of the state of affairs as it exists at present. Analytical research, on the other hand, to use facts or information already available, and analyze these to make a critical evaluation of the material.
2. *Applied vs. fundamental*: Applied research aims at finding a solution for an immediate problem facing a society or an industrial/business organization. Fundamental research is mainly concerned with generalizations and with the formulation of a theory.
3. *Quantitative vs. qualitative*: Quantitative research is based on the measurement of quantity or amount. It is applicable to phenomena that can be expressed in terms of quantity. Qualitative research, on the other hand is concerned with qualitative phenomenon, i.e. phenomena relating to or involving quality or kind. For instance, "motivation research" an important type of qualitative research.

   Qualitative research is specialy important in the behavioural sciences where the aim is to discover the underlying motives of human behaviour.
4. *Conceptual vs. empirical*: Conceptual research is that related to some abstract idea(s) or theory. It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones. Empirical research relies on experience or observation alone, often without due regard for system and theory.
5. *One-time research or longitudinal research*: The research is confined to a single time-period. Whereas in the latter case, the research is carried on over several time periods.
6. Field-settling research or laboratory research or simulation research.
7. Clinical or diagnostic research.
8. Exploratory research.
9. Historical research.
10. Conclusion-oriented research

11. Decision-oriented research

Table 22.3: Phases in research[10]	
Research phase	***Definition***
The conceptual phase	Formulating the clinical problem, reviewing the literature, and determining research purpose
The design and planning phase	Selecting a research design, developing study procedures, determining the sampling and data collection plan
The empirical phase	Collecting data and presenting data for analysis
The analytic phase	Analyzing data and interpreting the results
The dissemination phase	Communicating results to appropriate audience

Research Process[10,11,13]

***Definition of the research problem*:** This could be formulated based on the area of interest of the researcher or on what information is required at the hour; could be a life-threatening epidemic or a chronic disease condition burdening the health care system.

Technique involved in defining a problem

a. Statement of the problem in a general way

b. Understanding the nature of the problem

c. Surveying the available literature

d. Developing the ideas through discussions

e. Rephrasing the research problem

***Review of literature*:** As the saying goes "those who ignore or forget the past are bound to repeat its mistakes". A thorough review of the literature (online and hand search) will make the researcher aware of the studies already been conducted in the area of interest. Critically analyzing the literature will avoid repeating same type of research or its mistakes; failing in which will result in wasting money, manpower and time.

***Developing a hypothesis*:** It is the focal point in research. A hypothesis is tentative assumption made in order to draw out and test its logical and empirical consequences. They not only have an effect on the type of data to be collected but also on the analyzing and outcome measures.

***Simple hypothesis*:** It is that one in which there exists relationship between two variables one is called independent variable or cause and other is dependant variable or effect. For example:

1. Smoking leads to cancer
2. The higher ratio of unemployment leads to crimes

***Complex hypothesis*:** It is that one in which as relationship among variables exists. In this type, dependant or independent variables are more than two.

1. Smoking and chewing tobacco leads to cancer, tuberculosis, etc.
2. The higher the ratio of unemployment, poverty and illiteracy leads

to crimes like dacoit, robbery, murder, etc.

***Empirical hypothesis*:** Working/empirical hypothesis is one which is applied to a field. During the formulation, it is an assumption only but when it is pat to a test become an empirical/working hypothesis.

***Null hypothesis*:** It is contrary to the positive statement of a working hypothesis. According to null hypothesis, there is no relationship between dependent and independent variable. It is denoted by HO.

***Alternative hypothesis*:** Firstly, many hypotheses are selected, then among them select one which is more workable and most efficient. That hypothesis is introduced latter on due to changes in the old formulated hypothesis. It is denoted by HI.

***Logical hypothesis*:** It is that type in which hypothesis is verified logically. JS Mill has given four cannons of these hypothesis, e.g. agreement, disagreement, difference and residue.

***Statistical hypothesis*:** A hypothesis which can be verified statistically called statistical hypothesis. The statement would be logical or illogical but if statistic verifies it, it will be statistical hypothesis.

***Deciding on a research design*:** The first three steps in the research process will greatly determine the research design. The main function is to provide for the collection of relevant evidence with minimal expenditure of effort, time and money.[11,12]

Table 22.4: Research design and application[11,12]

Research design	*Description*	*Application*	*Advantage*	*Disadvantage*
Case series and case reports	Used to illustrate an aspect of a condition, the treatment or the adverse reaction to treatment	When you have a patient with unfamiliar condition, a rare syndrome case reports would help you decide on a direction of treatment or to assist a diagnosis	Easy to understand and can be written in a very short period of time	They have no control group, hence no statistical validity
Cross-sectional studies	It is a snapshot of the situation and assess disease and exposure status of a population at one particular time point	A study in which details like oral hygiene practices, tobacco usage and dental caries experience is collected in a particular population at one point in time	It is cost-effective, and completed in a short time, the initial associations observed can be used to formulate further research for stronger level of evidence	Causality cannot be determined with this study design Prone to biases like recall or selection bias
Case control studies	Designed to estimate the odds of developing the studied condition/disease. To test the association between condition and risk factor	A study in which oral cancer patients are asked what kinds of spicy food they have eaten in the past and the answers would be compared with the control group without the disease	They can be done quickly and are very efficient for conditions/diseases with rare outcome	Less reliable than RCTs/cohort studies Cannot directly obtain absolute risk of a bad outcome
Cohort studies	Used to establish causation of a disease or to evaluate the outcomes/impact of treatment, when RCTs are not possible	Framingham heart study, which followed generations of residents of Framingham, Massachusetts		Not reliable as RCTs, since the two groups may differ in ways other than the variable under study Require large sample size In efficient for rare outcomes Time consuming
RCTs	Considered to be the gold standard. Best in answering questions about the effectiveness of different interventions	This type of study is done to compare the effectiveness of a new drug against a gold standard old one in any given disease condition	Randomization avoids bias in patient selection A control group similar to the case group allows for comparison	Certain research questions on which RCTs cannot be done for ethical reasons, if patients were asked to undertake harmful experiences, or denied

				any treatment beyond a placebo when there are known effective treatments Does not reveal causation Loss of follow-up attributed to treatment
Meta-analyses	Systematic, objective way to combine data from many studies, usually from RCTs and arrive at a pooled estimate of effectiveness	To establish statistical significance with the studies that have conflicting results For a more correct estimate of effect magnitude To provide a more complex analysis of harms, safety data and benefits To examine subgroups with individual numbers that are not statistically significant	Greater statistical power Confirmatory data analysis Greater ability to extrapolate to general population affected It is an evidence-based resource	Difficult and time consuming to identify appropriate studies Not all studies provide adequate data for inclusion in analysis Requires advance statistical techniques Less effective in heterogeneity of study populations
Systematic review	Is a comprehensive survey of a topic that takes great care to find all relevant studies of the highest level of evidence, published or unpublished, assess each study and synthesize findings in an unbiased manner	Hypothetically when a drug and effect has been studied over years and an association has been established. All valid studies based on inclusion and exclusion will be critically analyzed and an evidence-based guideline will be formulated. For example, effectiveness of a certain fluoride varnish for the prevention of caries in children and adolescents in comparison to a placebo	Evidence-based tool which will avoid repetition in research Results can be generalized and extrapolated into general population more broadly than individual studies	Very time consuming Cannot be done effectively by a single investigator May not be easy to combine studies in all given scenarios

DETERMINING SAMPLE DESIGN[10]

Sampling can be defined as the investigation of part of a population, in order to provide information, which can then be generalized to cover the whole population.

Since we can seldom examine a whole population, we generally have to settle for examining a part of it. When we select a portion of a population, we refer to it as a sample. When we take a sample and study it, we want to be able to draw general conclusions about the population. For example, if you take a spoonful of ice-cream from a container and taste it, you will be able to make a general statement about how much you like that kind of ice-cream. You will have to taste a sample. You don't have to eat the whole thing in order to make an informed opinion.

In this case, the sample you tested is representative of the whole container because the whole container is filled with the same icecream.

How we choose a sample is often as important as the size of the sample we choose. Various sampling techniques have been developed which ensures that representative samples are selected. Sampling is of 2 types—probability sampling and non-probability sampling.

In probability sampling, the chance that an element in a target population will be selected is known. As a result, the sample is representative of the population.

In non-probability sampling, the chance that an element in a target population will be selected in the sample is unknown or the sample is not representative of the population.

Types of Sampling Techniques

Probability sampling	*Non-probability sampling*
1. Simple random	1. Accidental/convenience
2. Stratified random	2. Judgement/purposive
3. Systematic random	3. Network/snowball
4. Area/cluster sampling	4. Quota sampling
	5. Dimensional sampling
	6. Mixed sampling

Probability Sampling

a. Simple Random Sampling

Every member of the population has an equal chance of being included in the sample. This type of sampling is used when the population in homogenous. There are several methods of achieving random selection, e.g. lottery method (computer, roulette, table of random numbers).

Give numbers to all the persons, e.g. 00–99 every member has a chance of being included in the sample as they are replaced after every draw.

b. Stratified Random Sampling

The sample is deliberately drawn in a systematic way so that each portion of the sample represents a corresponding strata of the universe. The population is heterogeneous. This method is useful when one is interested in analyzing the data by a certain characteristic of population. For example, Hindus, Christians, Muslims as these groups are not distributed equally in the population.

In a sample size of 50; suppose the racial population distribution is as follows:

Hindus = 300

Muslims = 100

Christians = 80

SC/ST = 20.

A proportionate stratified sampling would require 10 people be selected from each group. A disproportionate sampling would mean the selection of each stratum at a percentage. In this case N = 50 is 10% of N = 500.

i.e. 10% of 300 = 30:

10% of 100 = 10: 10% of 80 = 8: 10% of 20 = 2.

In case of SC/ST, the number 2 will be under representation.

c. Systematic Random Sampling

This process involves the selection of certain elements in a series according

to predetermined sequence. To explain this we will take, e.g. to carry out a gingivitis survey in a town, we can take 10% sample. The houses are numbered firstly. Then a number is selected at random between 1 and 10 (say 5). Then every 10^{th} number is selected from the point on 5, i.e. 15, 25, 35, 45, etc. By this method, each unit in the sampling frame would have the same chance of being selected, but the number of possible samples is greatly reduced. The population can be homogeneous or heterogeneous.

d. Area or Cluster Sampling

The cluster or area sample is particularly appropriate when a simple random sample proves to be prohibitive in terms of travel, time and cost.

In a multistage random sampling, a large scale of survey is used. For example, selected school, roll numbers, classes, etc.

Non-Probability Sampling

a. Accidental or Convenience Sampling

One will not always be able to randomly sample from the population of interest. You will have to examine the people you are able to contact or get access to even though they are not representative of the population. They are inexpensive and less time consuming.

b. Judgement or Purposive Sampling

This involves the selection of elements, which represent a typical sample from a target population. When this approach is used, the quality of sample selected depends on the accuracy of the researchers judgement of what constitutes a typical sample.

c. Network or Snowball Sampling

This involves a multistage technique that utilizes social network of individuals who tend to share common characteristics. The researcher must first identify and interview a few subjects with requisite criteria. These subjects are then asked to identify others with the same criteria. These persons may be then asked to identify others until a satisfactory sample is obtained.

This procedure is useful for finding subjects who may not be willing to make themselves known in the population. For example, alcoholics, drug addicts, child abusers, etc.

d. Quota Sampling

This procedure involves the selection of proportional samples of subgroups within a target population to ensure generalization of findings. Quota sampling ensures the inclusion of population subgroups that are likely to be under represented. For example, racial minorities, elderly, poor and the very rich.

e. Dimensional Sampling

In this sampling technique, only a small sample is needed, since each selected case will be examined in more detail.

f. Mixed Sampling Designs

Mixed sampling designs constitute the combination of both probability and non-probability sampling procedures.

Sampling Frame

A sampling frame is a listing of the members of the universe from which the sample is to be drawn. The accuracy and completeness of the sampling frame influence the quality of the sample drawn from it.[1]

Sometimes a list of all individuals in the target population will be available. For example, electoral register, age sex register in a health centre. Such a list is known as sampling frame.

Sample Size

It depends upon the extent to which the sample population represents the general population. Make the sample size as large as possible to ensure adequate representation. A researcher should consider these factors.

1. Type of study (descriptive, experimental, etc.)
2. Variability of population (expressed as SD)
3. Number of variables (as variables increase sample size increase)
4. Level of precision (degree to which the sample population represents the general population)
5. Sensitivity of measurement tools
6. Sampling method employed
7. Expected effect size (expected difference in scores)
8. Data analysis techniques

Factors Governing Size of Sample

1. It should be easily handled by personnel in given amount of time.
2. Sample must be large enough to allow sensible conclusions to be drawn from it.

Use of Sampling

1. Sampling may be the only way to obtain information about a population, because the true extent of the population is unknown, or even if it were known access to the whole population is impossible.
2. The need to reduce labour and hence cost.
3. Savings in time, manpower and money.

Besides these, there are two important reasons why a sample should be random. Firstly, a random sample will avoid bias, which is a systematic tendency to overestimate or underestimate the population parameter. Secondly, with a random sample statistical techniques can be used to make probability statements about the population parameter. This is the basis of significance tests and confidence intervals.

Collecting the Data

Primary data can be collected either through experiment or through survey. If the researcher conducts an experiment, quantitative measurements are made. For example, amount of demineralization of teeth measured by using polarized light microscopy, the caries experience is measured by the number of filled, decayed and missing teeth. But in case of a survey, data can be collected by any one or more of the following ways: Observation, personal interview, telephone interviews, mailed questionnaires.

Analysis of Data

The data collected from a survey or an experimental trial is called a raw data. This further has to be subjected to coding, tabulation, in order to make it a processed data, so that it can further be subjected to statistical analysis and inference.

1. Raw data is transformed into useful and purposeful categories
2. Coding operation—categories are transformed into symbols that may be tabulated and counted.
3. Editing—it improves the quality of the data for coding.
4. Tabulation—classified data are presented in tables.

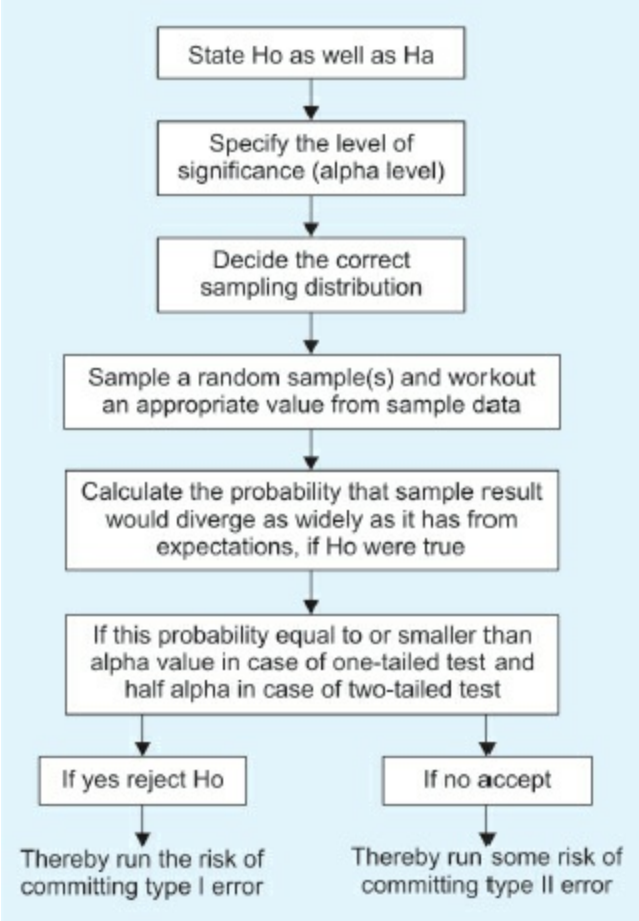
Hypothesis Testing[10,13]

After analyzing the data, the processed data is subjected to statistical tests which will help to either accept the proposed hypothesis or vice versa. If the researcher had no hypothesis to start with, generalizations established on the basis of data may be stated as hypotheses to be tested by further researches.

Hypothesis and Study Design

1. Descriptive studies—the results obtained from this study will enable us to formulate a hypothesis.
2. Analytical studies—the hypothesis proposed in the descriptive study will be tested. The conclusion of such studies would be to accept or reject null hypothesis.
3. Experimental studies—these are studies with high strength of evidence. The inference regarding hypothesis testing drawn from analytical studies are further strengthened by RCTs and other clinical trials, which will serve as foundation for evidence-based practice.

Flow Diagram for Hypothesis Testing[10]


State Ho as well as Ha
Specify the level of significance (alpha level)
Decide the correct sampling distribution
Sample a random sample(s) and workout an appropriate value from sample data
Calculate the probability that sample result would diverge as widely as it has from expectations, if Ho were true
If this probability equal to or smaller than alpha value in case of one-tailed test and half alpha in case of two-tailed test
If yes reject Ho
If no accept
Thereby run the risk of committing type I error
Thereby run some risk of committing type II error

Preparation of the Report[10]

The following must be considered while preparing and publishing the report.

1. The layout of the report should be as follows: (a) the prologue, (b) the main text, (c) the epilogue
    a. *Prologue*—title and date, acknowledgments, foreword, table of contents, list of tables, graphs and charts.
    b. *Main text*—introduction, review of literature, materials and methods, results, discussion, summary and conclusion.
    c. *Epilogue*—appendix for all technical data, bibliography or references.
2. Report should be written in a concise and objective style in simple language avoiding jargons or vague expressions.
3. Only relevant charts and illustrations should be used, repetition of data in charts and text should be avoided.
4. Any constraints or conflicts of interest encountered during the time of research should be mentioned.
5. Plagiarism should be avoided.
6. Extrapolation of the data or falsification of the results to show statistical significance should be avoided

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Section

G

Social Sciences

23. Behavioural Sciences

24. Behaviour Management

25. Cultural Taboos in Dentistry

26. Oral Health Care for Special Groups

CHAPTER

23

Behavioural Sciences

Social sciences are defined as those disciplines committed to the scientific examination of human behaviour.

Social sciences include:

a. Sociology

b. Social anthropology

c. Social psychology

d. Economics

e. Political science

Sociology, social anthropology, social psychology are termed as behavioural science.

SOCIOLOGY

Definition

Socious → companion or associated

Logus → science or study.

Sociology is defined as the study of human interactions and interrelations, their conditions and consequences.[4]

Sociology deals with the human relationships and of human behaviour for a better understanding of the pattern of human life.[4]

Social Group

Society is a group of individuals drawn together by a common bond of nearness and who act together in general for the achievement of certain common goals.

Different groups are needed for different purposes, these groups comprise social organisation.

Family

Family is a primary unit in all societies. It is the most powerful example of social cohesion. It is a group of biologically related individuals living together and eating from a common kitchen. As a biological unit, the family members share a pool of genes as a social unit, the family members share a common physical and social environment. As a cultural unit, the family reflects the culture of the wider society of which it forms a part and determines the behaviour and attitudes of its members.[4]

Types of Family

i. ***Nuclear family*:** The nuclear or elementary family is universal in all human societies. It consists of the married couple and their children while they are still regarded as dependents.

ii. ***Joint family*:** The joint or extended family is a kind of family grouping which is common in India, Africa, the Far East and the Middle East. It is more common in agricultural areas than in urban areas. The orthodox Hindu family in India is a joint family. As a price for education, urbanization and industrialization, we are losing the joint family system.

iii. ***Three generation family*:** It is common in the west. This tends to be a household where there are representative of three generations. It occurs usually when young couples are unable to find separate housing accommodation and continue to live with their parents and have their own children.

Community

From the time of birth until death, all normal human beings are part of a group, the family or community. The characteristics of a community are:

1. The community is a contiguous geographic area.
2. It is composed of people living together.
3. People co-operate to satisfy their basic needs.
4. There are common organizations, e.g. markets, schools, stores, banks, hospitals.

A community is a network of human relationships. It is a major functioning unit of society.

Social Class

People in a community are differentiated by certain characteristic, which they bear.

These may be:

a. Personal characteristics such as age, sex, marital status, place of birth and citizenship.

b. Economic characteristics such as occupation and type of activity.

c. Cultural characteristics such as language, religion and caste.

d. Educational characteristic such as literacy and level of education.

Social scientists have used occupation widely as a means of determining the levels of social standings of an individual in a community, because occupation has a enormous importance in all societies for understanding human behaviour.

***Occupation is a major determinant of*:**

1. *Economic rewards*: That is income and wealth which can promote or achieve health easier.
2. *Extent of authority*: Occupation is an important determinant of authority which the individual has over other people; it spills over into his life itself, his pleasures and other activities through control of purchasing power. Those who receive higher economic rewards tend to be vested with greater authority.
3. *Extent of obligations*: The extent of obligations demanded of individuals by the rest of the community will be determined by the occupation he holds.
4. *Degree of status*: Closely allied with the occupational role is the degree of status and standing of the individual in the community. The occupation itself will give the person status irrespective of personal characters, age, and experience.
5. *Values and lifestyles*: The occupation of an individual very largely will determine many of the values the individual has, the things he feels worth pursuing, his life goals, his lifestyle; his pleasures, friendships

and relationships with others.

Occupational Classification

Registrar General's occupational classification in England and Wales

I. professional occupation
II. Intermediate occupation
III. Non-manual skilled occupation
IV. Manual skilled occupation
V. Partly skilled occupation
VI. Unskilled occupation

Limitations of occupational classification

1. Heterogeneous grouping
2. Occupational mobility
3. Women

Other measures of social differentiation

1. *Education*: It measures the inculation of values, knowledge and achievements of the individual.
2. ***Income*****:** It is another way of distinguishing people.
3. ***Purchasing power*****:** This may be of more important value than occupation in classifying people.
4. Religion
5. Rural and urban

Types of Workers

***Skilled*:** Skilled employee is one who is capable of working independently and efficiently and turning out accurate working. He must be capable of reading and working on simple drawing circuits and process, if necessary, e.g. electrician, mechanic, tailor.

***Semi-skilled*:** Semi-skilled employee is one who has sufficient knowledge of the particular trade or above to do respective work and simple job with the help of simple tools and machines, e.g. asst. operator, asst. electrician.

Un-skilled worker is one who possesses no special training and whose work involves the performance of the simple duties which require the exercise of little or no independent judgement or previous experience although a familiarity with the occupational environment is necessary, e.g. chowkidar, watchman, cleaner, sweeper.

Status (Fig. 23.1)

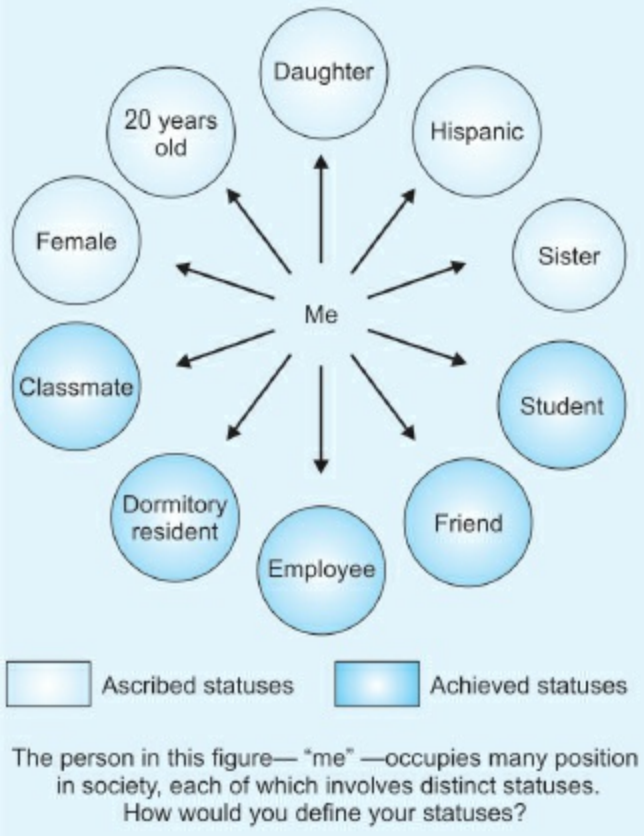


Fig. 23.1: Social statuses

Ascribed and Achieved Status

***Ascribed are*:**

- Race
- Sex
- Age
- Ethnicity
- Physical characteristics
- Caste

***Achieved are*:**

- Occupation

- Education
- Social class

Master Status

- A status that has special importance for social identity, often shaping a person’s entire life.
- Profession, job, family name, title, disability, applied stigma (felon).

Socioeconomic Status Scale[1]

Assessment of socioeconomic status (SES) is an important aspect in community based studies. Evaluation of SES of a family would mean the categorization of the family in respect of defined variables such as education, occupation, economic status, physical assets, social position, etc.

The socioeconomic status (SES) is an important determinant of health and nutritional status as well as of mortality and morbidity. Socioeconomic status also influences the accessibility, affordability, acceptability and actual utilization of various available health facilities. There have been several attempts to develop different scales to measure the socioeconomic status. The earliest attempts to find out the social class of an individual were from the standpoint of psychologists.

Hollingshed in USA employed three variables, i.e. education, occupation and residential address for measuring socioeconomic status. In Indian studies, the classification of British Registrar General based on occupation was tried earlier. Later on Prasad's classification of 1961 based on per capita monthly income and later modified in 1968 and 1970 has been extensively used. Nowadays Kuppuswamy scale is widely used to measure the socioeconomic status of an individual in urban community based on three variables namely education, occupation and income (Table 23.1).

1. Modified version of the Kuppuswamy's socioeconomic status scale for the year 2007 is given in Table 23.2.
2. Gaur's socioeconomic classification shown in Table 23.3.

Table 23.1: Kuppuswamy's socioeconomic status scale (urban)

Education of head of family	*Score*	*Occupation*	*Score*	*Family income*	*Score*
Professional degree	7	Professional	10	₹ 2000 and 1	12
Graduate	6	Semiprofessional	6	₹ 2000–1999	10
Intermediate/diploma	5	Clerical/shop/farmer	5	₹ 750–999	6
High school	4	Skilled worker	4	₹ 500–749	4
Middle school	3	Semiskilled	3	₹ 300–499	3
Primary school	2	Unskilled	2	₹ 101–299	2
Illiterate	1	Unemployed	1	₹ <100	1

*Kuppuswamy in India prepared a scale based on education and occupation of the head of the family and monthly family income for measuring socioeconomic status in urban areas

Table 23.2: Modified version of Kuppuswamy's socioeconomic status scale (2007)

(A)	*Education*	*Score*
1.	Profession or honours	7
2.	Graduate or postgraduate	6
3.	Intermediate or post-high school diploma	5
4.	High school certificate	4
5.	Middle school certificate	3
6.	Primary school certificate	2
7.	Illiterate	1

(B)	*Occupation*	*Score*
1.	Profession	10
2.	Semi-profession	6
3.	Clerical, shop-owner, farmer	5
4.	Skilled worker	4
5.	Semi-skilled worker	3
6.	Unskilled worker	2
7.	Unemployed	1

(C)	*Family income per month (in ₹ 1976)*	*Score*
1.	= 2000	12
2.	1000–1999	10
3.	750–999	6
4.	500–749	4
5.	300–499	3
6.	101–299	2
7.	= 100	1

Total score		**Socioeconomic class**
26–29		Upper (I)
16–25	Middle	Upper middle (II)
11–15		Lower middle (III)
5–10	Lower	Upper lower (IV)
<5		Lower (V)

Table 23.3: Gaur's socioeconomic classification

Education	*Scores*
Illiterate	0
Primary	1
Middle	2
High school	3
Intermediate	4
BA/BSc/BCom/Equilent	5
MA/MSC/MCom/Equilent	6
Professionals	7

Occupation	*Scores*
Unemployment	0
Unskilled worker	1
Semiskilled worker	2
Skilled worker	3
Clerk/farmers/shopkeepers	4
Semiprofessionals	5
Professionals	6
Corporate CMD/Chairman	7

®*Income per capita per month (in rupees as per CPI April 2012)*	*Scores*
<1000	0
1,000 to 4,999	1
5,000 to 9,999	2
10,000 to 14,999	3
15,000 to 19,999	4
20,000 to 24,999	5
25,000 to 29,999	6
30,000 and above	7

Expenditure	*Scores*
<10% of income	0
10 to 19% of income	1
20 to 29% of income	2
30 to 39% of income	3
40 to 49% of income	4
50 to 59% of income	5
60 to 69% of income	6
70% and above	7

Several methods or scales have been proposed for classifying different populations by socioeconomic status (India):

- Rahudkar scale 1960,
- Udai Parikh scale 1964,
- Jalota scale 1970,
- Kulshrestha scale 1972,
- Kuppuswamy scale 1976,
- Shrivastava scale 1978, and
- Bharadwaj scale 2001.

The most widely accepted scale for urban populations has been proposed by Kuppuswamy in India in 1976.

Attitude to Disease

The attitude of people to health and disease varies in different social classes.

Upper Middle Class

The members of this class include the professional, business and executive group living in preferred areas and well-maintained homes. They seek out expert advice and in areas where they feel it is important, follow the advice with considerable religiosity.

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 but also prevents decay and loss of teeth and makes a person teeth more attractive and useful. The members have the desire to have their own teeth for as long as possible.

Lower Middle Class

The members of this class include owners of small business, minor executives, teachers, salesmen and white-collar workers.

The dentist is regarded as an authority who fixes teeth. They are the most compulsive in their dental care attitudes. The dentist is considered as one who give directions as to how teeth should be cared for and who is useful for preventive dentistry. Dental health habits are began early and followed with persistence.

Upper Lower Class

This class includes skilled and semiskilled blue-collar workers. They are people of limited education; they are law-abiding respectable, hard-working citizens.

They are resigned to whatever happens and feel there is little they can do to stance off the inevitable, including the loss of their teeth. They receive artificial dentures at a relatively early age and are happy with them. Selfmedication based on popular notions interests them. They instruct their children how to care for their teeth, but the children are more or less on their own after that.

They are happy receiving care from a clinic than from individual practitioner. They acquire confidence in the reputation of the clinic because the clinic was started by a well-known agency and in part because they see their friends there. This can be called as “clinic habit”.

Lower Class

It consists of unskilled labourers, people who quit from job-to-job, have limited education, live in slum areas and exhibit no stable pattern of life.

They reveal the most consistent neglect of teeth and they require careful understanding if they are to receive adequate care in public health facilities.

SOCIAL PSYCHOLOGY

Definition

***Psychology*:** Psychology is defined as "the study of human behaviour—of how people behave and why they behave in just the way they do".[1]

***Social psychology*:** It is concerned with the psychology of individuals living in human society or groups.

The emphasis is on understanding the basis for perception, thought, opinion, attitudes, general motivation and learning in individuals and how these vary in human societies and groups.

It deals with the effect of social environment on persons, their attitudes and motivation.

Emotions

An emotion is a strong feeling of the whole organism. Emotions motivate human behaviour. An emotional experience is characterized by both external and internal changes. The external changes are those, which are apparent and easily seen by other such as changes in facial expression. The internal changes brought about by emotions are psychological such as rapid pulse, respiration, and increased blood pressure. [2] Some of the major emotions are:

Fear	Jealousy	Sympathy
Anger	Moodiness	Pity
Love	Joy	Lust
Hate	Sorrow	Grief

Motivation

It is a inner face which drives an individual to a certain action. It also determines human behaviour. Motivation is concerned with the factors that stimulate or inhibit the desire to engage in behaviour.

Motivation may be:

i. Positive Negative

ii. Extrinsic Intrinsic

Extrinsic motivation refers to rewards that are obtained not from the activity, but as a consequence of the activity. This motivation arises from the use of external rewards or bribes such as food, praise, free time, money or points toward an activity.

Intrinsic motivation refers to rewards provided by an activity itself. The motivation arises from internal factors such as a child's natural feeling of curiosity, exigent, confidence and satisfaction when performing a task. People who are involved in a task because of intrinsic motivation appear to be engaged and even consumed, since they are motivated by the activity itself and not some goal that is achieved at the end or as a result of the activity.

Positive motivation is often more successful than negative motivation. Motivation is not manipulation. A motivated person acts willingly and knowingly. Motivation is contagious, it spreads from one motivated person to another, we make use of motives and incentives in community health work.

Personality

It implies certain physical and mental traits which are characteristic of a given individual, there traits determine to some extent, the individual's behaviour or adjustment to his surroundings.[3]

Components of Personality

There are four components of human personality. They are:

1. ***Physical*:** These are physical traits of an individual namely, height, weight, colour, facial expression, etc.
2. ***Emotional*:** Emotions are the feelings we have fear, anger, love, jealousy, guilt, worries.
3. ***Intelligence*:** Personality also implies intellectual ability.
4. ***Behaviour*:** Behaviour is a reflection of one's personality.

Development of Personality

a. ***Infancy*:** The first one year of life is infancy.

b. ***Preschool child*:** This stage is marked by considerable growth of brain. He begins to mix with other small children.

c. ***School age*:** The school age period ranges from 5 to 15 years. By the age of 8, the mental powers are fully developed. There is gradual detachment from the family, and greater attachment to his playmates and friends.

d. ***Adolescence*:** Adolescence or "teenage" is a turbulent period in one's life. This is a period of rosy dreams, adventure, love and romance. The teenager strives for independence.

e. ***Adults*:** The person is mature and more balanced. The physical and mental characteristics are fully developed.

f. ***Old age*:** Old age is marked by certain psychological changes such as impaired memory, rigidity of outlook, irritability, bitterness, inner withdrawal and social maladjustment.

Thinking

Thinking is the base of all cognitive activities or processes and is unique to human beings. Thinking is organised and goal directed. It involves manipulation and analysis of existing information received from the environment. Such manipulation and analysis occur by means of abstracting, reasoning, imagining, problem solving, judging, and decision-making. Thinking includes perception, memory, imagination and reasoning. The highest form of thinking is said to be creative thinking, e.g. an artist painting a picture.[1]

Problem Solving

An aspect of thinking is problem solving. It is regarded as the highest stage in human learning. Some problems in life are relatively simple, there are other which are more difficult and complex calling for thinking and reasoning. Reasoning requires intelligence.

Intelligence

It is the ability to see meaningful relationships between things. It includes perceiving, knowing, reasoning and remembering.[2]

Mental Age

Binet and Simon devised the first tests of intelligence. They developed the concept of mental age.

Gessel indicated four sectors of intellectual development for consideration:

a. Motor ability
b. Adoptive behaviour
c. Language development
d. Personal-Social behaviour

Intelligence Quotient

It is obtained by dividing the mental age by chronological age, and multiplying by 100.

$$IQ = \frac{\text{Mental age}}{\text{Chronological age}} \times 100$$

SOCIAL ANTHROPOLOGY

Anthrops—man

Logas—science

Anthropology is the study of the physical, social and cultural history of man.

1. ***Physical*:** The study of human evolution,

racial difference, inheritance of bodily traits, growth and decay of human organisms is called physical anthropology.

2. ***Social*:** The study of the development and various types of social life is called social anthropology.
3. ***Cultural*:** The study of the total way of life of contemporary primitive man, his ways of thinking, feeling and action is called cultural anthropology.
4. ***Medical*:** It deals with the cultural component in the ecology of health and disease.

Social Scientist

The public health worker is very dependent upon the group behaviour of individuals, when he embarks on community programme. He faces difficulty in programme planning and implementation due to strong influence of cultural background.

During the last decade, social scientists have been called upon to aid in adapting new health programmes to existing cultural patterns.

Functions

1. Programme planning and evaluation.
2. Public health experiments.
3. Estimation of indigence's.

Social Worker

They are experts with special training in:

1. Appraising personal and family economic problems.
2. Organising sensible patterns for health care, education and home life.
3. They are needed where multiple problems exist, such as combination of low income, loss of parents, physical disability or mental illness.
4. The social worker can help the public health dentist in appraising the accessibility of low-income patients to health care facilities.

Conclusion

Social sciences have brought to the field of public health, the study of psychology, culture and other aspects of human behaviour, which are as important a part of our environment as the physical environment. The contribution, experiments and reports of social scientists and social workers should be watched with interest by the dental profession and their assistance sought in programme design, development, implementation and evaluation.

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CHAPTER

24

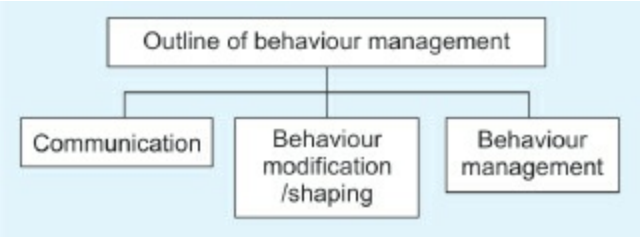
Behaviour Management

Behaviour management is as much a clinical skill as it is a science. It is meant to develop a relationship between doctor and patient which ultimately builds trust and diminishes fear and anxiety.

Successful dentistry for children depends not only upon the dentists technical skills, but also upon his ability to acquire and maintain a child's co-operation.

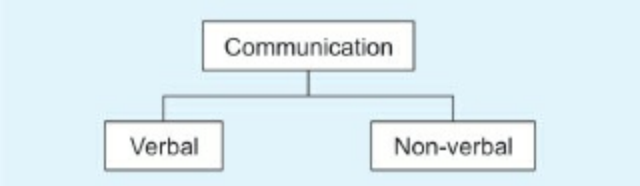
The management of a child's behaviour begins the moment the child enters the dental clinic and continues until the child leaves.[3]

OUTLINE OF BEHAVIOUR MANAGEMENT



Communication

The first objective in the successful management of the young child is to establish communication. Communication establishes a relationship with the child and may help the child to develop a positive attitude towards dental care.[2]



I. Verbal

a. ***Style of conversation*:** The wordings have to be natural, comfortable and relaxing. One should speak to gain the child's attention.

b. ***Matter of conversation*:** One should try to know the patient prior to the treatment, in the sense that:

1. Call the patient by name
2. Compliment the patients dress
3. Ask about hobbies, friends, etc.

c. ***Choice of words*:** The words you choose to speak to the child should not cause fear to the child.

Words should be in level with the IQ of the child.

Rubber dam—rain coat/umbrella

Alginate—pudding

d. ***Voice control*:** Voice control is controlled alteration of voice, volume, tone or pace to influence and direct a patient's behaviour.

II. Non-verbal

a. Give him a smiling face.

b. Walk with him/her around the clinic holding his/her hand-foot on the shoulder, show some pictures.

Eye contact: It should show—admiration, encouragement, friendliness.

c. Children are very sensitive to facial expressions.

BEHAVIOUR MODIFICATION/SHAPING

It is that procedure which very slowly develops behaviour by reinforcing successive approximations of the desired behaviour until the desired behaviour comes to be.[3]

It is a method of teaching the child step by step what is expected from him in the dental operation.

The ingredients involved in behaviour shaping are:

1. Systematic desensitisation
2. Tell, show, do
3. Modelling
4. Contingency management
5. Distraction

1. Systematic Desensitisation

This technique was introduced in the year 1957 by Joseph Wolfe. He introduced this method to eliminate fear and apprehension.

Here we teach the child step by step to adopt from one behaviour to another, i.e. we mould the child from a slight stimuli then gradually increase to a severe stimuli.[4]

This technique helps individuals with specific fears or phobias overcome them by repeated contacts. A hierarchy of fear-producing stimuli is constructed with patient input and the patient is then exposed to these fear-producing stimuli in an ordered manner, starting with the stimulus posing the lowest threat. In dental terms, fears are usually related to a specific procedure such as the use of local anaesthetic. First, the patient is taught to relax, and in this state exposed to each of the stimuli in the hierarchy in turn, only progressing to the next when they feel able. The technique is useful for a child who can clearly identify their fear and who can verbally communicate.

2. Tell, Show, Do

This technique is widely used to familiarize a patient with a new procedure and to reduce the anxiety of the child. The ‘tell’ phase involves an age appropriate explanation of the procedure. The ‘show’ phase is used to demonstrate the procedure, for example, demonstrating with a slow handpiece on a finger. The ‘do’ phase is initiated with a minimum delay, in this case a polish. The technique is useful for all patients who can communicate. There are no contraindications.

As soon as the child enters the reception area show him/her the surroundings, take him/her inside the clinic. Start showing from the minimal fear promoting object to severe fear promoting object. Show him/her the mechanism of moving the chair, allow him/her to switch on the light. This reduces the anxiety of the child.[2]

3. Modelling

This technique is based on the psychological principle that people learn about their environment by observing the behaviour of others. This can be achieved by using a model, either live or by video, who exhibits the appropriate behaviour in the dental environment. This technique may decrease the target child's anxiety by showing a positive outcome following a procedure that the target child requires themselves and will also illustrate the rewards for appropriate behaviour. For best effects, models should be the same age as the target child, should exhibit appropriate behaviour and be praised. They should also be shown entering and leaving the surgery. The technique is likely to be useful for all patients. There are no contraindications. Modelling is exhibiting desired or appropriate adaptive behaviour to the child to overcome his fear.[4] For example, another child being treated in the same clinic.

4. Contingency Management

Contingency management is based on the principle that behaviour is a function of its consequences. That is, what people do—how they behave—is related in a predictable way to the consequences of their behaviour. For example, if an action is followed by a positive consequence (positive for that person), then the individual is likely to repeat that action. In contrast, if an action is followed by a negative consequence (negative for that person), then the individual is unlikely to repeat the action.

It is of two types:

a. Positive

b. Negative

Positive reinforcement is a response that follows a behaviour and has the effect of increasing the likelihood of that behaviour occurring again—by providing a positive experience as a consequence. Examples: Giving a child food or a toy, child praise or a hug. Generally creates a more positive learning and communication environment. The limitation is when the child feels that the reinforcement is meaningless or childish the actual results of reinforcement may be the opposite of their intended results.

Negative reinforcement is the strengthening of a pattern of behaviour by the removal of a stimulus which the individual perceives as unpleasant (a negative reinforcer) as soon as the required behaviour is exhibited. The stimulus is applied to all actions except the required one, thus reinforcing it by removal of a negative stimulus. A well-known example of negative reinforcement in dental practice is selective exclusion of the parent. When in appropriate behaviour is exhibited the parent is asked to leave. When appropriate behaviour is exhibited the parent is asked to return, thus reinforcing that behaviour. Good practice for this technique includes gaining specific informed consent for the technique and the parent should be able to hear, but be out of sight of, the child.

5. Distraction

This approach aims to shift the patient's attention from the dental setting to some other situation or from a potentially unpleasant procedure to some other action. Cartoons have been shown to reduce disruptive behaviours in children when combined with reinforcement, which is when children knew the cartoon would be switched off, if they did not behave. This reinforcement technique is also effective with audio distraction. However, audio distraction, although proven effective for adults, has been shown to have variable success in children. Verbal distraction, e.g. the dentist who talks while applying topical paste and administering local anaesthetic, can also be effective. The technique is useful for all patients who can communicate.

BEHAVIOUR MANAGEMENT INGREDIENTS

Ingredients of behaviour management include:

1. Biofeedback
2. Voice control
3. Coping
4. Humour
5. Relaxation
6. Audio analgesia
7. Hypnosis
8. Implosion therapy
9. Aversive conditioning
10. Drug therapy.

1. Biofeedback

This helps in the self-controlled relief from pain. Process that can be controlled by biofeedback includes EMG activity (electromyographs, tension, headaches, heart rate, blood pressure). The physiologic function to be controlled must be monitored continuously and the monitoring device must be sensitive to detect any minute changes which are feedback to the subjects.[2]

2. Voice Control

The voice should be soft, gentle, modulated. Make the child secure by your voice. Make the child realize that you are his friend. You should increase or decrease according to need of the patient. Young children especially may often respond to tone of voice rather than the actual words. Such techniques aim to improve attention and compliance as well as to establish authority; e.g. an abrupt change from soft to loud to gain attention of a child who is not complying. Voice control has been shown to decrease disruptive behaviours without producing long-term negative effects. While reported as widely used by dentists. However, it is not appropriate for children too young to understand or with intellectual or emotional impairment.

3. Coping

Patients differ not only in their perception and response to pain but also in their ways of dealing or coping with stress associated with painful experiences.

Cognitively based coping strategies appear to be more efficacious in older children with younger children benefitting more so from coping strategies which offer emotional support. Older children show more coping behaviour when staff or parents make coping promoting statements. Examples of these coping behaviours include relaxation and rationalisation.

4. Humour

One should be humorous to elevate the mood of the child which helps the child to relax.

5. Relaxation

This technique is used to reduce stress and is based on the principle of elimination of anxiety. Relaxation of the patient helps in reducing the reaction to pain and in reducing anxiety present.

Snoezelen environment consists of a partially dimmed room with lighting effects, vibroacoustic stimuli and deep pressure. Shapiro et al. demonstrated that a snoezelen environment had a positive effect on children. The technique is useful for all patients including those who cannot verbally communicate. There are no contraindications

6. Audio Analgesia

The use of pleasant music has been used to reduce stress and also decrease the reaction to pain. Audio analgesia diverts the attention of the patient and patient starts relaxing which would be beneficial to the dentist.

7. Hypnosis

Hypnosis is an artificially induced altered state of consciousness in which the individual becomes more susceptible to suggestion. The technique is useful for all patients who can verbally communicate. Dentists are advised to receive training in hypnosis.

The use of hypnosis in dentistry is termed as hypnodontics. One great benefit of hypnosis is to reduce anxiety in the patient.

Clinical features include:

1. Closed eyelid begins to flutter.
2. Breathing becomes deeper.
3. There is a progressive sense of relaxation.

8. Implosion Therapy

This refers to the picturization of animated movies to the child, e.g. wild life.

9. Aversive Conditioning

This method is usually used for a child who displays negative behaviour and does not respond. Here we use physical restraints.[3]

Physical restraints include:

1. ***Use of mouth props***
    - Mouth prop is used at the time of administration of local anaesthesia to prevent child from closing mouth.
    - Used in handicapped children.
    - Used in young children who cannot keep their mouth open for extended periods of time.

      For example, of mouth prop is MOLT mouth prop.
2. ***Restraint of the patient by dentist and dental assistant***
    - This involves the restriction of the movement of child's hands and feet or body.
    - The assistant must be trained to control the child's hands, head, body, etc.

      For example, for a radiograph, the child can be made to sit on parent's lap.

Home

- It is also known as hand over mouth exercise.
- This comes under avasive conditioning.
- The home has been used to re-establish communication with the child.

Procedure

The dentists hand is placed over the child's mouth to muffle the noise.

10. Drug Therapy

If a child does not respond to either psychologic or physical management procedure, then drug therapy is required. Premedicative agents could be used.

1. Very young children.
2. Very apprehensive children.
3. Physically handicapped children.
4. Mentally handicapped.

***Drugs used*:**

a. *Sedative and hypnotics*: Chloralhydrate and barbiturates

b. *Antianxiety drugs*: Diazepam, promethazine

c. *Narcotics*: Meperidine Combination of these drugs is also used.

General Anaesthesia

It is a controlled state of unconsciousness accompanied by a loss of protective reflexes. It is done in an hospital setting to render dental care. This can be a life-threatening procedure, hence its use should be restricted only to specific causes.

Conclusion

The rendering of necessary dental care to children is very rewarding. Behaviour management when used judiciously can result in the most satisfying of all results. Desensitization, modelling, contingency management techniques have been found useful by the behaviour therapists and in the dentist office. Application of these techniques, separately or in combination will frequently enable the dentist to elicit successively more appropriate behaviour.

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CHAPTER

25

Cultural Taboos in Dentistry

Since time immemorial, the teeth, the mouth and the face have held a seemingly intrinsic fascination for mankind. They have been and continue to be the subject of many oral and written beliefs, superstitions, and traditions and the object of a wide range of decorative and mutilatory practices. At the same time, they have been the cause of considerable suffering for many.

CULTURE

Culture is defined as “Learned behaviour which has been socially acquired”.[1]

Anthropologists have provided many definitions, the most famous being **Tylor’s definition** in 1871 ‘that complex whole which includes knowledge, belief, morals, art, law custom, and any other capabilities and habits acquired by man as a member of society’.[2]

Cultural factors in health and disease have engaged the attention of medical scientists and sociologists. Every culture has its own customs which may have significant influence on health and oral health.

ROLE OF CULTURE AND RELIGION ON ORAL HEALTH[3]

Different cultures influence the way in which a person will respond to illness and the treatment. Culture may influence a matrix of elements.

- The way in which illness and disease and their causes are perceived by the patient.
- The behaviour of patients and their attitudes towards healthcare providers.
- The delivery of services by the providers who may not appreciate or understand the cultural traditions and requirements of the patient.
- The patient's belief system with regard to health, well-being and healing.

MUTILATIONS OF TEETH

In the modern world, body decoration and mutilation is universal in its occurrence and is observed among people in all regions of the developed and underdeveloped world. Tooth-related and oral soft tissue mutilations are well-recognized forms of mutilation.[7]

A knowledge of these practices is important for the valuable insights they provide into the cultural beliefs and traditions of the people who practise them and for the very pragmatic reason that many comprise examples of customs which directly give rise to pathology of the teeth and orofacial tissues.

An understanding of these customs is important for diagnosis and treatment of complications arising from these acquired forms of pathology. Many of the dental and orofacial mutilations have relatively specific features and patterns reflecting different ethnic or tribal affiliations. Aknowledge of these customs is also important in the context of forensic odontology.[7]

Tooth Mutilations

Tooth mutilation practices have been recorded for inhabitants of non-tropical environments, but most of these customs are observed among people living in the tropical regions of the world.

These practices include non-therapeutic tooth extraction (evulsion); the breaking off of tooth crowns; alteration in the shape of the tooth crowns by filing and chipping, dental inlay work; lacquering and staining of teeth; and miscellaneous practices such as the placement of gold crowns for adornment purposes.

Reasons for Tooth Mutilations

Basic themes such as initiation identification, and aesthetics underlie many of the mutilation customs encountered throughout the tropics. Beliefs and associations ascribed to the practice of tooth evulsions are as follows:

1. Tribal identification
2. Initiation rite
3. Sign of manhood or bravery
4. Differentiation of sexes
5. Sign of marriageable age in females
6. Sign of ceremonial rebirth
7. To ensure a life after death
8. Aesthetics and fashion
9. Therapeutic purposes
10. Sign of mourning
11. Sign of subjugation
12. Form of punishment
13. Cultural mimicry
14. To enable an individual to spit properly
15. Local superstition associated with phenomena such as rain.

A number of people ascribed prophylactic benefit to certain root

mutilation customs. For example, Mosha (1983)[4] describes the removal of the permanent mandibular central incisors among the Iraq, Waarusha, and Masai people of Tanzania. Over half of the individuals who had submitted to this procedure indicated that the space left following removal of these teeth provided a route allowing passage of fluids in the event of a person becoming ill and being unable to open his or her mouth (due to tetanus—lock jaw).

The enucleation of unerupted deciduous teeth has been described by Pindborg (1969),[5] which appears to be confined to certain regions of Africa including Northern Nigeria and Tanzania, is considered to confer therapeutic benefit upon children. Among Nigerian tribes, the practice of deciduous canine (usually mandibular) germinectomy is considered to guard against symptoms such as high fever which may be associated with teething in children. In this area of Africa, parents take their children, suffering from fever, diarrhoea and vomiting, to local ‘doctors’ who advise the removal of the lower deciduous tooth germs. The reason given by these ‘doctors’ for the enucleation of the teeth is that the symptoms suffered by the child are due to a new type of tooth, namely the ‘nylon tooth’ which grows in children’s jaws and which, if not removed, will cause death. The term ‘nylon tooth’ apparently has been invented by the ‘doctor’s to describe the clinical appearance of the enucleated tooth germs which have a white, glistening appearance.

The practice of blackening the teeth among the Jivaro Indian people of Northern Peru and Ecuador, is a custom carried out in order to prevent dental caries. Tooth lacquering and dyeing is a custom performed in several other countries of the world including Vietnam, Laos, Thailand, Indonesia and the Philippines. While aesthetics is the usual motive for this practice, it is possible that the custom has an unintended caries-preventive effect.

Tooth Evulsion

Tooth evulsion describes the deliberate removal of a tooth for ritual or traditional purposes. The various motives underlying tooth evulsion usually have a non-therapeutic basis.

Reasons for Tooth Evulsion

In general terms, ritual tooth evulsion is carried out for reasons of identification, religious-spiritual reasons, to signify some life event, such as the transition from childhood to manhood or womanhood, or for aesthetics and fashion.

Number and Type of Teeth Involved

The Atayal people of Taiwan are reported to extract their ‘back teeth’ for aesthetic purpose. The number of teeth extracted for reasons for ritual or custom is usually between one and four. However, examples of the evulsion of more than four teeth in one jaw and the extraction of total or more than four teeth in both the jaws are recorded. Among some people, tooth evulsion may be carried out in association with other tooth mutilation practices such as chipping and filing.

Age and Sex Distribution

The age at which ritual tooth evulsions are performed varies. Clearly, procedures involving deciduous teeth are carried out on persons in their infancy or childhood. Evulsion of permanent teeth may be carried out at any age from childhood onwards. However, in general, permanent tooth evulsion tends to be performed on individuals in their late, childhood-teenage years. In some cultures, the practice of tooth evulsion is associated with events such as puberty and initiation rites in males or the time of first menstruation or marriage in females.

Methods of Tooth Evulsion

In majority of cultures where tooth evulsion is performed, the tooth or teeth are knocked out rather than extracted. This is usually carried out by placing a piece of wood or metal against the labial aspect of the tooth crown and then

striking the end of this object, from the appropriate direction, with some form of mallet. The latter may comprise a stone, a piece of rock, the back of an axe, or some other suitable instrument. Teeth may be completely evulsed by this method or loosened sufficiently to allow removal using the fingers.

The relative positions of operator and patient during tooth evulsion vary. The patient may be seated, but more commonly, lies on the ground. When the patient is in the latter position the operator may sit at the head of the patient, sometimes cradling the patient's head on the lap, and remove the tooth by working from behind the patient. In other instances, the operator may work from the front of the patient by either straddling the prone patient or by crouching at the side of the patient.[3]

Pain relieving or anaesthetic measures are not routinely prescribed preoperatively, during the operation, or postoperatively. The operation does cause considerable suffering and mental anguish for the patients.

Following tooth evulsion, attempts to control postoperative haemorrhage may be employed. Finger pressure on the socket, the use of a hot twig applied to the wound, and application of a variety of plant materials such as twigs and leaves which are believed to have styptic properties.

Complications following Tooth Evulsion and Germinectomy

Dentoalveolar complications include alveolar bone fracture, damage to mucosal tissues, and fracture of the tooth crown leaving the tooth root in situ.

Complications could also include gross wound sepsis, periapical granuloma, abscess formation, pulp necrosis and bacterial infestation of the root canal.

Complications following deciduous tooth removal are wound sepsis, haemorrhage and extensive soft tissue laceration.

Fate of Evulsed Teeth

Great care is sometimes taken to dispose of evulsed teeth in an appropriate manner. In some tribes, the teeth were buried by ceremonial fire, kept as charms, or sent to members of other tirbes. In central Australia, Aboriginal tribe pounded the evulsed teeth into fragments which were then placed in a

piece of meat.[1] If the tooth had been removed from a female then the pulverized tooth was eaten by girls mother. In case of a male, the tooth was eaten by his mother-in-law. Other customs include embedding of evulsed teeth in the bark of a tree, burying of the teeth beside water pool, throwing the extracted teeth into water and throwing the tooth as far as possible towards a legendary camp-site.

Mutilations of the Tooth Crown

Mutilations of tooth crown includes alteration in shape or appearance of teeth. The alteration of the shape or appearance of tooth crown are done by chipping and filing, dyeing and lacquering of teeth, decoration of the tooth crown by inlays, overlays, etc. The custom of altering tooth crown shape is confined to anterior teeth (canine-to-canine) of the upper and lower jaws.

Reasons for Altering the Shape of Teeth

The reasons include aesthetics, tribal identity, initiation rituals, religious motives and identification with animals. Peacock recorded that many of the people who submitted to customs such as flattening of incisal surfaces, grinding of incisors to gum level, etc. were ignorant of the reason why they were done. The usual answer being “It is the law of the old people, sir”. According to village headman, this practice related to the belief that at death all people enter a purgatory and undergo a trial of chewing green bamboo. If a person’s teeth are sharp, then the bamboo is likely to splinter and pierce the mouth and intestine. If the teeth are smooth, the bamboo can be chewed without ill effects.

Number and Type of Teeth Involved

Two to twelve permanent anterior teeth are the most commonly involved. The teeth most affected by these procedures are the central and lateral incisors of each jaw and also the canines.

Age and Sex Distribution

Tooth crown mutilations such as chipping and filing are carried out in the late childhood and teenage years. Tooth chipping and filing may be performed on both male and female members of the society.

Patterns of Chipping and Tooth Filing

In general, the various forms of chipping and filing of the tooth crown primarily involve mutilation of:

1. Incisal edge.

2. The mesial and/or distal incisal angle.
3. The mesial or distal surface.
4. The labial face.
5. The whole tooth crown.

Incisal edge mutilation may involve horizontal flattening of the incisal surface such that the length of the tooth crown is shortened.

Methods of Chipping and Filing

The operations producing deformations generally involve a process of chipping away enamel and dentin with some form of chisel and mallet until the desired shape is achieved.

The instrument used as the chisel is generally a metal instrument such as knife or axehead. The mallet with which the chisel is struck may be a hammer, the back of an axehead or stone.

The operation is undertaken by having the patient sit or lie on the ground with their head on the operator's lap. Patients may be restrained by having their head clamped between the operator's knees or by being held by other individuals. Prior to chipping of the teeth, a piece of wood is placed between the molar teeth to act as a form of retractor to keep the lips and tongue out of the way. The teeth are then chiselled to the desired shape. The chipped teeth may be left as they are or subjected to a secondary process of smoothening using a file or abrasive stone. It could take from few hours to several weeks. The custom performed on children involves the sawing off of the tooth crowns of the six maxillary anterior teeth using a hack-saw blade or paddy knife.

Complications of Tooth Chipping and Filing

Immediate complications associated with chipping and filing of tooth crowns include severe pain, unintended tooth fracture, pulp exposure, laceration of oral soft tissues. Occasionally, children suffered fatal haemorrhage or "went out of their minds" as a result of the operation.

Delayed complications include:

a. Pulp necrosis producing non-vital teeth

b. Inflammatory periapical pathology

c. Sequelae of periapical pathology (cellulitis, osteomyelitis)

d. Caries

e. Tooth loss

Lacquering and Dyeing of Teeth

Extensive staining of the erupted tooth crown can be a consequence of a variety of causes. These include poor oral hygiene, habits such as tobacco smoking and chewing, betel usage, application of stains and dyes to tooth crown. The blackening of teeth using an iron-containing mixture applied to the tooth surface was custom practiced in ancient Japan.[1]

The blackening of tooth was primarily used to signify marriage and fidelity in marriage and for aesthetic reasons. Among some people, the principal purpose appears to be related to concepts of beauty and sexual appeal or maturity. In Vietnam, tooth lacquering is used for cosmetic purposes. Some people blacken their teeth to help prevent tooth decay. Staining of teeth is usually accomplished by chewing the leaves or bark of specific plant species. The custom of lacquering teeth involves a process of preconditioning or etching of the enamel surface, followed by the application of appropriate staining lacquering agents. People recorded that lacquering involved the etching of enamel for two days using lemon juice followed by the application of black paints, ginger and mango. Other techniques include the use of iron-containing mixtures, shellac and spices such as cloves, cinnamon and pomegranate peel.

Decorative dental inlays and crowns

The use of dental inlays and crowns for adornment purposes is a form of non-therapeutic tooth mutilation occasionally encountered among contemporary peoples within and outside the tropics. In general, these practices are usually carried out for purposes of beautification, to signifying wealth or to signify some event.[7] The nature of inlay materials used are haematite, jade, pyrite, torquoise, obsidian and gold. The practice of placing decorative inlays in front teeth was also carried out in India in previous times. The teeth of Maharajahs were reportedly inlaid with glass or pearls. The dyaks of Borneo are reported to drill small holes into the labial surface of the maxillary teeth

and place pieces of copper in variously shaped defects. In the modern world, the use of gold crowns on teeth is related to a therapeutic need to replace lost or damaged dental tissues.

Among muslims, the presence of a gold crown (cap) on a front tooth is used to signify that the wearer has visited mecca, the spiritual centre of that religion.

MUTILATIONS OF SOFT TISSUES

Tattooing

Tattooing of soft tissues is a practice which remains relatively popular in many nontropical and tropical areas of the world. While tattooing of the skin is the most commonly encountered expression of this practice, tattooing of the lip and gingiva is occasionally seen.

The gingiva may be tattooed when females reach puberty, become betrothed, or when they become married. It is practiced by men to relieve the pain associated with ‘diseased gums’. It is believed that gingival tattooing has therapeutic benefit.[6]

The technique of gingival tattooing involves painting the gingiva with a layer of pigmented material usually carbon which is then impregnated into the gingival mucosa by means of sharp thorns nor needles which pierce the mucosa. A blue black colouration is the usual hue achieved with gingival tattoos. The material used to tattoo the gingiva may be obtained from calcified peanuts, burned wood or from lamp black (the black soot obtained from burning oil lamp). A tattooed lower lip in a Sudanese woman signifies that the woman is married. Facial tattoos may incorporate a triangular-shaped tattoo on the skin surface at the angle of mouth. It has its basis in ritual warding off of the “evil eye”.

Other Forms of Soft Tissue Mutilation

A variety of other mutilation practices having their basis in ritual or custom and involving orofacial soft tissues occasionally may be encountered among people in tropical regions.

These include:

1. Piercing of lips and perioral soft tissues and the insertion of materials such as wood, ivory or metal.
2. The temporary piercing of orofacial soft tissues for ceremonial purposes.
3. Uvulectomy.
4. Facial scarring.

The best known example of temporary mutilation of soft and perioral soft tissues is that practiced by Hindu men in India. During the ceremony of the Thapasyam (Penace-white; Thaipusam), men in a state of apparently selfinduced trance pierce the skin of the body with a variety of sharp weight-bearing hoops and lances.[2] The person gives no signs of experiencing pain and the wounds do not bleed. Facial soft tissues are often subjected to scarification. Scarification may be carried out for a variety of reasons including tribal identity, aesthetics, to enhance sexual appeal, to indicate status and to signify events such as puberty, marriage or childbirth.

Conclusion

The developed and under developed regions of the tropics comprise a vast repository of beliefs and knowledge concerning health, disease and treatment. In some instances, these knowledge have been retained for hundreds of years. Awareness of them is important for those who are involved in the treatment of patients and for those involved in the planning of dental health care delivery system.

This awareness is important in the context of:

1. Sensitive approach and respect for cultural belief by those treating patients according to modern methods and by those planning dental care delivery system.
2. Giving thought to the incorporation of local beliefs and practices.
3. Convincing people of the harmful effects of some practices.

Those involved in providing dental care and professional dental education should identify the cultural practices involving the teeth and oral soft tissues.

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CHAPTER

26

Oral Health Care for Special Groups

A compromised individual is a person who has one or more physical, medical, mental or emotional problems that result in a limitation of that person's ability to function normally in fulfilling the activities of daily living.[2]

Although some of the causative factors for these compromised conditions such as trauma, birth defects, or adult onset diseases allow impairment patterns to appear along age stratification lines, the age of the individual per se must not be the main determining factor in deciding the quality and quantity of preventive dental instruction provided for that persons. Instead, this decision should be made after consideration of a number of other factors, including the individuals cognitive abilities, sensory perception, functional expertise, and oral hygiene condition.

Sensory Capabilities

Communication channels are impeded, if the patient’s hearing of vision is significantly impaired, in which case a modification in communication modalities must be made. Otherwise recommendations for an oral-health home care programme will not be understood much less carried out.

Visual Deficits

A number of aetiologies, from harmful prenatal and perinatal environments to the normal aging process can lead to alteration in visual acuity. These changes may range from correctable deficiencies to total blindness. Other common visual deficits include a loss of peripheral vision as occurs with glaucoma or visual field cuts resulting from a cerebrovascular accident.

Instructional materials to be used with patients who have decreased visual acuity could include selective use of commercial products that have been developed for pedodontic programmes. Routinely such products have large pictures. Custom-made instructional sheets may be produced by the dental office using large black letters of at least 12-point type on off-white or white paper. The use of cassette tape for recording personalized hygiene instructions is recommended chairside instructions of toothbrushing and flossing should be demonstrated with a giant-sized tootbrush. These large models allow the patients with limited visual acuity to see and to understand some of the more subtle aspects of the toothbrushing, such as the correct angulation of the bristles into the gingival crevice. A green-coloured floss can help when demonstrating flossing to those with visual impairment who have difficulty seeing the conventional white floss. Red floss is also available and can be used; in fact, red is a colour that is visualized by the aging eye better than green. While coloured floss is useful for demonstrations. Once the flossing technique is understood and visual acuity permits, the patient may switch to white floss for regular home use. This change allows the patient to continually check the colour of the floss for possible gingival bleeding.[2]

To demonstrate brushing and flossing techniques in the office, an inexpensive magnifying mirror should be employed to assist the patient in observing his or her own performance. A similar mirror should be recommended for the patient’s use at home. If a patient has visual problems so significant that a mirror cannot be used, the individual must be sensitized instead to the “feeling” and “smell” of a clean mouth to attest to the success of oral hygiene measures.

Hearing Disabilities

The commonest problem in communicating with the hearing disabled is that the provider does not sit directly in front of the patient and at the same eye level, speaking face-to-face. The hearing disable patients rely heavily on the communicator's facial expression and body language to understand the message. Therefore, speaking distinctly with a slightly decreased rate of speed. Without exaggeration and in a well-modulated voice facilitates intercommunication. One should avoid any back lighting that places the speaker's face in a shadow. Shouting should never be used with the hearing disable patients since it is actually more difficult for the impaired ear to understand. Speaking to the patient with any equipment running is contraindicated. Similarly, it is not desirable to speak while performing other functions, such as writing while the head is down, looking at radiographs with the face turned from the patient or while entering or leaving the room[2].

Pantomime and demonstration may be necessary when working with the hearing disabled. Once the message is transmitted, it is expedient to have the patient demonstrate the suggested oral hygiene skills on models followed by demonstration in his or her own mouth. Suggest to the patient that hearing aid be removed or turned off prior to treatment and replaced or turned back on prior to receiving instructions.

Speech and Languages Disorders

One cannot discuss the role of communication between the patient and the provider without considering speech and language. It is a good idea when dealing with such an individual to frame questions in such a way that they can be answered with a “yes” or a “no” or even just a shake of the head. One solution is to provide the patient with lap board containing preprinted letters, common words, or pictures. Individuals with a knowledge of language but an inability to speak or to have their speech or writing understood, can point to the letters or words or pictures to communicate.

Cognitive Capacities

The cognitive capacity of a patient is of far greater importance than a person's intelligence quotient (IQ) test results in determining the capability of a individual to benefit from preventive dentistry instructions. To attain success, the dental care provider must first determine the level of congnitive ability of the patient and then direct all instruction to that level. If it is determined that the patient has intellectual or cognitive impairment, the traditional educational programme used to convey preventive oral hygiene techniques must be modified. For example, it should be recognized the brushing the teeth is a complex task that needs to be broken down into very simple but discrete steps. This allows the impaired patient to follow the instructions and to succeed at every step of the way toward the final goal, thereby integrating the simple tasks into a final complex task. At the first appointment, it may be possible to address only the brushing of the occlusal surfaces of the teeth to achieve satisfactory compliance and to reinforce only this activity until it becomes a natural part of the patient's daily repertoire. Reinforcement throughout the learning period should be supplemented with both verbal and nonverbal rewards; for example, a smile or a gift of a new toothbrush are often motivating techniques.

Functional Performance

An accurate assessment of a patient's expected functional performance depends upon the evaluation of each of the separate tasks necessary to complete the oral hygiene task. Once the difficulty has been identified, it then requires either a device of a luman to compensate for a patient's inadequacy. Gross motor skills, such as grasping a tooth brush handle, can often be improved by orthotic appliances specifically the electric toothbrush may serve as a highly effective substitute for this lack of dexterity.

Attendant Care

There will be many compromised individuals who will be unable to handle their own hygiene due to sensory, cognitive, or physical deficits. For these individuals, an attendant or family member should be instructed in the proper oral health care for the patient. If a patient has tender, friable gingival tissue that can easily become damaged by an initially dry toothbrush, the brush can be pre-wet to soften it. The elimination of the toothpaste increases visibility and decreases the possibility of gagging. Those patients who enjoy the taste or appreciate the aesthetic value of toothpaste can use a non-foaming ingestible toothpaste developed for the astronauts. Since this toothpaste does not foam and can be swallowed, it is not necessary for the patient to be near a basin to expectorate.

If a patient would like to rinse his or her mouth after brushing with water or a mouth wash, a two-paper cup technique can be used. One paper cup holds the rinse, the other is for the expectorate after the patient was swished the rinse around. Since the cups are lightweight, patients can often hold both, bringing each of the cusps up to their lips as they are needed. This two-cup technique provides a mean to control dribbling or drooling. This technique is valuable for an individual who is unable to lean over the basin such as an arthritic patient or for an individual who cannot pursue the lips to expect the fluid as is the case with muscular dystrophy.[2]

PREGNANCY

It is a common belief that every pregnancy invites the loss of a tooth by the mother. Pregnancy has no direct causation of tooth loss, but there are a number of factors which influences the rapidity and progression of incipient or already well-established oral disease. The expectant mother may be involved in a multitude of extra activities. During this time, her own oral care may be neglected both with regard to home care and also visits to the dentist. There may be a change in eating habits, with an increased intake in carbohydrates, sweets and candies which may coincide with a desire for bizarre or exotic foods.

The factors responsible for dental caries may be listed as follows:

1. ***Diet*:** The expectant mother may have her cravings for sugary drinks or sweets, or other cariogenic foods.
2. ***Home care*:** In view of the extra plaque which may form because of the increased sucrose intake, there should be more scrupulous brushing.
3. ***Other factors*:** Acid attack in the plaque may be accelerated by acid from the stomach from nausea occurring early in some pregnancies.

Gingival disease can be quite significant during pregnancy. There are hormonal changes at this time, so that any mild inflammation (which otherwise may not be detected) may become quite marked sometimes with grossly enlarged and bleeding gingivae.[1]

Isolated enlargements may relate to the papillae of one or two teeth and these may interfere with eating because of bleeding. Although termed pregnancy ‘tumours’ these are composed of inflammatory tissue and should eventually resolve with the removal of the irritants, but occasionally surgery is required for complete return to normal. These conditions do not occur where there has been careful plaque control from the beginning. Therefore, it is necessary to go over brushing and other home care methods with such patients and to stress the importance of paying particular attention to the regions where bleeding is experienced.

Preventive Attention for the Expectant Mother

The dentist should be attended as early as possible in the first stages of pregnancy for a thorough examination so that all the necessary treatment can be carried out well in advance. Advice should be given on a suitable diet to be adopted both to protect the parent and the developing child. Apart from the usual sensible mixed diet of carbohydrates, fats, and proteins, essentially the mother's diet should include all the proteins, minerals, and vitamins which the fetus need.

- An adequate daily intake of milk or milk products.
- Proteins—meat, eggs, fish, poultry.
- Vegetables—greens, cabbage, sprouts, etc. for vitamin A and iron.
- Citrus fruits—oranges, lemons, grape fruit. etc. for vitamin C.

The expectant mother should be careful to avoid taking tetracycline antibiotics; otherwise there would be a danger of discoloured teeth in the child.[1]

THE NEW BABY

Breastfeeding, if possible, of the newborn child is preferable to bottle-feeding for the following reasons:

1. The maternal milk contains immune factors which have been acquired by the mother against various diseases so that the child has built-in resistance to such disease for the first few weeks of life.
2. The milk contains all the balanced nutrients.
3. The act of sucking on the breast is of importance to the proper development of the jaws. The action of the tongue and the pressure of the jaws and lips are enhanced by the effort made by the child to obtain the milk. All too often the bottles used do not give this pressure and the milk may be obtained too easily with resulting lack of stimulation of jaw growth. If, however, for some reason the mother finds it impossible to breastfeed the baby, the bottle must be chosen from the number of well-designed feeding bottles which stimulate the action of the breast. The mother should be warned against purchasing a teat with a large hole or enlarging the existing hole with a pin in order to satisfy the impatient child. Too easy sucking may lead to ‘tongue thrusting’ and developmental errors.[1]

THE HANDICAPPED CHILD

Special consideration must be given to the handicapped child (or adult), although it should be borne in mind that more often than not the patient will not be as conscious of the handicap as the operator. However, handicapped patients require more time, thought and care in oral hygiene training and many of them will need more efficient plaque removal than their more fortunate contemporaries. The following handicap categories are considered:

Oral	Cleft palate, mucosal lesion, cleft lip, etc.
Heart	Congenital
	Rheumatic (acquired)
Senses	Blindess
	Deafness
Limbs	Arm movements defective
	Leg movements defective
Mental	Continuous—retardation, defects emotional, psychic
Periodic	Petit mal
	Grand mal

Oral Lesions

For the patient with cleft palate, it is essential to use all preventive measures possible to preserve the remaining teeth. Efforts should be made to avoid extractions, as both deciduous and permanent teeth are needed for retention or stabilization for any appliances. Therefore, appointments for preventive care should be frequent, and the intervals between recall should be short. Some parents initially may reject the deformity, and therefore, avoid the necessary cleaning of the mouth. It may be that they fear doing harm to an area which appears to be already damaged. Thus, to avoid neglect for whatever reason, the patients must be told of the importance of home care and its bearing on future success. Later it will be necessary to demonstrate effective cleaning of any obturator or appliance.[1]

Cleft lip is usually repaired at a very early stage and, therefore, presents little problem except that before repair there are feeding problems which require advice and assistance.

Congenital Heart Disease

Here exceptional oral hygiene control is imperative, with antibiotic cover for all procedures which might provoke bacteraemia. Increase of antibiotic dosage may be necessary during dentistry for those already on regular maintenance antibiotic therapy.

Rheumatic heart disease requires the same considerations as above, and these patients are more likely to be on permanent antibiotic cover. The risk for all these heart patients is, of course, the possibility of bacterial endocarditis. All septic areas should be removed under suitable chemotherapy cover. The successful handling of these cases will depend on a careful history, records and a close cooperation with the patient's physician at all times.

Senses—Deafness

The deaf will benefit by visual aids and carefully written instruction sheets for home reading. An intermediary who uses finger sign language may help to solve their communication problem.

Blindness

The blind will benefit by use of large tactile teaching aids such as models with large tooth brushes will help considerably. Cassette tapes may also be prepared and given for home use.

Defective Limb Movements

This calls for assistance of a third party or in lesser handicaps the use of various aids such as automatic brushes, floss holders, ‘perio aids’ may be tried, probably successively until one suitable for the patient is discovered.

Mental Handicaps

For those on phenytoin to control epileptic seizures, it is essential to teach or somehow to ensure plaque control to avoid the tendency for gross enlargement of the gingiva. There is no doubt that this will not occur in the 100% clean mouth. Mentally retarded patients may require a great deal of patience to overcome fears of the dentist's environment. Therefore, the approach must be gradual and in terms the patient can cope with. Restraint may have to be used occasionally and it is better not to use drugs. The brushing and other oral care may be best accomplished by nurses or other personnel, if the patient is hospitalized. The value of preventive measures is soon appreciated in the growing confidence of the patient and the reduction in the amount of restorative work which may be traumatic for such patients.[1]

Leukaemia

Careful oral cleansing with as much freedom from trauma as possible is essential with leukaemics; often antibiotic cover is required. No extraction should be carried out without very special precautions and it is better to refer the child to a hospital.

Conclusion

Individuals with physical, medical, mental, or emotional problems often have a greater need for dental care than their healthy counterparts. This may be because the disability itself has oral manifestations, but more commonly, it is due to (1) the limited capabilities of the individual or the family members to understand and to perform important oral hygiene tasks, (2) a lack of understanding of the importance of preventive dental care, (3) a lack of ability to finance dental care. When the compromised patient does present to a dental office, the main essentials will be the preservation of the teeth, the avoidance of major operative interference and primary prevention from the earliest possible moment in order to prevent the onset of destructive disease.

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Multiple Choice Questions

Chapter 1: Health, Disease and Infection

1. **The concept of disease in which the ancient man believed is known as:**
   a. Theory of four humours
   b. Theory of spontaneous generation
   c. Supernatural theory of disease
   d. Germ theory of diseases
2. **The medical system that is truly of Indian origin is:**
   a. Unani-Tibb system
   b. Homeopathy
   c. Acupuncture
   d. Ayurveda and Siddha systems
3. **Which one of the following is true about Hippocrates?**
   a. Father of medicine
   b. Born on the little Island of Cos
   c. His book “Airs, Water and Places” is considered a treatise on social medicine and hygiene
   d. All of the above
4. **“Dark ages of medicine” is:**
   a. Middle ages
   b. Renaissance
   c. Neolithic age
   d. Stone age
5. **Which one of the following does not represent the submerged portion of the “Iceberg of disease”?**
   a. Presymptomatic cases
   b. Carriers
   c. Clinical cases

d. Undiagnosed cases

6. The concept which considers/views that health is being influenced by "social, psychological, cultural, economic and political factors" is known as:

a. Biomedical concept
b. Psychosocial concept
c. Ecological concept
d. Holistic concept

7. Screening for dental caries among school children is:

a. Health promotion
b. Specific protection
c. Early diagnosis and treatment
d. Disability limitation

8. The "great sanitary awakening" took place in the mid-19th century at:

a. France
b. Germany
c. China
d. England

9. The concept that "all sectors of society have an effect on health, in particular, agriculture, animal husbandry, food, industry, education, housing, public works, communication" is:

a. Holistic concept
b. Social engineering phase
c. Biomedical concept
d. Ecological concept

10. The fourth dimension of health according to WHO is:

a. Physical dimension
b. Mental dimension
c. Social dimension

d. Spiritual dimension

11. The best known medical manuscripts belonging to the Egyptian times are:

a. Susruta Samhita
b. Yang and Yin
c. Edwin Smith Papyrus and Ebers Papyrus
d. Hygiea and Panacea

12. Who is often called the "father of medicine"?

a. Hippocrates
b. Hammurabi
c. Susruta
d. Ambroise Pare

13. Who is often called the "father of surgery"?

a. Susruta
b. Ambroise Pare
c. Rhazes
d. Andreas Vasalius

14. Germ theory of disease was advanced by:

a. Avicenna
b. John Hunter
c. Louis Pasteur
d. John Snow

15. The epidemiological triad of disease is:

a. Host, agent, environment
b. Agent, vector, host
c. Vector, carrier, environment
d. Agent, treatment, carrier

16. The term "hygiene" is derived from:

a. Health
b. Panacea

c. Hygiea

d. Hyos

17. The prevention that is done at the late pathogenesis stage of a disease is called as:

a. Primary

b. Secondary

c. Tertiary

d. Quarternary

18. "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" this definition was given by:

a. UNICEF

b. UNO

c. WHO

d. UNESCO

19. The concept that views health as an "absence of disease" is known as:

a. Ecological concept

b. Biomedical concept

c. Disease control phase

d. Health for all phase

20. The concept that considers health as a "dynamic equilibrium between man and his environment, and disease a maladjustment of the human organism to environment" is known as:

a. Ecological concept

b. Holistic concept

c. Biomedical concept

d. Psychosocial concept

Chapter 3: Environment and Health

1. **"The Water (prevention and control of pollution) Act" was enacted in the year:**
   a. 1970
   b. 1964
   c. 1974
   d. 1984
2. **The optimum period of storage of river water is considered to be about:**
   a. 10–14 days
   b. 24 hours
   c. 30 days
   d. 48 hours
3. **Slow sand filters were first used for water treatment in 1804 in:**
   a. Iceland
   b. Denmark
   c. Geneva
   d. Scotland
4. **Slow sand filter is otherwise known as:**
   a. Mechanical filters
   b. Berkefeld filters
   c. Katadyn filters
   d. Biological filters
5. **The depth of the supernatant water above the sand bed is usually:**
   a. 1 to 1.5 mt
   b. 1.5–2 mt
   c. 2–3 mt
   d. 3–4 mt

6. **“Schmutzdecke”:**
   a. Vital layer
   b. Zoogleal layer
   c. Biological layer
   d. All of the above
7. **The formation of vital layer is known as:**
   a. Straining
   b. Hardening
   c. Ripening
   d. Scraping
8. **It is considered uneconomical to run the filter when the loss of head exceeds:**
   a. 4 metres
   b. 1.3 metres
   c. 2.5 metres
   d. 0.5 metre
9. **Slow sand filters have been shown to reduce total bacterial counts by:**
   a. 98–99%
   b. 99.9 to 99.99%
   c. 90%
   d. 95%
10. **The first rapid sand filter was installed in USA in:**
   a. 1900
   b. 1885
   c. 1905
   d. 1800
11. **In rapid sand filter, the effective size of the sand particles is between:**
   a. 0.4–0.7 mm

b. 1–2 mm

c. 1.5–2 mm

d. 2–2.1 mm

12. In slow sand filter, the vital layer is considered the "heart" of the filter because:

a. It removes organic matter

b. Holds back bacteria

c. Oxidizes ammonical nitrogen into nitrates

d. All the above

13. Examples of rapid sand filters are:

a. Paterson's filter

b. Candy's filter

c. Both of the above

d. None of the above

14. In mechanical filters, the procedure of cleaning filter is called as:

a. Scraping

b. Ripening

c. Back-washing

d. Peeling

15. The effective size of the sand particles in biological filters is between:

a. 0.2–0.3 mm

b. 0.4–0.7 mm

c. 0.5–1 mm

d. 1–2 mm

16. The point at which the chlorine demand of water is met is called the:

a. Meet-point

b. Contact-point

c. Break-point

d. Set-point

17. For disinfecting large bodies of water, chlorine is applied as:

a. Chlorine gas
b. Chloramine
c. Perchloron
d. All the above

18. The free and combined chlorine in water can be demonstrated by:

a. Orthotolidine (OT) test
b. Orthotolidine-arsenite (OTA) test
c. Orthotolidine-zinc (OTZ) test
d. a and b are correct

19. Which among the following is best for disinfection of water on larger scale?

a. Chlorination
b. Ozonation
c. UV irradiation
d. All of the above

20. Which one of the following can be used for household purification of water?

a. Boiling
b. Bleaching powder
c. Ceramic filters
d. All of the above

21. Which among the following is NOT used for household purification of water?

a. Perchloron
b. Chlorine tablets
c. Iodine
d. Ozonation

22. The disadvantage in using iodine as a municipal water supply

disinfectant is:

a. High costs
b. Physiologically active
c. Its colour
d. a and b are correct

23. The chlorine demand of the well water is estimated by:

a. Venturi meter
b. Horrock's apparatus
c. Boyle's tube
d. Hare's apparatus

24. Double-pot method is used to disinfect:

a. Ponds
b. Rivers
c. Wells
d. Lakes

25. The % of population accessible to safe drinking water in India is:

a. 90
b. 50.9
c. 65.8
d. 75

26. Drinking water should be:

a. Hard water
b. Moderately hard
c. Soft water
d. Very hard water

27. Softening of water is recommended when the hardness exceeds:

a. 1 mEq/litre
b. 3 mEq/litre
c. 5 mEq/litre
d. 0.5 mEq/litre

28. The hardness in water is caused by:

a. Calcium bicarbonate
b. Magnesium bicarbonate
c. Calcium sulphate
d. All of the above

29. Permanent hardness can be removed by:

a. Boiling
b. Addition of lime
c. The base exchange process
d. a and b are correct

30. Temporary hardness can be removed by:

a. Boiling
b. Addition of lime
c. Addition of sodium carbonate
d. All of the above

31. "The Air (Prevention and Control of Pollution) Act" was enacted in the year:

a. 1974
b. 1980
c. 1981
d. 1990

32. The normal conversation produces a noise of:

a. 20–30 db
b. 60–80 db
c. 60–65 db
d. 30–40 db

33. The human ear can hear frequencies from about:

a. 20–20,000 Hz
b. 10–20 Hz
c. 20–40 Hz

d. 20,000–30,000 Hz

34. Permanent hearing loss may result due to repeated or continuous exposure to noise around:

a. 100 db

b. 50–60 db

c. 60–80 db

d. 75 db

35. Where the terrain is moderately sloping, the type of controlled tipping chosen is:

a. Trench method

b. Ramp method

c. Area method

d. Dumping

36. Which among the following is a source of soil pollution?

a. Fertilizers and pesticides

b. Soil erosion

c. Deforestation

d. All of the above

37. Identify the green house gases:

a. CO_2 and CH_4

b. CFC and N_2O

c. Sulphur dioxide and CO

d. a and b are correct

38. UNEP is:

a. United Nations Economic Programme

b. United Nations Educational Programme

c. United Nations Environmental Programme

d. United Nations Emergency Programme

39. “World environment day” is observed every year on:

a. 5^{th} of June

b. 1^{st} of June

c. 2^{nd} of June

d. 4^{th} of June

40. Population, urbanization, social changes are:

a. Physical components of environment

b. Social components of environment

c. Cultural components of environment

d. Biological components of environment

41. "World population day" is observed on:

a. June 5

b. July 11

c. August 5

d. August 11

42. "World ozone protection day" is observed on:

a. September 11

b. September 16

c. November 1

d. November 21

43. "The Environmental (Protection) Act" was enacted in:

a. 1947

b. 1981

c. 1986

d. 1991

44. The method by which the land depressions, disused quarries and clay pits are filled with refuse is known as:

a. Ramp method

b. Area method

c. Incineration

d. Dumping

45. Bangalore method is:

a. Hot fermentation process
b. Anaerobic method
c. Aerobic method
d. a and b are correct

46. Bangalore method of waste disposal is a type of:

a. Dumping
b. Controlled tipping
c. Composting
d. Incineration

47. Taj Mahal is losing its brightness because of the attack by:

a. SO_2
b. CO
c. CO_2
d. CaO

48. Methyl isocyanate is:

a. Used for making pesticide
b. Related with Bhopal gas tragedy
c. Both are correct
d. None of the above

49. The bacteriological indicator of faecal contamination of water is presence of:

a. Coliform organisms
b. Faecal streptococci
c. *Clostridium perfringens*
d. None of these

50. Humus is produced at a temperature of:

a. 40°C

b. 60°C

c. 50°C

d. 70°C

51. Human anatomical waste, animal waste, soiled cotton are seggregated in:

a. Blue bags

b. Black bags

c. Yellow bags

d. Red bags

52. Black-coloured bags are used for collecting:

a. Incineration ashes

b. Cytotoxic drugs

c. General wastes

d. All of the above

53. Blue/white transluscent bags are used for collecting:

a. Sharps

b. Intravenous sets

c. Catheters and gloves

d. All of the above

54. The hospital refuse is best disposed off by:

a. Incineration

b. Trench method

c. Area method

d. Dumping

55. The process of mixing waste with cement and other substances minimize the risk of toxic substances migrating into surface or groundwater is called as:

a. Shredding

b. Mutilation

c. Inertization

d. Wet treatment

56. Type of waste NOT to be incinerated:

a. Radiographic waste
b. PVC
c. Broken thermometers
d. All of the above

57. Plastic wastes is well disposed off by:

a. Municipal dump
b. Shredding
c. Smelting
d. Incineration

58. The process by which the waste is reduced by 80% in volume and by 20–35% in weight is known as:

a. Inertization
b. Smelting
c. Shredding
d. Encapsulation

59. Shredding is unsuitable for treating:

a. General waste
b. Sharps
c. Catheters
d. Radioactive waste

60. The process in which puncture-proof containers are filled with sharps waste and immobilizing material, then sealed and buried in land fill is known as:

a. Smelting
b. Shredding
c. Encapsulation
d. Inertization

61. Encapsulation is indicated for:

a. Sharps waste
b. Pharmaceutical waste
c. Used batteries and thermometers
d. All of the above

62. Incineration ash is best disposed off by:

a. Municipal dump
b. Sanitary landfill
c. Burial
d. None of the above

63. Plastic waste (PVC) should not be incinerated to avoid:

a. Dioxins and furans emission
b. Fly ashes
c. All of the above
d. None of the above

64. Red-coloured bags should not be incinerated as they contain:

a. Fluoride
b. Cadmium
c. Mercury
d. Phosphate

Chapter 4: Nutrition in Health and Disease

1. **Deficiency of ascorbic acid causes:**
   a. Enlargement of marginal gingiva
   b. ANUG
   c. Lack of periodontal support making teeth loose to the point of exfoliation.
   d. All the above
2. **Following are the richest sources of ascorbic acid:**
   a. Green peppers and red peppers
   b. Citrus fruits
   c. Broccoli, cabbage and spinach
   d. Potatoes
3. **Vitamin A deficiency causes:**
   a. Atrophy of salivary glands
   b. Enamel hypoplasia
   c. Reduced salivary flow and thereby increase in caries
   d. All of the above
4. **Richest source of vitamin E is:**
   a. Vegetable oil
   b. Animal fat
   c. Milk
   d. None of the above
5. **Fertility vitamin is:**
   a. Vitamin A
   b. Vitamin E
   c. Vitamin C
   d. B complex vitamins
6. **Coagulation vitamin is:**

a. Vitamin E
b. Vitamin A
c. Vitamin K
d. Vitamin D

7. The primary function of vitamin K is:

a. To catalyze the synthesis of prothrombin by liver
b. To produce clotting factor VII
c. To produce clotting factor IX
d. To produce stuart factor

8. Excellent source(s) of vitamin K is/are:

a. Lettuce
b. Spinach
c. Cauliflower
d. All of the above

9. The most biologically active form of vitamin D is:

a. Cholecalciferol
b. 25-hydroxycholecalciferol
c. 1,25-dihydroxycholecalciferol
d. None of the above

10. Rich source(s) of vitamin D is/are:

a. Fish liver oil
b. Eggs and butter
c. Milk
d. a and b are correct

11. Thiamin deficiency causes:

a. Beriberi
b. Burning tongue
c. Hyperesthesia of the oral mucosa
d. All of the above

12. Thiamin can be lost through:

a. Milling of cereals
b. Overheating of milk
c. Canning of meat
d. All of the above

13. Niacin deficiency causes:

a. Pellagra
b. Cheilosis and angular stomatitis
c. Tongue soreness, swelling and scarlet discolouration
d. All of the above

14. Riboflavin deficiency causes:

a. Circumcorneal injection
b. Seborrhoeic dermatitis around the nasolabial fold
c. Angular cheilosis and glossitis
d. All the above

15. Anti-egg white injury factor is:

a. Pantothenic acid
b. Biotin
c. Riboflavin
d. Thiamin

16. Vitamin B_{12} deficiency causes:

a. Pernicious anaemia
b. Atrophic glossitis
c. Lemon-Yellow complexion
d. All of the above

17. The combination of dysphagia, koilonychia, angular stomatitis and atrophic glossitis is called as:

a. Plummer-Vinson syndrome
b. Sturge-Weber syndrome
c. Ramsay Hunt syndrome

d. Peutz-Jeghers syndrome

18. Conversion of cholecalciferol into 25-hydroxycholecalciferol takes places in:

a. Kidney
b. Liver
c. Intestine
d. None of the above

19. Conversion of 25-hydroxycholecalciferol into 1,25-dihydroxycholecalciferol takes place in:

a. Kidney
b. Liver
c. Intestine
d. None of the above

20. Magnesium deficiency causes:

a. Reduction in alveolar bone formation
b. Gingival hyperplasia
c. Widening of periodontal ligament
d. All of the above

21. Vitamin D deficiency causes:

a. Rickets
b. Osteomalacia
c. Osteoporosis
d. All of the above

22. Protein deficiency causes:

a. Kwashiorkor
b. Delayed eruption and hypoplasia of deciduous teeth
c. Retarded cementum deposition
d. All of the above

23. Which among the following is/are considered as energy giving foods?

a. Roots and tubers
b. Fats and oils
c. Meat and poultry
d. a and b are correct

24. Which among the following is/are considered as protective foods?

a. Vegetables
b. Fruits
c. Meat
d. a and b are correct

25. Among the water-soluble vitamins, the body is unable to produce or store:

a. Vitamin B_2
b. Vitamin A
c. Vitamin B_1
d. Vitamin C

26. Which among the following is/are rich source of omega 3 fatty acids?

a. Herring
b. Sardines
c. Mackerel
d. All of the above

27. Which one of the following is an antioxidant?

a. Ginger, garlic and onion
b. Papaya
c. Carrot
d. All of the above

28. The best method of checking for compliance with nutritional counselling is:

a. Decrease in caries prevalence
b. Questioning the patient

c. Repeating the dietary survey

d. Significant plaque reduction

29. Vitamins act as:

a. Hormones

b. Sources of energy

c. Catalysts

d. Stimulants

30. The richest source of vitamin A is:

a. Cod liver oil

b. Butter

c. Carrot

d. Green leafy vegetables

31. Angular stomatitis and cheilosis are associated with the deficiency of:

a. Niacin

b. Thiamine

c. Riboflavin

d. Pyridoxine

32. Which of the following is the richest source of calcium?

a. Rice

b. Wheat

c. Ragi

d. Jowar

33. Which of the following is the richest source of proteins?

a. Red gram

b. Soya bean

c. Bengal gram

d. Black gram

34. Which of the following is NOT a characteristic of the diet diary?

a. It should include the amount of sugar added to foods

b. Household measures should be used for mentioning amounts
c. Patient should encircle all sugar containing foods
d. None of the above

35. Bleeding from gums, gingival hyperplasia and swelling of tongue are features of:

a. Vitamin A deficiency
b. Vitamin C deficiency
c. Riboflavin deficiency
d. Calcium deficiency

36. Diet counselling programme is an example of:

a. Primary prevention
b. Secondary prevention
c. Tertiary prevention
d. None

37. Cheapest source of iron is:

a. Dates
b. Kismis
c. Banana
d. All of the above

38. Vitamin B_{12} deficiency causes:

a. Angular cheilitis
b. Hunter's or Moeller's glossitis
c. Scurvy
d. All of the above

39. High protein diet may:

a. Prevent caries formation
b. Promote periodontal disease
c. Increase salivary pH
d. All of the above

40. Acute protein deficiency causes:

a. Salivary gland atrophy
b. Decreased salivary flow
c. Increase in caries susceptibility
d. All of the above

Chapter 5: Health Education

1. **Which one of the following is an objective of health education?**
   a. Informing people
   b. Motivating people
   c. Guiding into action
   d. All of the above
2. **“Epidemic Disease Act” is an example of:**
   a. Service approach in public health
   b. Regulatory approach in public health
   c. Educational approach in public health
   d. All of the above
3. **Which one of the following is NOT a principle of health education?**
   a. Interest
   b. Comprehension
   c. Leaders
   d. Family health care
4. **Awakening the fundamental desire to learn is called:**
   a. Reinforcement
   b. Interest
   c. Motivation
   d. Learning by doing
5. **The Chinese proverb “If I hear, I forget; if I see, I remember; if I do, I know” can be related with:**
   a. Interest
   b. Comprehension
   c. Soil, seed, sower
   d. Learning by doing
6. **Group discussions are:**

a. Two-way communication

b. 4 to 8 qualified persons who sit and discuss a given problem in front of a large audience

c. A series of lectures given by experts on a selected subject

d. Both b and c are correct

7. A series of meetings designed to convey specific instruction and information in particular areas of work is known as:

a. Institute

b. Symposium

c. Panel discussion

d. Group discussion

8. Symposium is:

a. A series of speeches on a selected subject by experts

b. Few qualified persons sit and discuss a given problem

c. A place where people learn by exchanging their views and experiences

d. A series of meetings, usually four or more with emphasis on individual work within the group, with the help of consultants and resource personnel

9. Flannel graph is:

a. A series of cards with illustrations pertaining to the talk is being displayed before a group

b. A piece of flannel fixed over a wooden board for displaying cut-out pictures, graphs, drawings

c. Nothing but films and charts

d. Nothing but pamphlets

10. Which one of the following is nonprojecting visual aid?

a. Flash cards

b. Flannel graph

c. Booklet

d. All of the above

11. The stage in "adoption of new ideas and practices" where a person weighs the pros and cons of the practices before adopting them is:

a. Trial
b. Evaluation
c. Interest
d. Awareness

12. The stage in "adoption of new ideas and practices" where a person is willing to listen or read or learn more about a new concept/practice is known as:

a. Evaluation
b. Interest
c. Trial
d. Adoption

13. School dental health programmes should include provisions for:

a. Dental health education
b. Dental care
c. A healthful environment
d. All of the above

14. The most effective means of education is:

a. Mass media
b. Pamphlets
c. Individual instruction
d. Lecture

15. Which of the following is most likely to lead to learning?

a. Participating in an experience
b. Watching a film
c. Dramatizing a situation
d. Reading a textbook

16. Visual aids in the dental office will be most effective, if they are:

a. Displayed prominently in the office

b. Used for “shock” effect
c. Used to illustrate specific points when talking with the patient
d. All of the above

17. The major role of the teacher in dental health education is to:

a. Lecture to students about dental health
b. Provide sufficient dental health education materials
c. Guide student’s behaviour materials in the desirable direction
d. Direct them to the dentist for needed dental care

18. Which among the following is NOT a type of communication method?

a. Didactic method
b. Socratic method
c. Democratic method
d. Verbal communication

19. Theta is:

a. Statistical method
b. Dental organization
c. Booklet of dental health education programme
d. Insurance plan

20. A series of speeches on a selected subject is:

a. Institute
b. Workshop
c. Symposium
d. Panel discussion

21. The most effective approach to promote public health is:

a. Service or administrative approach
b. Educational approach
c. Regulatory approach
d. All the above

22. The objectives of health education are:

a. To inform people about promotion of health and prevention of disease

b. To motivate people to change their habits and adopt healthy practices

c. To guide people into action so that they adopt and maintain healthy lifestyle and practices throughout their life

d. All the above

23. There is a basic desire to learn in each and every individual, awakening this desire is known as:

a. Education

b. Motivation

c. Stimulation

d. All the above

24. Mass media includes the following:

a. Newspapers and television

b. Audiovisual aids

c. Panel discussion and group discussion

d. Symposium and seminar

Chapter 6: Health Care Delivery Systems

1. **The term "comprehensive health care" was first used by:**
   a. Bhore Committee in 1946
   b. Mudaliar Committee in 1962
   c. Chadah Committee in 1963
   d. Mukerji Committee in 1965
2. **Which one is NOT the principle of primary health care?**
   a. Equitable distribution
   b. Community participation
   c. Appropriate technology
   d. Basic health services
3. **Which one of the following is correct about "National Strategy for Health for All by the year 2000"?**
   a. Reduction of infant mortality from the level of 125 to below 60
   b. To raise the expectation of life at birth from the level of 52 to 64 years
   c. To achieve a net reproduction rate of one
   d. All the above are correct
4. **The "Village Health Guide Scheme" was introduced:**
   a. On 2nd October 1977
   b. On 11th October 1977
   c. On 11th September 1977
   d. On 2nd September 1977
5. **The training for village health guides is given at:**
   a. PHC
   b. Subcentre
   c. MCH centre
   d. Both a and b are correct

6. The training for local dais is given at:

a. PHC
b. Subcentre
c. MCH centre
d. All of the above

7. The beneficiaries of ICDS scheme are:

a. Nursing mothers
b. Women of reproductive age
c. Children below the age of 6 years
d. All of the above

8. Primary health care is delivered in rural areas through:

a. PHC only
b. Subcentre only
c. Both a and b
d. None of the above

9. There should be one PHC to serve a population of:

a. 30,000 in the plains and 20,000 in hilly, tribal and backward areas
b. 5,000 in the plains and 3,000 in hilly, tribal and backward areas
c. 80,000 to 1.20 lakh irrespective of the areas
d. 10,000 to 20,000 in general

10. There should be one subcentre to serve a population of:

a. 30,000 in the plains and 20,000 in backward areas
b. 5,000 in the plains and 3,000 in the hilly, tribal and backward areas
c. 80,000 to 1.20 lakh in general
d. 10,000 to 20,000 in general

11. The following is an example of tertiary care level:

a. PHC
b. Subcentre

c. Community health centres

d. Regional or central level institutions

12. The principle of "placing people's health in people's hands" is achieved through:

a. Primary health care approach

b. National health programmes

c. Conducting health camps

d. Both b and c are correct

13. The number of medical officers required for community health centers is:

a. 1

b. 2

c. 3

d. 4

14. Employees State Insurance Scheme provides:

a. Medical and sickness benefit

b. Maternity benefit

c. Disablement benefit

d. All of the above

15. Central Government Health Scheme provides:

a. Domiciliary visit

b. Out patient care and supply of drugs

c. Hospitalization facilities

d. All of the above

16. The function of female health assistant in PHC is to:

a. Carry out supervisory house visit

b. Supervise immunization of all pregnant women and children (0–5 years)

c. Conduct MCH and family planning clinics and carry out educational activities

d. All of the above

17. The function of male health assistant in PHC is:

a. To refer all cases of blindness to MO of PHC

b. To collect, compile information about vital events and report to MO of PHC

c. To assist MO of PHC in organizing family planning camps

d. All of the above

18. The ICDS scheme was started in:

a. 1975

b. 1970

c. 1980

d. 1964

19. The rural population of India according to year 2000 is:

a. 74.2%

b. 78%

c. 38%

d. 84%

20. Adult literacy rate in India as per year 2001 is:

a. 55%

b. 75%

c. 65.38%

d. 60.38%

21. The population below 15 years of age as per year 2000 is:

a. 38.33%

b. 34.33%

c. 36.33%

d. 38.34%

22. The number of doctors available for 1,00,000 population in India is:

a. 48

b. 100
c. 135
d. 20

23. The number of nurses and midwives available in India per 1,00,000 population is:

a. 112
b. 5
c. 8.8
d. 45

24. The official birth of WHO was on:

a. 8th April 1948
b. 7th April 1948
c. 7th June 1948
d. 7th April 1945

25. 7th April every year is celebrated as:

a. No tobacco day
b. Doctors day
c. World health day
d. Mother's day

26. The WHO headquarters for South East Asia is at:

a. New Delhi
b. Harare
c. Manila
d. Singapore

27. The WHO headquarters for Europe is at:

a. Geneva
b. Copenhagen (Denmark)
c. Paris
d. Rome

28. The headquarters of WHO is at:

a. Geneva
b. New Delhi
c. Washington DC
d. Alexandria

29. The WHO headquarters for Western Pacific region is at:

a. Manila
b. Harare
c. Washington DC
d. Alexandria

30. The WHO headquarters for Africa is at:

a. Cairo
b. Harare
c. Botswana
d. Alexandria

31. The WHO headquarters for Eastern Mediterranean region is at:

a. Mecca
b. Medina
c. Cairo
d. Alexandria

32. The WHO headquarters for the Americans is at:

a. New York
b. California
c. Washington DC
d. St. Louis

33. UNICEF was established in the year:

a. 1946
b. 1948
c. 1945
d. 1949

34. The headquarters of the UNICEF is at:

a. New York
b. Boston
c. Miami
d. Florida

35. The process of restriction of movement of healthy individuals who come in contact with diseased persons is called:

a. Isolation
b. Quarantine
c. Active surveillance
d. None

36. The campaign known as GOBI is promoted by:

a. WHO
b. UNICEF
c. UNDP
d. FAO

37. The headquarters of Food and Agriculture Organization is at:

a. New York
b. Colombo
c. Manila
d. Rome

38. FAO's prime concern is:

a. To increase the production of food
b. To increase the literacy of women
c. To improve the maternal and child care
d. Worldwide immunization

39. The headquarters of International Labour Organization (ILO) is at:

a. Geneva
b. Cairo

c. New Delhi

d. Colombo

40. The US Government extends aid to India through:

a. United States Agency for International Development (USAID)

b. The Public Law 480 Programme

c. The US Export-Import Bank

d. All of the above

41. All India Institute of Hygiene and Public Health at Kolkata was established by the cooperation of:

a. Rockefeller Foundation

b. Ford Foundation

c. Care

d. International Red Cross

42. The founder of International Red Cross was:

a. Henry Dunant

b. Sir John Snow

c. John D Rocke Feller

d. Reed

43. The Indian Red Cross was established in:

a. 1929

b. 1930

c. 1920

d. 1925

44. The headquarters of International Red Cross is at:

a. Geneva

b. Rome

c. Copenhagen

d. Beijing

45. International Red Cross is an agency of:

a. Government of China

b. Common wealth agency
c. Government of USA
d. Non-political, non-governmental agency

46. "Colombo plan" is a plan of:

a. UNO
b. WHO
c. Common wealth countries
d. World Bank

47. World Bank is special agency of:

a. UNO
b. Government of USA
c. WHO
d. Government of UK

48. Hind Kusht Nivaran Sangh was founded:

a. In the year 1950
b. To control leprosy incidence and prevalence rate
c. To provide financial assistance to leprosy homes and clinics
d. All of the above

49. Tuberculosis Association of India was founded in:

a. 1952
b. 1938
c. 1939
d. 1942

50. Central Social Welfare Board was founded:

a. In August 1953
b. Promoting and setting up of social welfare organization
c. Initiated "family and child welfare services" in rural areas
d. All of the above

51. The headquarters of Family Planning Association of India is at:

a. New Delhi

b. Mumbai

c. Kolkata

d. Chennai

52. All India Blind Relief Society was established in:

a. 1945

b. 1946

c. 1950

d. 1952

53. All India Women's Conference Welfare:

a. Established in 1926

b. The only women's voluntary welfare organization

c. Its branches are running MCH clinics, medical centres, milk centres and family planning clinics

d. All of the above are correct

Chapter 7: Epidemiological Methods

1. **Tools of measurement in epidemiology are:**
   a. Rates and ratios
   b. Rates, ratios and proportions
   c. Rates and proportions
   d. Ratios and proportions
2. **If there had been 3,000 new cases of dental caries in a population of 30,000 in a year, then the incidence rate would be:**
   a. 50 per 1,000 per year
   b. 100 per 1,000
   c. 100 per 1,000 per year
   d. 50 per 1,000
3. **The relationship between prevalence and incidence is:**
   a. $P = I \times D$
   b. $I = P \times D$
   c. $P = I/D$
   d. $P = D/I$
4. **If the incidence rate is 10 cases per 1,000 population per year and the mean duration of disease is 5 years, then the prevalence is:**
   a. 50 per 1,000 population
   b. 500 per 1,000 population
   c. 25 per 1,000 population
   d. 100 per 1,000 population
5. **Observing the distribution of disease or health-related characteristics in human population with respect to time, place and person is known as:**
   a. Analytical epidemiology
   b. Descriptive epidemiology
   c. Experimental epidemiology

d. Intervention studies

6. Cross-sectional study is also known as:

a. Longitudinal study
b. Incidence study
c. Prevalence study
d. Follow-up study

7. The study which provides very little information about the natural history of disease or about the rate of occurrence of new cases is known as:

a. Field trials
b. Cohort study
c. Cross-sectional study
d. Incidence study

8. Longitudinal studies are useful:

a. To study the natural history of disease
b. For identifying risk factors of disease
c. For finding out incidence rate
d. All of the above

9. The epidemiological method which provide background data for planning, organizing and evaluating preventive and curative services is:

a. Analytical epidemiology
b. Experimental epidemiology
c. Descriptive epidemiology
d. Ecological studies

10. Case control studies are often called as:

a. Prospective studies
b. Retrospective studies
c. Follow-up studies
d. Ecological studies

11. Which one of the following is correct about case control method?

a. Both exposure and outcome have occurred before the start of the study
b. The study proceeds forward from cause to effect
c. Often referred as prospective study
d. Involves larger number of subjects

12. Which one of the following is correct about case control method?

a. The study is expensive
b. Long follow-up period is often needed
c. Yields incidence rates and attributable risk
d. It uses a control or comparison group

13. The process by which the controls are selected in such a way that they are similar to cases with regard to certain pertinent selected variables (e.g. age) is known as:

a. Randomization
b. Matching
c. Blinding
d. Fixing

14. The components of epidemiology are:

a. Disease frequency
b. Distribution of disease
c. Determinants of disease
d. All of the above

15. Cohort study is also known as:

a. Longitudinal study
b. Prospective study
c. Incidence study
d. All of the above

16. Which one of the following is correct about cohort study?

a. The cohorts are identified prior to the appearance of the disease

under investigation

b. The study proceeds backward from effect to cause

c. It uses a control or comparison group

d. Both exposure and outcome have occurred prior to the study

17. Cohort studies are indicated:

a. When there is good evidence of an association between exposure and disease exist

b. When exposure is rare, but the incidence of disease high among exposed

c. When follow-up is easy

d. All of the above

18. The basic approach in cohort studies is to work from:

a. Cause to effect

b. Effect to cause

c. Both a and b are correct

d. None of the above

19. Which one of the following is correct about cohort study:

a. Starts with the disease

b. Involves fewer number of subjects

c. Yields incidence rate

d. Relatively inexpensive

20. Pilot study is done to:

a. Find the feasibility in conducting study

b. Determine the sample size

c. Find the unknown effect

d. All of the above

21. The statistical procedure by which the participants are allocated into groups called “study” and “control” groups is known as:

a. Blinding

b. Randomization

c. Matching

d. None of the above

22. The loss of study individuals during the follow-up of the cohort study is known as:

a. Erosion

b. Attrition

c. Abrasion

d. Narrowing

23. The benefits of the experimental measure such as reduced incidence or severity of the disease can be termed as:

a. Negative results

b. Null results

c. Positive results

d. Bias

24. Any systematic error in the determination of the association between the exposure and disease is known as:

a. Attrition

c. Matching

b. Blinding

d. Bias

25. The trial that is so planned that neither the doctor nor the participant is aware of the group allocation and treatment received is known as:

a. Single blind trial

b. Double blind trial

c. Triple blind trial

d. Field trial

26. Which of the following is a type of randomized controlled trials:

a. Uncontrolled trials

b. Natural experiments

c. Before and after comparison studies

d. Clinical trials

27. The "unusual" occurrence of disease in a community clearly in excess of "expected occurrence" is known as:

a. Endemic
b. Epidemic
c. Sporadic
d. Pandemic

28. The constant presence of a disease within a given geographic area without importation from outside is referred as:

a. Epidemic
b. Pandemic
c. Exotic
d. Endemic

29. The occurrence of a disease in an irregular, haphazard and infrequent manner is known as:

a. Sporadic
b. Epidemic
c. Pandemic
d. Exotic

30. Disease affecting a larger portion of the population occurring over a wide geographic area such as a nation, continent or the world is known as:

a. Exotic
b. Pandemic
c. Endemic
d. Epidemic

31. When diseases imported into a country in which they do not otherwise occur is known as:

a. Exotic
b. Sporadic
c. Pandemic

d. Endemic

32. Transmission of infection from vertebrate animals to man is known is:

a. Anthropozoonoses
b. Zooanthroponoses
c. Amphixenoses
d. Epizootic

33. Transmission of infection from man to vertebrate animal is known as:

a. Anthropozoonoses
b. Amphixenoses
c. Zoonosis
d. Zooanthroponoses

34. Termination of the transmission of infection by extermination of the infectious agent through surveillance and containment is known as:

a. Eradication
b. Immunization
c. Elimination
d. Both a and c are correct

35. The level of resistance of a community or group of people to a particular disease is known as:

a. Active immunity
b. Passive immunity
c. Herd immunity
d. Combination of a and b

36. Experimental studies are:

a. Cohort and case-control studies
b. Prevalence and incidence studies
c. Randomized controlled trials and non-randomized trials
d. Both a and b are correct

37. Matching is done to:

a. Eliminate bias in sampling
b. Eliminate confounding factors
c. Collect data in pathfinder survey
d. Eliminate interviewer's bias

38. Picking every 5^{th} or 10^{th} unit at regular intervals is:

a. Random sampling
b. Systematic sampling
c. Stratified sampling
d. Quota sampling

39. Hypothesis is:

a. A theory
b. An experiment
c. A report
d. A supposition from an observation

40. Epidemiology is the study of:

a. Distribution and determinants of a disease in a population
b. Changes in lifestyle in a population
c. Study of aging in a population
d. None of the above

41. Risk factors related to dental caries are:

a. Bacteria, host susceptibility, food and time
b. Bacteria, periodontal disease, food
c. Host, time and gingival disease
d. None of the above

42. The total number of cases (old + new) of a specific disease in existence in a given population at a certain period of time or at a point of time is known as:

a. Incidence
b. Prevalence

c. Morbidity
d. None of the above

Chapter 8: Epidemiology of Oral Diseases

AETIOLOGY, PREVENTION AND EPIDEMIOLOGY OF PERIODONTAL DISEASE

1. **The carbohydrate present in the greatest amount in the matrix of supragingival plaque is:**
   a. Levan
   b. Galactose
   c. Dextran
   d. Methylpentose
2. **The non-bacterial portion of plaque is termed as:**
   a. Interbacterial matrix
   b. Intrabacterial matrix
   c. Extrabacterial matrix
   d. Intercellular matrix
3. **The principal inorganic components of the supragingival plaque matrix are:**
   a. Magnesium and potassium
   b. Potassium and sodium
   c. Magnesium and sodium
   d. Calcium and phosphorus
4. **The salivary immune component which is responsible in controlling the rate of supragingival plaque accumulation by preventing bacterial attachment is:**
   a. IgA
   b. IgG
   c. IgE
   d. IgM
5. **Prolonged use of mouthwash containing chlorhexidine causes**

dental stain of:

a. Yellowish brown to brown colour
b. Orange colour
c. Green colour
d. Yellowish green to green colour

6. The first bristle toothbrush appeared about the year 1500 AD in:

a. England
b. China
c. Egypt
d. Greece

7. The electrically powered toothbrushes were invented in:

a. 1939
b. 1938
c. 1942
d. 1964

8. In dentifrices, sodium lauryl sulfate and sodium lauryl sarcosinate are used as:

a. Abrasives
b. Thickening agents
c. Humectants
d. Detergents

9. In Bass method, the intrasulcus position of brush to long axis of tooth should be at an angle of:

a. 350°
b. 43°
c. 45°
d. 90°

10. The technique that can be recommended for temporary cleaning in areas of healing wounds following periodontal surgery is:

a. Bass method

b. Charters method
c. Modified Stillman method
d. Stillman method

11. Powered tooth brushes are recommended for:

a. Individuals lacking fine motor skills
b. Handicapped individuals
c. Both a and b are correct
d. Reasons that they are superior to manual brushes

12. Dental floss is recommended in:

a. Type I embrasures
b. Type II embrasures
c. Type III embrasures
d. Type IV embrasures

13. In type II embrasures, the recommended interdental cleanser is:

a. Unitufted brush
b. Prox-a-brush
c. Dental floss
d. Wooden tips

14. In type III embrasures, the recommended interdental cleanser is:

a. Wooden tips
b. Dental floss
c. Miniature bottle brush
d. Unitufted brush

15. The European formulation of mouthwash containing chlorhexidine is:

a. 0.2%
b. 0.12%
c. 0.3%
d. 0.5%

16. Subgingival calculus is referred as:

a. Internal calculus
b. Salivary calculus
c. Serumal calculus
d. Secretory calculus

17. Which among the following constitutes the highest % of the inorganic component of supragingival calculus?

a. Magnesium whitlockite
b. Brushite
c. Hydroxyapatite
d. Octacalcium phosphate

18. Which of the following is NOT a disclosing agent?

a. Merbromin
b. Mercurochrome
c. Aniline dyes
d. Copper sulphate dyes

19. In two-tone dyes, the older and newer plaques are stained:

a. Blue and red, respectively
b. Red and blue, respectively
c. Blue and green, respectively
d. Pink and blue, respectively

20. In which of the following disclosing agents, UV light is used to disclose the dental plaque?

a. Fast green
b. Fluorescein
c. Two-tone
d. Mercurochrome preparation

21. Which of the following is a disclosing agent?

a. Bismarck brown
b. Skinners solution
c. Plaklite

d. All of the above

22. Which disclosing solution stains only dental plaque?

a. Iodine solution

b. Aniline dyes

c. Red erythrosin

d. 1–3 tetrazolium compound with methylene blue

23. Soon after cleaning the tooth surface, the salivary mucoprotein that forms is the:

a. Materia alba

b. Plaque

c. Pellicle

d. Bacterial colony

24. Dental plaque of a person on a high protein, high fat and very low sucrose diet would be:

a. Dense, heavily infected with streptococci

b. Thin, structure less with few organisms

c. Dense, heavily stained but with few organisms

d. None of the above

25. The plaque matrix consists primarily of:

a. Dextrans

b. Levans

c. Trophans

d. Both a and b

26. A white coating, composed of microorganisms, dead epithelial cells and leucocytes, that is loosely adherent to the tooth and can be removed by water spray or rinsing is:

a. Dental plaque

b. Materia alba

c. Calculus

d. Acquired pellicle

27. Which of the following tooth brushing methods is destructive to both the hard and soft tissues?

a. Side-to-side
b. Roll
c. Bass
d. Up and down

28. The primary reason for using dental floss is to:

a. Remove calculus
b. Remove interdental plaque
c. Stimulate gingiva
d. Prevent cigarette stains

29. Gingivitis and periodontitis:

a. Occur at younger age groups
b. Increases with age
c. Associated with poor oral hygiene
d. Both b and c are correct

30. Periodontitis is significantly:

a. Lower in females
b. Higher in males
c. Higher in females
d. Both a and b are correct

31. Gingivitis occurs more commonly at:

a. Puberty
b. Pregnancy
c. Postmenopausal period
d. All of the above

32. Periodontal disease occurs more commonly in:

a. Asia
b. Africa
c. Australia and America

d. Both a and b are correct

33. Which among the following is/are associated with periodontal disease?

a. Dental plaque and calculus
b. Tobacco use
c. Betel-chewing
d. All of the above

34. Periodontitis is significantly:

a. Lower in females
b. Higher in females
c. Higher in males
d. Lower in males

35. Identify the habit associated with periodontal disease:

a. Pencil biting
b. Cigarette smoking
c. Mouth breathing
d. All of the above

36. Identify the microorganism causing periodontal disease:

a. Actinobacillus actinomycetemcomitans
b. Capnocytophaga
c. Fusobacterium
d. All of the above

37. Prevalence and severity of periodontal disease are:

a. Higher in rural areas
b. Lower in rural areas
c. Lower in urban areas
d. Both a and c are correct

38. Prevalence and severity of periodontal disease are:

a. Higher is South East Asian countries
b. Higher in Eskimos of Alaska

c. Higher in Ecuador, Columbia and Ethiopia

d. Higher in European countries

39. Within India, prevalence and severity of periodontal disease are higher in:

a. Chennai

b. Kerala

c. Punjab

d. Goa

40. Which among the following is associated with periodontal disease?

a. Vitamin C deficiency

b. Iron deficiency

c. Calcium deficiency

d. All of the above

41. Identify the habits associated with periodontal disease:

a. Unilateral mastication

b. Pipe smoking

c. Finger nail biting

d. All of the above

42. Most commonly affected teeth by periodontal disease are:

a. Upper molars

b. Lower premolars

c. Upper canines

d. Both b and c are correct

43. In the mandibular arch, the most commonly affected teeth by periodontal disease are:

a. Molars

b. Premolars

c. Incisors

d. Canines

44. For a right-handed individual, the prevalence and severity of

periodontal disease is higher:

a. On left half of the mouth
b. On right half of the mouth
c. No such concept
d. For gingivitis and not for periodontitis

45. Smoking causes:

a. Production of nicotine, carbon monoxide and hydrogen cyanide
b. Irritation of gingival tissues
c. Tissue ischaemia due to vasoconstriction
d. All of the above

46. Identify the factor associated with periodontal disease:

a. Nutritional deficiency
b. Poor oral hygiene
c. Lack of oral health awareness
d. All of the above

47. Mercury, lead and thallium produces:

a. Gingivitis
b. A dark line parallel to gingival margin
c. Alveolar bone resorption
d. All of the above

48. Vitamin C deficiency causes:

a. Gingivitis
b. Scurvy
c. Gingival hypertrophy
d. All of the above

49. The daily requirement of vitamin C is:

a. 200 mg/day
b. 30 mg/day
c. 150–200 mg/day
d. 200–250 mg/day

50. Identify the local factors responsible for periodontitis:

a. Traumatic occlusion
b. Plunger cusps
c. Food impaction
d. All of the above

51. Calcium deficiency causes:

a. Gingival inflammation
b. Increase in pocket depth
c. Alveolar bone resorption
d. All of the above

52. The anticalculus agent used in dentifrices is:

a. Pyrophosphate
b. Calcium carbonate
c. Silicate
d. Sodium chloride

53. Supragingival calculus is also referred as:

a. Serumal calculus
b. Salivary calculus
c. Secretory calculus
d. External calculus

54. Brushing the teeth in horizontal direction would cause:

a. Attrition
b. Erosion
c. Abrasion and recession
d. Corrosion

AETIOLOGY, PREVENTION AND EPIDEMIOLOGY OF DENTAL CARIES

1. Caries on the incisal edge of the anterior teeth or on the occlusal cusps of the posterior teeth are classified as:

a. Class-II
b. Class-Ia
c. Class-VI
d. Class-Va

2. Most caries susceptible teeth are:

a. U/L I permanent molars
b. U/L I primary molars
c. U/L II premolars
d. U/L primary canines

3. Most caries susceptible primary teeth are:

a. U/L I molars
b. U/L II molars
c. U/L central incisors
d. U/L canines

4. The commonly affected surfaces by caries in both the dentitions are:

a. Mesial surfaces
b. Smooth surfaces
c. Occlusal surfaces
d. Distal surfaces

5. In nursing bottle caries:

a. The lower anteriors are affected
b. The lower anteriors are spared
c. The upper anteriors are spared

d. Both a and c are correct

6. The specific gravity of enamel is:

a. 3
b. 0
c. 1.3
d. 2.8

7. The carious dentin is often stained:

a. Deep blue
b. Deep brown
c. Purple
d. Green

8. Arrested caries is:

a. Chronic dental caries
b. Eburnation of dentin
c. Secondary caries
d. Smooth surface caries

9. The proteolysis theory was given by:

a. Gottileb
b. Jenkins
c. Eggers-Lura
d. WD Miller

10. The normal salivary flow per day is:

a. <750 ml
b. 800–1500 ml
c. 1500 ml
d. 650–750 ml

11. The concentration of IgA in saliva averages about:

a. 6 mg%
b. 15 mg%
c. 1.5 mg%

d. 15–20 mg%

12. Which of the following is helpful in defensive mechanism against caries?

a. Lactoferrin

b. IgA

c. Lactoperoxidase

d. All of the above

13. The number of experimental groups used in Vipeholm study is:

a. 7

b. 6

c. 3

d. 4

14. Which of the following are believed to have caries protective factors?

a. Pyridoxine and tannic acid

b. Constituents of cocoa and chocolate

c. Fats and cheese

d. All of the above

15. Which among the following is cariogenic?

a. Strontium

b. Vanadium

c. Molybdenum

d. Selenium

16. Which among the following is cariogenic?

a. Fluorine

b. Phosphorous

c. Iron

d. Lead

17. Which among the following is cariogenic trace element?

a. Barium

b. Palladium
c. Magnesium
d. Aluminium

18. As temperature increases dental caries:

a. Decreases
b. Increases
c. Remains same
d. None of the above

19. The microorganism predominantly seen in pit and fissure caries is:

a. Lactobacillus acidophilus
b. Streptococcus mutans
c. Staphylococcus aureus
d. Capnocytophaga

20. According to WHO, the DMFT value of 1.2–2.6 at 12 years is categorized as:

a. Very very low
b. Very low
c. Low
d. Moderate

21. Identify the hydrolytic enzyme in saliva:

a. Lactoperoxidase
b. Lysozyme
c. Lactoferrin
d. IgM

22. Which of the following is NOT a significant factor for root caries?

a. Gingival recession
b. Actinomyces viscosus
c. Toothbrush abrasion
d. Dentifrice

23. The most effective method of preventing dental caries in general

population is:

a. Oral prophylaxis
b. Community water fluoridation
c. Diet counselling
d. Fluoridated dentifrices

24. In the relationship between carbohydrates intake and caries, which of the following factors is least important?

a. Quantity ingested
b. Frequency of ingestion
c. Physical form of carbohydrates
d. Time of ingestion

25. Which of the following sugars contribute least to dental caries?

a. Fructose
b. Galactose
c. Sucrose
d. Xylitol

26. A simple method of educating children to the problem of caries control is:

a. Snyder's test
b. Enamel solubility test
c. Disclosing solution
d. Using microscope to examine plaque

27. An incipient carious lesion on an interproximal surface is usually located:

a. At contact area
b. Gingival to contact area
c. Facial to contact area
d. Lingual to contact area

28. Which of the following is least cariogenic?

a. Sucrose

b. Fructose

c. Lactose

d. Glucose

29. Clinically the earliest evidence of caries is:

a. Brown area on tooth surface

b. Roughness on tooth surface

c. Chalky white area on tooth surface

d. Sensitivity to sweets

30. Caries involving the proximal surface and incisal angle of an anterior tooth is:

a. Class-I

b. Class-III

c. Class-IV

d. Class-V

31. Caries involving the proximal surface and facial surface of an anterior tooth is:

a. Smooth surface caries

b. Class-IV

c. Class-V

d. Class-VI

32. Which tooth in the deciduous dentition is the most susceptible to dental caries?

a. Maxillary 1^{st} molar

b. Maxillary 2^{nd} molar

c. Mandibular 1^{st} molar

d. Mandibular 2^{nd} molar

33. The main culprit in producing root surface caries is:

a. Actinomyces

b. Streptococcus

c. Pneumococcus

d. Lactobacillus

34. In caries progression, the component destroyed first is:

a. The organic component
b. Inorganic component
c. Both destroyed simultaneously
d. Intermittently organic and inorganic

35. The principle buffer in the saliva is:

a. Carbonates
b. Bicarbonates
c. Phosphates
d. Ornithine

36. When the plaque pH is 5, the enamel solubility:

a. Increases
b. Decreases
c. Unchanged
d. None of the above

37. Which is the most important organism in the progression of caries in the dentin?

a. Streptococcus mutans
b. Streptococcus sanguis
c. Lactobacillus
d. Actinomyces

38. Remineralising properties of saliva can be enhanced by:

a. Topical application of fluorides
b. Keeping the mouth free of plaque
c. Rinsing with NaF mouthrinse
d. All of the above

39. Which of the following is NOT true?

a. Increased sugar consumption at meal time produces no increase in caries

b. Caries increment is linked to physical form of carbohydrates consumed

c. Following sugar intake, plaque pH falls to 4.5–5

d. This fall in plaque pH occurs in about 30 minutes

40. The anticariogenic component of crevicular fluid is:

a. IgG

b. T and B lymphocytes

c. Complement

d. IgM

41. A carious lesion will cause pain when irritants or acids reach:

a. Enamel

b. Dentin

c. DEJ

d. Pulp

42. Streptococci produce lactic acid from glucose by:

a. Tricarboxylic acid cycle

b. Embden-Meyerhof pathway

c. Oxidative phosphorylation

d. Hexokinase reaction

43. Which caries susceptibility test is based on the quantitative detection of microorganisms in saliva?

a. Snyder's test

b. Salivary reductase test

c. Lactobacillus test

d. Enamel solubility test

44. For American Blacks and Whites living in the same geographic area under similar conditions:

a. Blacks show fewer carious lesions

b. Whites show fewer carious lesions

c. Both show same number of lesions

d. Both show no carious lesions

45. Earliest carious teeth have been revealed in:

a. Dolichocephalic skulls from neolithic period
b. Brachycephalic skulls from neolithic period
c. Brachycephalic skulls from pre-neolithic period
d. Dolichocephalic skulls from pre-neolithic period

46. Caries in enamel do not cause any pain because:

a. Mineral content of enamel is high
b. Enamel does not have any nerve supply
c. The occlusal enamel is very thick
d. None of the above

47. Best ages for the application of fissure sealants in children are:

a. 6–12
b. 3–9
c. 9–14
d. Above 18

48. The 3rd generation pit and fissure sealants are:

a. Autopolymerising
b. UV light cured
c. Visible light cured
d. None

49. Sealant application by dentists falls under which level of prevention:

a. Primary
b. Secondary
c. Tertiary
d. All of the above

50. The critical pH is about:

a. 4.5
b. 5.5

c. 6.5

d. 3.5

51. Which type of lasers are usually used for fissure sealing?

a. Er: YAG

b. CO_2

c. HeNe

d. Diode

52. It is necessary to brush at night because:

a. Salivary flow is greatly increased

b. Salivary flow is greatly reduced

c. Sleep allows greater remineralization

d. None of the above

53. Which among the following is/are associated with dental caries?

a. Familial heredity

b. Emotional disturbance

c. Total hardness of water

d. All of the above

54. Enamel etched by a tooth conditioner but not covered with a fissure sealant will:

a. Remineralize within a month

b. Remineralize within 3 months

c. Discolour the tooth

d. Leave the tooth more susceptible to caries

55. Which of the following is the primary cause of tooth loss among school children?

a. Periodontal disease

b. Malocclusion

c. Accident

d. Dental caries

56. The ultimate responsibility for the prevention and control of dental

disease rests with:

a. Public health agencies
b. School
c. Dentists
d. Parents

57. Most effective toothbrush for caries control should have:

a. Round cut ended bristles
b. Soft textured nylon bristles
c. Straight cut ended bristles
d. Both a and b are correct

58. Which of the following is NOT a disaccharide?

a. Sucrose
b. Maltose
c. Lactose
d. Fructose

59. Which of the following are signs of dental caries?

a. Discolouration
b. Decalcification
c. Loss of translucency
d. All of the above

60. The loss of teeth is termed:

a. Tooth morbidity
b. Tooth mortality
c. Oral death
d. Pathos

61. A 10-year-old child is found to have 2 filled deciduous teeth, 2 missing 3rd molars, 3 permanent teeth with active carious lesions and 1 permanent 1st molar missing. What would be the DMF score?

a. 8

b. 3

c. 4

d. 12

62. Acidogenic bacteria survive and produce acid best in dental plaque which is rich in:

a. Mannose

b. Fructose

c. Sucrose

d. Maltose

63. In order to reduce caries levels, diet modifications should be directed towards:

a. High fat intake

b. Fruits and detergent foods

c. Reduction of refused carbohydrates in take

d. None

64. Caries-causing microorganisms are cultured in a laboratory normally at:

a. 14°C

b. 20°C

c. 37°C

d. 52°C

65. The culture medium used in the LA colony count test is:

a. Tomato agar

b. Bromocresol green

c. Glucose agar

d. Rabbit heart broth

66. Vitamin A deficiency during tooth development may result in defective formation of:

a. Enamel

b. Dentin

c. Pulp

d. Cementum

67. Artificial sweeteners are:

a. Lactose, saccharin, xylitol

b. Sorbitol, mannitol, xylitol

c. Fructose, lactose, saccharin

d. None of the above

68. Which of the following is NOT considered a host factor for dental caries?

a. Sex

b. Race

c. Age

d. Bacteria

69. In calorimetric Snyder's test, the indicator dye used is:

a. Methyl blue

b. Methyl red

c. Bromocresol green

d. Diazoresorcinol

70. If green colour sustains at the end of 72 hours in Snyder's test, then the patient's caries susceptibility is:

a. Markedly carious

b. Definitely carious

c. Caries inactive

d. Limitedly carious

71. Dye used in salivary reductase test is:

a. Bromocresol green

b. Diazoresorcinol

c. Basic fuchsin

d. Bismarck brown

72. Appearance of red colour in 15 minutes in salivary reductase test

indicates that the individual is:

a. Non-conducive to caries
b. Highly conducive to caries
c. Moderately conducive to caries
d. Slightly conducive to caries

73. Vipeholm study is related to:

a. Diet
b. Fluorosis
c. Oral cancer
d. Periodontal disease

74. The organisms involved in the initiation of caries is:

a. Streptococcus mutans
b. Lactobacillus acidophilus
c. Actinomyces
d. Staphylococcus aureus

75. The organisms involved in the lateral spread of caries is:

a. Streptococcus mutans
b. Lactobacillus acidophilus
c. Actinomyces
d. Capnocytophaga

76. In primary dentition, the prevalence of dental caries is higher among:

a. Girls
b. Boys
c. Equal in boys and girls
d. None of the above

77. Prevalence of dental caries is lesser in Asian and African groups as compared to Caucasoid group:

a. True
b. False

c. Reverse is true

d. None of the above

78. "Concordance for carious sites in monozygotic twins is much higher than in dizygotic twins" this statement is:

a. False

b. True

c. Reverse is true

d. None of the above

79. As the latitude increases, the prevalence of dental caries:

a. Decreases

b. Increases

c. No relation with latitude

d. None of the above

80. "An inverse relationship exist between mean daily sunshine hours and dental caries", this statement is:

a. No such relationship

b. False

c. True

d. None of the above

81. As one travels down from head waters of river to its mouth, the prevalence of dental caries:

a. Decreases

b. Remains same

c. Increases

d. None of the above

82. In permanent dentition, the prevalence of dental carries is higher in:

a. Boys

b. Girls

c. Same in boys and girls

d. None of the above

83. As one travels from inland areas to coastal areas, prevalence of dental caries:

a. Increases
b. Decreases
c. Remains same
d. None of the above

84. Prevalence of dental caries increases when:

a. Relative humidity decreases
b. Relative humidity increases
c. No relation with relative humidity
d. None of the above

85. Green colour at the end of 72 hours in Synder's test indicates that the patient's caries susceptibility is:

a. Slight
b. Moderate
c. High
d. Nil

86. Prophylactic odontomy termed by:

a. Bowen in 1965
b. Hyatt in 1923
c. Bowen in 1960
d. Muhler in 1968

87. Risk factors related to dental caries are:

a. Bacteria, host susceptibility, food and time
b. Bacteria, periodontal disease, food
c. Host, time and gingival disease
d. None of the above

AETIOLOGY, PREVENTION AND EPIDEMIOLOGY OF ORAL CANCER

1. In the global scenario, the incidence of oral cancer is very high particularly in:

a. India
b. Sri Lanka
c. UK
d. Both a and b are correct

2. Incidence of oral cancer is high among:

a. Men
b. Women
c. No predilection for sex
d. 20–30 years age group

3. In South and Eastern India, the most commonest site of occurrence of oral cancer is in:

a. Tongue
b. Buccal mucosa
c. Palate
d. Labial mucosa

4. Older age shows increase incidence in carcinoma whereas the younger age shows increase in sarcoma:

a. True
b. False
c. No such concept
d. None of the above

5. 90 to 95% of all oral cancers are:

a. Verrucous carcinoma
b. Squamous cell carcinoma
c. Basal cell carcinoma

d. Carcinoma in situ

6. The use of Khaini is widespread in:

a. Maharashtra
b. Tamil Nadu
c. Kerala
d. Andhra Pradesh

7. The use of Mainpuri tobacco is widespread in:

a. Kerala
b. Uttar Pradesh
c. Andhra Pradesh
d. Pondicherry

8. The use of Hookli is common in:

a. Bhavnagar district of Gujarat
b. Tamil Nadu
c. Pondicherry
d. Andaman and Nicobar Islands

Chapter 10: Introduction to Dental Public Health

2. The slogan "a clean tooth never decays" was given by:

a. ML Rhein
b. Walter Reed
c. J Leon Williams
d. Manmoth

3. Who discovered and coined the word Colarado stains?

a. GM Wright
b. Fredrick Mckay
c. Alfread C Fones
d. Ebersole

4. The first training school for dental nurses came into existence in New Zealand in Willington in:

a. 1920
b. 1922
c. 1919
d. 1921

5. The founder of dental nurses scheme is:

a. TA Hunter
b. GM Wright
c. Rhazes
d. Jenkins

6. Who is considered as the "father of dental hygiene"?

a. Dr Black and McKay
b. Dr Ebersole
c. Dr TA Hunter
d. Dr Alfred Civilian Fones

7. Dental hygienists course was started by Dr Alfred C Fones in the

year:

a. 1913
b. 1914
c. 1920
d. 1915

8. The element fluorine was identified as the "mysterious factor" responsible for mottling of enamel by:

a. Churchill HV in 1931
b. JM Eager in 1902
c. Churchill HV in 1930
d. GV Black in 1931

9. The first dental college in India was established by:

a. Alfred C Fones in Ahmedabad
b. Dr R Ahmed in Calcutta
c. Dr AL Mudaliar is Madras
d. Dr Clive in Calcutta

10. Dentist Act of India was enacted in:

a. 1949
b. 1950
c. 1947
d. 1948

11. Tools of dental public health are:

a. Epidemiology, biostatistics and social sciences
b. Principles of administrations and preventive dentistry
c. All of the above
d. None of the above

12. The objectives of epidemiology are:

a. To define the magnitude and occurrence of disease conditions in man
b. To identify the aetiological factors

c. To provide data for planning, implementation and evaluation of programmes aimed at preventing, controlling and treating diseases

d. All of the above

13. Social sciences includes:

a. Sociology and anthropology

b. Psychology, economics, and political science

c. Geography and History

d. All of the above

14. The first step in dental public health is:

a. Analysis

b. Programme planning

c. Programme appraisal

d. Survey

15. Survey is basically the same as:

a. Diagnosis

b. Examination

c. Treatment

d. Evaluation

16. Analysis is similar to:

a. Examination

b. Diagnosis

c. Treatment planning

d. Evaluation

17. “Programme operation” in community health care is same as:

a. Approval

b. Treatment

c. Treatment planning

d. Diagnosis

18. Principles of administration includes:

a. Organization and management
b. Management alone
c. Planning and evaluation
d. Evaluation alone

19. Who suggested the formation of a subspeciality of the dental profession called "dental hygienists"?

a. CM Wright
b. Dr Alfred C Fones
c. Rochester
d. Churchill

20. The first dental college in India was started in:

a. 1920
b. 1926
c. 1936
d. 1931

21. In 18^{th} century, dental treatment was mainly provided by:

a. Priests
b. Monks
c. Barbers
d. None of these

22. Which of the following is NOT a part of behavioural science?

a. Social psychology
b. Sociology
c. Economics
d. Social anthropology

23. Testing for infection or disease in populations or in individuals who are not seeking health care is:

a. Diagnosis
b. Case-finding
c. Screening

d. Case looking

24. The use of clinical and/or laboratory tests to detect disease in individuals seeking health care for other reasons is:

a. Screening

b. Case-finding

c. Diagnostic test

d. None of the above

Chapter 12: Indices for Oral Diseases

1. **The property that an index must measure what it is intended to measure is known as:**
   a. Clarity
   b. Validity
   c. Acceptability
   d. Sensitivity
2. **The property that an index should measure consistently at different times and under a variety of conditions is known as:**
   a. Quantifiability
   b. Sensitivity
   c. Validity
   d. Reliability
3. **The property of an index which makes it amenable to statistical analysis is known as:**
   a. Reliability
   b. Quantifiability
   c. Sensitivity
   d. Validity
4. **The property of an index which reasonably detects the small shifts in either direction in the disease condition is known as:**
   a. Sensitivity
   b. Validity
   c. Reliability
   d. Clarity
5. **Gingival index is an example of:**
   a. Irreversible index
   b. Cumulative index
   c. Simplified index

d. Reversible index

6. DMF Index is an example of:

a. Irreversible index
b. Cumulative index
c. Both a and b are correct
d. None of the above

7. Plaque index is an example of:

a. Reversible index
b. Simple index
c. Both a and b are correct
d. None of the above

8. The score 1.3–3.0 in OHI-S denotes that the oral cleanliness of the individual is:

a. Excellent
b. Good
c. Fair
d. Poor

9. The index teeth examined in OHI-S are:

a. 16, 11, 26, 36, 31, 46
b. 16, 11, 25, 35, 31, 46
c. 16, 12, 25, 36, 31, 46
d. 16, 11, 26, 36, 32, 45

10. The drawback of Russell's periodontal Index is/are:

a. Scores are overlapping
b. Lack of clarity over criteria
c. Underestimation of periodontal condition
d. All of the above

11. On inserting the CPITN probe into periodontal pocket, if the gingival margin is situated on the black area of the probe, then the score given is:

a. 1
b. 2
c. 3
d. 4

12. On inserting the CPI probe to the bottom of the periodontal pocket, which covers the entire black area of the probe indicates that the pocket depth is:

a. Less than 5.5 mm
b. Equal to or more than 5.5 mm
c. Less than 3.5 mm
d. Between 3.5 and 5.5 mm

13. The diameter of the ball end of the CPI probe is:

a. 0.4 mm
b. 0.6 mm
c. 0.5 mm
d. 1 mm

14. The CPITN probe that is used in clinical examination is called as:

a. CPITN-C probe
b. CPITN-E probe
c. PPITN-A probe
d. CPITN-B probe

15. Which among the following has a greater bactericidal effect on plaque bacteria:

a. Acidulated phosphate fluoride
b. Sodium fluoride
c. Stannous fluoride
d. Strontium fluoride

16. In Russell's Periodontal Index, when there is early notch-like resorption of the alveolar crest is seen in radiograph, the score given is:

a. 0

b. 1

c. 3

d. 4

17. In gingival index, when there is tendency to spontaneous bleeding, the score given is:

a. 1

b. 2

c. 3

d. 4

18. In gingival index, when the gingival scores fall between 2.1 and 3.0, then the condition is referred as:

a. Mild gingivitis

b. Severe gingivitis

c. Moderate gingivitis

d. Simple gingivitis

19. When a continuous heavy band of subgingival calculus around the cervical portion of the tooth is determined, the score given for the calculus component of the OHI-S is:

a. 3

b. 0

c. 2

d. 1

20. The probe that is used for recording OHI-S is:

a. Naber’s probe

b. Shepherd’s hook

c. Florida probe

d. Pig tail probe

21. Oral hygiene index was simplified in the year:

a. 1960

b. 1961

c. 1964

d. 1963

22. OHI was developed by:

a. Greene and Vermillion

b. Silness and Loe

c. Ramfjord

d. Russell

23. Silness and Loe developed Plaque index in the year:

a. 1960

b. 1963

c. 1964

d. 1965

24. Russell's periodontal index was introduced in the year:

a. 1949

b. 1952

c. 1956

d. 1959

25. In CPITN:

a. 3^{rd} molars are included

b. 3^{rd} molars are not included

c. 3^{rd} molars included when they are functioning in place of 2^{nd} molars

d. None of the above

26. Number of index teeth examined in CPITN for individuals below 20 years is:

a. 10

b. 6

c. 8

d. 12

27. In CPITN, when children below the age of 15 are examined:

a. Pocket depth not recorded
b. Bleeding on probing included
c. Subgingival calculus recorded
d. All the above

28. The CPITN probe was introduced in the year:

a. 1980
b. 1978
c. 1984
d. 1990

29. While using CPITN probe, the maximum sensing force allowed is:

a. 30 grams
b. 20 grams
c. 35 grams
d. 30–50 grams

30. When the loss of attachment is 4–5 mm, the score given is:

a. 1
b. 2
c. 3
d. 4

31. When the CEJ is between 8.5 mm and 11.5 mm then the loss of attachment score is:

a. 1
b. 2
c. 3
d. 4

32. CPITN was developed by:

a. Greene and Vermillion
b. J Ainamo et al
c. Berger et al
d. Dean et al

33. In Russell's periodontal index, when inflammation completely circumscribing the tooth, but there is no apparent break in the epithelial attachment then the score given is:

a. 1
b. 2
c. 6
d. 8

34. Which of the following scores are missing in Russell's periodontal index?

a. 3 and 5
b. 3 and 7
c. 6 and 8
d. 3, 5 and 7

35. Which one is NOT an ideal requisite of an index?

a. Validity
b. Simplicity
c. Quantifiability
d. Quantity

36. In dentition status and treatment need, the permanent tooth missing due to caries is coded as:

a. 3
b. 4
c. 5
d. 6

37. In dentition status and treatment need, the permanent tooth having permanent restoration with decay is coded as:

a. 1
b. 3
c. 5
d. 2

38. In dentition status and treatment need, the permanent tooth

serving as bridge abutment is coded as:

a. 7
b. 5
c. 3
d. 2

39. In dentition status and treatment need, when the tooth requires pulp care and restoration, the code given is:

a. 2
b. 3
c. 4
d. 5

40. In dentition status and treatment need, the score 6 is given under treatment column for:

a. Veneer/laminate
b. One surface filling
c. Extraction
d. Crown for any reason

41. In dentition status and treatment need, the score "F" is given under treatment column for:

a. Fissure sealant
b. Fluoride application
c. Formocresol pulpotomy
d. To be filled

42. When a notch-like resorption is detected in the radiograph, the score in Russell's Periodontal Index given is:

a. 0
b. 2
c. 4
d. 6

43. In CPITN probe, the colour coding is done between:

a. 5.5 and 8.5 mm
b. 3.5 and 5.5 mm
c. 8.5 and 11.5 mm
d. 0.5 and 3.5 mm

44. deft and defs index was given by:

a. Gruebbel AO
b. Ainamo et al
c. Klein
d. Palmer

45. DMFT and DMFS index was given by:

a. Henry Klein
b. Carole E Palmer
c. Knutson JW
d. All of the above

46. The DMFT score for 5 individuals are 0, 0, 1, 2, and 2. Find the group average:

a. 0.5
b. 1
c. 2
d. 3

47. Which one of the following is NOT an index used for oral hygiene assessment?

a. OHI
b. OHI-S
c. PHP
d. Stone's index

48. Which one of the following is NOT used for assessing gingival inflammation?

a. PMA index
b. Gingival index

c. Moller's index

d. None of the above

49. In which one of the following index, disclosing agent is not used:

a. Patient hygiene performance index

b. Plaque component of periodontal disease index

c. Turesky-Gilmore-Glickman modification of Quigley Hein plaque index

d. Plaque index (PI)

50. The indicator teeth used in the Ramfjord index are:

a. 11, 16, 26, 31, 36, 46

b. 16, 21, 24, 36, 41, 44

c. 11, 16, 21, 26, 36, 46

d. 11, 14, 21, 24, 36, 46

51. The P1 and PDI measures:

a. Dental caries

b. Periodontal diseases

c. Dental fluorosis

d. None of the above

52. PMA is:

a. Caries index

b. Materia alba index

c. An index to assess gingival inflammation

d. Pulp capping index

53. Examination of a 7-year-old child revealed 6 deciduous teeth with active carious lesions, 4 missing 3rd molars, 1 deciduous and 1 permanent tooth missing and 1 filled permanent tooth. The 'df' Index score for this child is:

a. 13

b. 9

c. 7

d. 6

54. An index for assessment of dental fluorosis was introduced by Trendley H Dean in:

a. 1930

b. 1931

c. 1934

d. 1938

55. The markings missing in Williams's periodontal probe are:

a. 2 and 4

b. 4 and 6

c. 3 and 6

d. 5 and 7

56. Which of the following is NOT a caries index?

a. Moller's index

b. Stone's index

c. CPI

d. RC index

57. Russell's periodontal index is used:

a. To measure the amount of calculus

b. To measure the presence or absence of gingival inflammation and pocket formation

c. To measure the bone loss

d. None

58. In general, uses of indices are/is:

a. To study and record oral health status of people

b. To study the incidence and prevalence of disease

c. For comparison nationally and internationally

d. All of the above

59. Quigley-Hein index is used to assess:

a. Calculus

b. Dental caries
c. Dental plaque
d. Gingival condition

60. DMF index is not used in:

a. Epidemiological surveys
b. Prevalence studies
c. In diagnosing early caries lesions
d. All of the above

61. The following index is used to assess periodontal condition:

a. DMF index
b. PMA index
c. PDI index
d. OHI-S

62. CPITN index is by:

a. Klein
b. Aniamo
c. Schour and Massler
d. None of the above

63. PMA index is used to record the status of:

a. Gingival disease
b. Carious teeth
c. Root caries
d. Periodontal disease

Chapter 13: Planning, Survey and Evaluation

1. **The purpose of planning is:**
   a. To match the limited resources with many problems
   b. To eliminate wasteful expenditure
   c. To develop best course of action to reach the aim
   d. All of the above
2. **Planning includes:**
   a. Plan formulation
   b. Execution
   c. Evaluation
   d. All of the above
3. **Resources implies:**
   a. Manpower and money
   b. Material and skills
   c. Knowledge, techniques and time
   d. All of the above
4. **The sequence of activities designed to implement policies and accomplish objectives is called as:**
   a. Programme
   b. Schedule
   c. Plan
   d. None of the above
5. **The first step in health planning is:**
   a. Establishment of objectives and goals
   b. Fixing priorities
   c. Assessment of resources
   d. Analysis of the health situation
6. **The day-to-day follow-up of activities during the implementation**

of health programme is known as:

a. Evaluation
b. Monitoring
c. Re-evaluation
d. Management

7. **The purpose of evaluation is:**

a. To assess the achievement of the objectives of a programme
b. To assess the adequacy, efficiency of a programme
c. To assess the acceptance of a programme
d. All of the above

8. **The first step in evaluation is:**

a. Planning the methodology
b. Gathering information
c. Determine what is to be evaluated
d. Establishment of standards and criteria

9. **The "appropriateness" of the health services is known as:**

a. Adequacy
b. Accessibility
c. Relevance
d. Acceptability

10. **The Quarantine Act was promulgated in British India in the year:**

a. 1825
b. 1850
c. 1900
d. 1920

11. **Birth and Death Registration Act was promulgated in British India in:**

a. 1850
b. 1873
c. 1888

d. 1890

12. The first All India (British India) Census was taken in the year:

a. 1873

b. 1888

c. 1881

d. 1890

13. The Indian Research Fund Association (Indian Council of Medical Research) was established in:

a. 1910

b. 1912

c. 1913

d. 1911

14. The All India Institute of Hygiene and Public Health, Calcutta was established in the year:

a. 1911

b. 1920

c. 1930

d. 1940

15. India joined the WHO as a member state in the year:

a. 1946

b. 1950

c. 1954

d. 1948

16. The south East Asia Regional office of the WHO was established in New Delhi in the year:

a. 1948

b. 1949

c. 1950

d. 1951

17. Initially, the community dentist studies:

a. The needs and demands of the community in relation to dental health

b. The availability of natural resources

c. The economic status of the people in a community

d. Both b and c are correct

18. In public health administration “resources” means:

a. Man power

b. Materials

c. Finance

d. All of the above

SURVEY PROCEDURES

1. An investigation in which information is systematically collected, but in which experimental method is not used is known as:

a. Survey
b. Screening
c. Case finding
d. Clinical trial

2. The sampling technique used in path finder survey is:

a. Random sampling
b. Snow ball sampling
c. Quota sampling
d. Stratified cluster sampling

3. Which of the following are WHO recommended index ages and age groups?

a. 12, 15, 35–44 and 65–74
b. 5, 12, 15, 35–44 and 65–74
c. 35–44 and 15
d. 12, 15 and 65–74

4. The WHO index age "5 years" is important:

a. To assess caries levels in primary dentition
b. To assess gingival status
c. To assess oral hygiene status
d. To assess caries level in permanent molars

5. The WHO index age "12 years" is important:

a. To assess caries prevalence in 10 dentition
b. To assess caries levels in permanent dentition
c. To assess oral hygiene status
d. To assess subgingival calculus

6. The WHO Index age groups "35–44 years" are important:

a. To assess dental caries
b. To assess periodontal involvement
c. To assess the general effects of care provided
d. All of the above

7. The first step in survey procedures is:

a. Selecting the sample
b. Designing the investigation
c. Establishing the objectives
d. Conducting the examination

8. Calibration is:

a. A method to achieve intra-examiner consistency
b. A method to achieve inter-examiner consistency
c. Training of examiners to produce consistent clinical judgments
d. All are correct

9. The type of examination done in epidemiological survey is:

a. Type I
b. Type II
c. Type III
d. Type IV

10. The type of examination followed to discover the children who need treatment is:

a. Type I
b. Type II
c. Type III
d. Type IV

11. Pathfinder survey is based on:

a. Simple random sampling
b. Systematic random sampling
c. Multistage sampling
d. Stratified cluster sampling

12. A pilot study is:

a. Carried out on small scale before the main survey
b. Carried out together with main survey
c. Carried out after the main survey
d. None of the above

Chapter 14: Dental Auxiliaries

1. **The first professional dental journal was:**
   a. The American Journal of Dental Science
   b. The European Journal of Dental Science
   c. Canes Research
   d. Journal of Public Health
2. **A person licensed to practice dentistry under the law of appropriate state, province, territory or nation is:**
   a. School dental nurse
   b. Dental therapist
   c. Dentist
   d. Laboratory technician
3. **The idea of formation of subspecialty for dental hygienist was suggested first by:**
   a. CM Wright in 902
   b. DD Smith in 1900
   c. AC Fones in 1905
   d. Mrs Irene New Man
4. **Which one of the following is a non-operating auxiliary?**
   a. School dental nurse
   b. Dental therapist
   c. Dental laboratory technician
   d. Dental hygienist
5. **Which one of the following is an operating auxiliary?**
   a. Dental surgery assistant
   b. EFDA
   c. Dental therapist
   d. Both b and c are correct

6. **Sterilization care and preparation of instruments are the works of:**
   a. Dental laboratory technician
   b. Dental surgery assistant
   c. Dental hygienists
   d. Dental therapists
7. **The art of seating both the dentist and the dental assistant in a way that both are within easy reach of the patient's mouth is:**
   a. EFDA
   b. Four-handed dentistry
   c. Principles of administration
   d. Helper dentistry
8. **Dental laboratory technician is known as:**
   a. Non-operating auxiliary
   b. Dental mechanic
   c. Dentist
   d. All of the above
9. **The person who is permitted to diagnose, to plan and to carry out certain specified preventive and treatment measure without the supervising dentist is:**
   a. School dental nurse
   b. Dental therapist
   c. Dental hygienist
   d. EFDA
10. **Which of the following is NOT a duty of school dental nurse?**
   a. Oral examination
   b. Oral prophylaxis
   c. Topical fluoride application
   d. Extraction of secondary teeth
11. **Dental therapists are otherwise called as:**
   a. EFDA

b. New cross auxiliaries
c. Dental licentiate
d. Dental aide

12. EFDA is:

a. Expanded function dental assistant
b. Expanded function dental hygienist
c. Expanded function auxiliary
d. All of the above

13. Expanded function dental auxiliary is also known as:

a. Technotherapist
b. Expanded duty dental auxiliary
c. Expanded function dental assistant
d. All of the above

14. Which of the following is the duty performed by EFDA?

a. Placing and removing matrix band
b. Fitting and removing orthodontic bands
c. Removing sutures
d. All of the above

15. Other forms of dental auxiliaries are:

a. Frontier auxiliaries
b. Dental licentiate
c. Dental aide
d. All of the above

16. Utilization of dental care is:

a. Lowest for children below 5 years
b. Lowest for persons above 65 years
c. More in females than males
d. All of the above are correct

17. Utilization of dental care depends on factors like:

a. Income

b. Age and sex
c. Occupation
d. All of the above

Chapter 16: Payment for Dental Care

1. **Delta dental plan is:**
   a. Post-payment plan
   b. Private fee for service
   c. Capitation plan
   d. Non-profit health service corporations
2. **Post-payment plan is otherwise called:**
   a. Delta dental plan
   b. Budget payment plan
   c. Third party prepayment plan
   d. Capitation
3. **The portion of the cost of the dental service that a patient pays is called:**
   a. Deductible
   b. Budgeting
   c. UCR fee
   d. Fee schedule
4. **90^{th} percentile is followed in:**
   a. UCR fee
   b. Capitation plan
   c. Delta dental plan
   d. Salary
5. **Medicare is:**
   a. For people aged 65 and above
   b. For children below 18 years
   c. Voluntary health organization
   d. None of the above
6. **Medicaid is:**

a. For adults aged 65 and above
b. For children below 18 years
c. Capitation plan
d. Voluntary health organization

7. Third party payment in dentistry refers to the financial arrangements between:

a. A dentist and a carrier
b. An individual and a dentist
c. Individuals
d. None of the above

8. Dental insurance is a:

a. Protective measure
b. Contract
c. Policy
d. None

9. Payment of a fixed monthly income to a dental surgeon for all dental care rendered to the employees of that organization is known as:

a. Capitation
b. Salary
c. UCR fee
d. Fee schedule

10. An advantage of group dental practice over individual practice is that:

a. It reduces fragmentation of care, making care more accessible to consumers
b. The individual practitioners will have much more control over their time
c. There is less freedom of choice of doctor on the part of the patient
d. None of the above

Chapter 17: Ethical Issues

1. **Ethics can be best defined as:**
   a. A set of rules to be followed by a profession
   b. A set of unwritten rules and guidelines
   c. The science of moral duty
   d. None
2. **Grievance injury to the tooth structure is punishable under:**
   a. IPC-302
   b. IPC-304
   c. IPC-306
   d. IPC-307
3. **Jurisprudence can be defined as:**
   a. The science of the system of laws
   b. Laws of consumer protection act
   c. A set of laws in the societies
   d. None
4. **The concept of “beneficence” is:**
   a. To do no harm
   b. To do good
   c. Truthfulness
   d. Justice
5. **The concept of “non-maleficence” is:**
   a. Truthfulness
   b. To do good
   c. To do no harm
   d. Justice

Chapter 18: Dentists Act and Association

1. **The practice of dentistry in India is governed by Dentists Act of:**
   a. 1947
   b. 1948
   c. 1949
   d. 1950
2. **The chemical disintegration of enamel is called:**
   a. Abrasion
   c. Attrition
   b. Erosion
   d. Caries
3. **Dental Council of India consider the following practices as unethical:**
   a. Employing unregistered assistants
   b. Issuing fake certificate
   c. Advertising frequently
   d. All of the above
4. **The Indian Dental Association was established in the:**
   a. 1948
   b. 1949
   c. 1950
   d. 1951

Chapter 21: Fluorides in Caries Prevention

1. **The atomic weight of fluorine is:**
   a. 9
   b. 8
   c. 19
   d. 10
2. **The atomic number of fluorine is:**
   a. 6
   b. 9
   c. 11
   d. 21
3. **Which one of the following minerals is a source of fluoride?**
   a. Fluorspar
   b. Fluorapatite
   c. Cryolite
   d. All of the above
4. **Which one of the following is correct about 22 cities study done by Trendley H Dean:**
   a. No mottling of aesthetic significance were observed in areas with water containing 1 ppm fluoride
   b. The element fluorine was identified as the “mysterious factor” responsible for mottling of enamel
   c. Dean developed the index called mottling index
   d. Both b and c are correct
5. **The fact that at l ppm of F in drinking water reduces 60% of caries experience was observed in:**
   a. 1931
   b. 1934
   c. 1942

d. 1945

6. World's first artificial fluoridation study was done on:

a. 25th January 1945

b. 25th January 1950

c. 25th January 1934

d. 25th January 1955

7. In Grand Rapids-Muskegon study:

a. Grand Rapids is test town; Muskegon is control town

b. Grand Rapids is control town; Muskegon is test town

c. Artificial fluoridation was not done

d. None of the above is correct

8. Find the odd one out:

a. Tiel-Culemborg study

b. Newburg-Kingston study

c. Evanston-Oak park study

d. Nalgonda study

9. Fluoride emissions in the atmosphere occurs:

a. Due to coal burning

b. During the production of aluminum

c. During the production of phosphate fertilizers

d. All of the above

10. Which of the following is/are rich source (s) of fluoride?

a. Sardines

b. Cassava

c. Jowar

d. All of the above

11. Bones of the mature animals take up:

a. Less fluoride than that of the younger ones

b. More fluoride than that of the younger ones

c. Same fluoride amount as that of younger ones
d. No fluoride at all

12. The concentration of fluoride is higher in:

a. Enamel
b. Dentin
c. Cementum
d. Periodontal ligament

13. In cementum, the fluoride concentration generally:

a. Decreases from surface to interior
b. Increases from surface to interior
c. Remains the same throughout
d. High in the middle than in the surface and interior

14. In dentin, the fluoride concentration is generally:

a. Higher near pulpal surface
b. Lower near enamel surface
c. Remains the same everywhere
d. Both a and b are correct

15. Excretion of fluorides is through:

a. Urine
b. Faeces
c. Breast milk
d. All of the above

16. Fluoride is excreted in:

a. Sweat
b. Tears
c. Saliva
d. All of the above

17. The renal clearance of fluoride is related to:

a. pH of urine
b. Urinary flow rate

c. Creatinine level

d. Both a and b are correct

18. The lake which records highest concentration of fluoride?

a. Lake Victoria

b. Lake Malawi

c. Lake Nakuru

d. Lake Chitticaca

19. Open carious lesions acquire:

a. Larger amounts of fluoride than sound enamel

b. Similar amounts of fluoride as of sound enamel

c. Lesser amounts of fluoride than sound enamel

d. None of the above is correct

20. The average reduction in dental caries by community water fluoridation method is:

a. 40%

b. 50–65%

c. 30–40%

d. 20–50%

21. The most common and cheapest form of systemic fluoride administration is:

a. Community water fluoridation

b. Salt fluoridation

c. Milk fluoridation

d. Topical fluoride application

22. "Repeated application of sodium fluoride to teeth of children significantly reduces caries prevalence" was first demonstrated by:

a. Hetzer in 1973

b. Petersson in 1973

c. Murray JJ et al in 1977

d. Bibby in 1942

23. The concentration of NaF in Duraphat is:

a. 2.26%

b. 0.7%

c. 1.8%

d. 3%

24. Fluor protector contains:

a. NaF

b. Difluoro silane

c. Epoxylite

d. SnF_2

25. The first fluoridated prophylactic paste contained:

a. SnF_2 as active ingredient

b. Zirconium silicate as the abrasive

c. Both a and b are correct

d. None of the above

26. The advantages of thixotropic gels are:

a. Gel adheres to teeth for a considerable time

b. Eliminates the continuous wetting of enamel surfaces as required in aqueous solution.

c. It is possible to treat 2 or 4 quadrants simultaneously

d. All of the above

27. The concentration of neutral NaF as topical agent is:

a. 8%

b. 10%

c. 2%

d. 1.23%

28. The recommended ages in Knutson's technique of NaF application are:

a. 3, 11 and 13

b. 3, 7, 11 and 13

c. 3, 7, 9 and 13

d. 3, 5, 7 and 9

29. The commonly used concentration of SnF_2 as topical agent is:

a. 10%

b. 1.23%

c. 8%

d. 2%

30. The disadvantage of SnF_2 topical agent is:

a. Staining of teeth

b. Etching of porcelain crown

c. Repeated visits

d. Both b and c are correct

31. The acidulated phosphate fluoride is called:

a. Nalgonda solution

b. Ringer's solution

c. Brudevold's solution

d. Muhlemann's solution

32. The concentration of fluoride in APF solution is:

a. 10%

b. 8%

c. 1.23%

d. 2%

33. The disadvantages of APF application are:

a. Repeated application over porcelain or composite restoration causes surface roughening

b. Bitter in taste

c. Cannot be stored in glass containers

d. All of the above

34. The mode of action of fluoride in reducing caries is:

a. Reduction in enamel solubility
b. Interference with plaque microorganisms
c. Modification in tooth morphology
d. All of the above

35. The commonly used fluoride in dentifrices is:

a. Stannous fluoride
b. Sodium monofluorophosphate
c. Amine fluoride
d. Silico fluorides

36. Fluoridated dentifrices and rinses are not recommended for children below:

a. 12 years
b. 4 years
c. 8 years
d. 10 years

37. Agents that are added to dentifrices to prevent the loss of water are called:

a. Binders
b. Thickening agents
c. Abrasives
d. Humectants

38. The agents, which are added to dentifrices to prevent the separation of solid and liquid phases, are called?

a. Humectants
b. Surface active agents
c. Abrasives
d. Binders

39. Glycerol, sorbital are examples of:

a. Humectants
b. Thickening agent

c. Flavouring agent

d. Binders

40. Methyl cellulose is used in dentifrices as:

a. Polishing agent

b. Humectants

c. Binding agent

d. Detergents

41. Certainly lethal dose of fluoride is:

a. 32 to 64 mg/kg body wt

b. 5 to 10 mg/kg body wt

c. 8 to l6 mg/kg body wt

d. 50 to 100 mg/kg body wt

42. STD of fluoride is:

a. 32 to 64 mg/kg body wt

b. 8 to 16 mg/kg body wt

c. 100–150 mg/kg body wt

d. 5–10 gm for a 70 kg adult

43. Dental fluorosis occurs:

a. Symmetrically within the dental arches

b. Lesser in mandibular incisors

c. Frequently in premolars

d. All of the above

44. The fluoride dosage necessary to produce pathologic skeletal fluorosis is:

a. 20 to 80 mg F/day for 10 to 20 years

b. 1 to 2 mg F/day for 20 to 30 years

c. 5 to 10 mg F/day for 5 to 10 years

d. 3 to 5 mg F/day for 10 years

45. Excessive intake of fluoride during the period of tooth development causes:

a. Dental fluorosis
b. Skeletal fluorosis
c. Genu valgum
d. None of the above

46. Identify the fluoride compound used in water fluoridation:

a. Fluorspar
b. Sodium fluoride
c. Silico fluorides
d. All of the above

47. The following is equipment used for water fluoridation:

a. Saturator system
b. Dry-feeder system
c. Solution-feeder system
d. All of the above

48. Which one of the following districts is an endemic fluoride area?

a. Ananthpur
b. Karim Nagar
c. Kurnool
d. All of the above

49. Which one of the following is used as a method of defluoridation?

a. Anion exchange resin
b. Cation exchange resin
c. Addition of chemicals to water during treatment
d. All of the above

50. The Nalgonda Technique of Defluoridation was developed by:

a. WHO
b. AIIMS
c. NEERI
d. IIT (Kanpur)

51. Defluoron-2 is:

a. An anion exchange resin
b. Cation exchange resin
c. Nalgonda technique
d. Water purifying system

52. Which among the following countries have used salt as a vehicle for fluoridation?

a. Hungary
b. Columbia
c. Switzerland
d. All of the above

53. Fluoride absorption from stomach is:

a. Directly related to the pH of gastric contents
b. Inversely related to the pH of gastric contents
c. Independent of gastric contents
d. None of the above

54. Identify the cause of fluoride pollution in air:

a. Mining of phosphates and fluorspar
b. Pesticides containing fluoride
c. Gases emitted from volcanic eruptions
d. All of the above

55. The recommended concentration of fluoride in drinking water by WHO is:

a. 1–2 ppm
b. 0.7–1.2 ppm
c. <1 ppm
d. 1.5 ppm

56. School water fluoridation is an alternative method to:

a. Salt fluoridation
b. Milk fluoridation
c. Community water fluoridation

d. Both a and b are correct

57. Salt fluoridation was first introduced in:

a. Columbia

b. Spain

c. Hungary

d. Switzerland

58. Milk fluoridation as a possible method of systemic use was first mentioned by:

a. Wespi in 1961

b. Ziegler in 1956

c. Inamura in 1959

d. Toth in 1976

59. The fluoride content in fluorprotector is:

a. 0.7%

b. 1.7%

c. 2%

d. 8%

60. In Dean's fluorosis index, when the white opaque areas are more extensive but do not involve more than 50% of the surface, then it is:

a. Very mild

b. Mild

c. Moderate

d. Severe

61. The classification "questionable" in Dean's fluorosis index is given a score of:

a. 0

b. 1

c. 2

d. 0.5

62. If the community fluorosis index score is 1.5, then the public health significance is:

a. Borderline
b. Negative
c. Slight
d. Medium

63. If CFI score is 3, then the public health significance is:

a. Very marked
b. Marked
c. Medium
d. Slight

64. In a village of 100 individuals, if 50 people are in very mild category, 25 people are normal and 25 people are in mild category of Dean's fluorosis index, then the CFI score for that village is:

a. 1
b. 0.5
c. 2
d. 1.5

65. Identify the index used for dental fluorosis:

a. CPITN
b. TSIF
c. RCI
d. DHI

66. Find the odd man out:

a. Moller's index
b. CH
c. TSIF
d. FRI

67. Identify the index used for dental fluorosis:

a. FMI

b. FRI
c. Thylstrup-Fejerskov index
d. All of the above

68. The concentration of sodium fluoride mouthrinse for daily use is:

a. 0.2%
b. 1%
c. 0.05%
d. 0.5%

69. The concentration of sodium fluoride mouthrinse for weekly use is:

a. 0.2%
b. 1%
c. 0.05%
d. 0.5%

70. Fluoride supplements should be prescribed in communities where the fluoride level in drinking water is less than:

a. 1.5 ppm
b. 1 ppm
c. 0.7 ppm
d. 2 ppm

71. In enamel, the fluoride concentration:

a. Decreases from outer surface towards dentin
b. Increases from outer surface towards dentin
c. Remains the same
d. Irregular

72. The best time to apply topical fluoride is:

a. Soon after eruption of permanent teeth
b. Any time during course of life
c. After 45-year-old
d. Soon after first year of birth

73. The fluoride content in an individual is shown as:

a. Enamel > Dentin > Bone
b. Bone > Dentin > Enamel
c. Dentin > Enamel > Bone
d. Bone > Enamel > Dentin

74. The recommended school water fluoridation level, where community water supply is not fluoridated, is:

a. 0.7 ppm
b. 1 ppm
c. 4.5 ppm
d. 2.5 ppm

75. Fluoride in human enamel was founded by:

a. Morichini in 1805
b. Scheele in 1771
c. Moissan in 1886
d. Mckay in 1901

76. Fluorine was discovered by the chemist:

a. Moissan in 1886
b. Scheele in 1771
c. Morichini in 1805
d. Mckay in 1901

77. The pre-eruptive action of systemic fluorides is most effective in preventing:

a. Fissure caries
b. Smooth surface caries
c. Incisal caries
d. Proximal surface caries

78. Dentifrices used for adults have fluorides in the concentration of:

a. 250–500 ppm
b. 800–1,000 ppm
c. 2,000 ppm

d. 3,000–5,000 ppm

79. APF gel should be applied for the full:

a. 60 seconds
b. 4 minutes
c. 30 minutes
d. 40 seconds

80. In the adult teeth, the distribution of fluoride in the surface enamel is:

a. Highest in incisal edge, lowest near cervical margin
b. Highest near cervical margin, lowest in incisal edge
c. Highest near the proximal surface
d. None of the above

81. The following is/are rich source(s) of fluoride:

a. Dried fish
b. Tea leaves
c. Turmeric
d. All of the above

82. The "choking off" mechanism takes place after topical application of:

a. NaF
b. SnF_2
c. APF
d. NaCl

83. The cleaning property of a toothpaste is primarily a function of its:

a. Fluoride content
b. Physical form, paste/powder
c. Binding agents
d. Abrasiveness

84. The newly erupted tooth:

a. Is protected by dental plaque

b. Has an early immunity to caries

c. Has a high affinity for fluoride

d. All of the above

85. In comparison to normal enamel, carious enamel will take up fluoride:

a. Faster

b. Slower

c. At the same rate

d. Not at all

86. What is formed when teeth are exposed to high concentrations of fluoride?

a. HF

b. NaF

c. SnF_2

d. CaF_2

87. Which of the following affects the bioavailability of fluorides?

a. Calcium

b. Aluminium

c. Food itself

d. All of the above

88. Fluoridation is an example of which level of prevention?

a. Primary

b. Secondary

c. Tertiary

d. All of the above

89. The recommended level of fluoride in drinking water for India is:

a. 1.1–1.6 ppm

b. 0.5–0.8 ppm

c. 1–1.2 ppm

d. 0.3–0.6 ppm

90. In non-fluoridated areas, a daily supplement of sodium fluoride may be recommended in the amount of:

a. 20 mg
b. 2.2 mg
c. 10 mg
d. 12.2 mg

91. One ppm is equal to:

a. 1 mg per litre of water
b. 1 gm per litre of water
c. 10 gm per 100 ml of water
d. 1 mg per 100 ml of water

92. The concentration of APF mouthrinse for daily basis is:

a. 0.02%
b. 0.10%
c. 0.5%
d. 1.23%

93. The concentration of SnF_2 mouthrinse for daily basis is:

a. 0.10%
b. 0.02%
c. 0.05%
d. 0.2%

94. Fluoride varnishes were first developed by:

a. Scheen in 1964
b. Schimdt in 1964
c. Dean in 1934
d. Mckay in 1934

95. Two percent sodium fluoride refers to:

a. 2000 ppm
b. 200 ppm
c. 20,000 ppm

d. 2,00,000 ppm

96. Orthotoludine is used to detect excess:

a. Fluorine
b. Iodine
c. Carbon
d. Chlorine

97. For daily rinse, the concentration of NaF used is:

a. 0.05%
b. 0.2%
c. 0.5%
d. 0.02%

98. To advise intake of 1 mg of fluoride, the recommended prescription is:

a. 2.2 mg of NaF tablet
b. 1.1 mg of NaF tablet
c. 1 mg of NaF tablet
d. 2 mg of NaF tablet

99. McKay discovered 'Colorado' stain in:

a. 1801
b. 1901
c. 1906
d. 1930

100. An aqueous solution of APF is prepared by dissolving:

a. 20 gm of NaF in 1-litre of 0.1M phosphoric acid
b. 20 mg of NaF in 1-litre of 0.1M phosphoric acid
c. 20 gm of NaF in 2-litre of 0.2M phosphoric acid
d. 20 gm of NaF in 1-litre of 0.01M phosphoric acid

101. The percentage of stannous fluoride used for topical application is:

a. 2%
b. 8%

c. 10%

d. 1.23%

102. Who identified the presence of fluoride in the water supplies of the endemic areas in USA:

a. GV Black and McKay

b. Churchill and Smiths

c. Dean and McKay

d. None of the above

Chapter 22: Applied Biostatistics and Research Methodology

1. **The functions of statistics are:**
   a. Collection of data
   b. Presentation of data
   c. Analysis and interpretation of data
   d. All of the above
2. **The data which are collected from the units or individual directly and these data have never been used for any purpose earlier are:**
   a. Secondary data
   b. Primary data
   c. Questionnaire
   d. None of the above
3. **Statistical results are:**
   a. Absolutely correct
   b. Not true
   c. True on average
   d. Universally true
4. **A series showing the sets of all discrete values individually with their frequencies is known as:**
   a. Simple frequency distribution
   b. Grouped frequency distribution
   c. Cumulative frequency distribution
   d. None of the above
5. **A simple table represents:**
   a. Only one factor
   b. Always two factors
   c. Two or more number of factors

d. All of the above

6. Charts and graphs facilitate:

a. Comparison of values
b. To know the trend
c. To know the relationship
d. All of the above

7. Which diagram is used to represent quantitative data?

a. Bar diagram
b. Pie chart
c. Histogram
d. Multiple bar diagram

8. Bar diagram is used to represent:

a. Qualitative data
b. Quantitative data
c. Secondary data
d. Primary data

9. A variable is able to express by certain measurements units is called as:

a. Qualitative variable
b. Quantitative variable
c. Secondary data
d. Primary data

10. To represent two or more factors simultaneously, which of the following diagrams is used?

a. Bar diagram
b. Histogram
c. Pie chart
d. Multiple bar diagram

11. Compilation of data means:

a. Grouping of similar data

b. Collection of data
c. Presentation of data
d. Tabulation of data

12. Median is a measure of:

a. Average
b. Variation
c. Correlation
d. All of the above

13. Following are the measures of central tendency, *except:*

a. Mean
b. Median
c. Mode
d. Standard deviation

14. Following are the measures of variation, *except*:

a. Range
b. Standard deviation
c. Mean deviation
d. Mean

15. Extreme value has no effect on:

a. Mean
b. Median
c. Geometric mean
d. Harmonic mean

16. Sum of the observations by number of observation is known as:

a. Arithmetic mean
b. Geometric mean
c. Harmonic mean
d. Absolute mean

17. Calculate the median age for the following data on age at which permanent teeth starts for 10 children in a community 6 769 6 78 6

7:

a. 6
b. 7
c. 8
d. 9

18. Among the given observations, if any observation repeats maximum number of time is known as:

a. Median
b. Arithmetic mean
c. Mode
d. None of the above

19. In a class of 50 students, the mean mesiodistal width of upper right first permanent molars for 30 boys were 5.9 mm. The mean mesiodistal width of the same for 20 girls were 6.3 mm. The overall mean was:

a. 6.1 mm
b. 6.06 mm
c. 6.0 mm
d. 6.2 mm

20. To determine the average age in an epidemiological study, the best measure is:

a. Mean
b. Median
c. Mode
d. Range

21. The difference between the maximum and minimum observations, is known as:

a. Range
b. Mode
c. Quartile deviation
d. Standard deviation

22. For comparison of two different series, the best measure of dispersion is:

a. Range
b. Mean deviation
c. Standard deviation
d. Coefficient of variation

23. If a constant value 10 is subtracted from each observation of a set, the standard deviation is:

a. Reduced by 10
b. Increased by 10
c. Decreased by 100
d. No change

24. The other name for root mean square deviation is:

a. Mean deviation
b. Standard deviation
c. Quartile deviation
d. None of the above

25. Find the range for the following data on DMF level of 8 children 2 0 6 4 6 7 1 2:

a. 7
b. 6
c. 2
d. 0

26. Calculate the coefficient of variation for the following data. The mean DMFT for 200 boys is 0.79 with a standard deviation of 1.24:

a. 157%
b. 63.7%
c. 50.3%
d. 141%

27. The mean and standard deviation of a set of values are 50 and 5 respectively. If a constant value 10 is added to each value, the

coefficient of variation of the new set of values is:

a. 25%

b. 10%

c. 8.3%

d. 20%

28. Sum of the deviations about mean is:

a. Positive

b. Negative

c. Zero

d. None of the above

29. If the data follows a normal distribution, then:

a. Mean > Median > Mode

b. Mean < Median < Mode

c. Mean = Median = Mode

d. Mean > Median < Mode

30. If the data follows a normal distribution, then Mean + Standard deviation consists of:

a. 90% of the observations

b. 68.7% of the observations

c. 95% of the observations

d. 99.9% of the observations

31. To compare two means of sample size below 30, the statistical test adopted is:

a. Chi-square test

b. Student's 't' test

c. ANOVA test

d. Correlation coefficients

32. To find out the association between tobacco chewing and oral cancer, the common statistical test applied is:

a. Chi-square test

b. Student's 't' test
c. ANOVA test
d. Correlation coefficient

33. To find out the relationship between two continuous variables, the common statistical test adopted is:

a. Chi-square test
b. Student's 't' test
c. ANOVA test
d. Correlation coefficient

34. 20 houses are selected from a village of 120 houses, then 120 houses are called:

a. Population
b. Sample
c. Sample size
d. None of the above

35. In a village, 40 houses are selected by lottery method. The technique is called:

a. Simple random sampling
b. Cluster random sampling
c. Stratified random sampling
d. Systematic random sampling

36. A list of all the units in the study population is known as:

a. Sample size
b. Sampling frame
c. Sample details
d. None of the above

37. The difference between the sample estimate and the population parameter is known as:

a. Sampling error
b. Non-sampling error

c. Total error

d. Surrogate error

38. Sampling error can be reduced by:

a. Increasing sample size

b. Decreasing sample size

c. Increasing population size

d. None of the above

39. If 10 units are selected in a sample from 200 units, the sampling fraction is:

a. 10/200

b. 1/200

c. 1/10

d. 200/10

40. In an urban area, a school is selected randomly and all the students in the school were examined for prevalence of dental caries. The type of sampling done is known as:

a. Stratified random sampling

b. Cluster random sampling

c. Systematic random sampling

d. Simple random sampling

41. In a community dental survey, if every 10^{th} house is selected as sample unit in a village, the type of sampling technique is known as:

a. Cluster random sampling

b. Stratified random sampling

c. Simple random sampling

d. Systematic random sampling

42. The sample units are selected proportionately with respect to the Socioeconomic status of a family of a village. The sampling technique followed is:

a. Cluster random sampling

b. Stratified random sampling
c. Simple random sampling
d. Systematic random sampling

43. How many errors are possible in a statistical testing of hypothesis?

a. Only one
b. Two errors
c. Three errors
d. Four errors

44. Whether a test is one-sided or two-sided based on:

a. Null hypothesis
b. Alternative hypothesis
c. Both
d. None of the above

45. Power of the test is related to:

a. Type I
b. Type II
c. Type III
d. Type IV

46. Level of significance is the probability of:

a. Type I
b. Type II
c. Not committing an error
d. None of the above

47. Degrees of freedom is:

a. Number of observations in a set
b. Number of hypothesis in the study
c. Number of independent observations in a set
d. None of the above

48. Comparing the prevalence of dental caries in a community = 20% against 20% leads to:

a. One-sided lower-tailed test
b. One-sided upper-tailed test
c. Two-tailed test
d. None of the above

49. The mean difference between pre- and post-test score of 16 men in a community was 20 with a standard deviation of 10. The value of statistic 't' is:

a. 16
b. 8
c. 12.5
d. 4

50. Probability can take values

a. ∞ to ∞
b. ∞ to 1
c. –1 to 1
d. 0 to 1

51. The relation in size between two random quantities is:

a. Rate
b. Ratio
c. Proportion
d. Case fatality

52. Histogram is:

a. Pictorial representation
b. Series of blocks
c. Areas of segments in circle compound
d. Bars separated by appropriate spaces

53. The following statistical test is used to evaluate significance of difference between two means in small samples:

a. Chi-square test
b. t-test

c. F-test

d. Z-test

54. Standard deviation is a measure of:

a. Variability

b. Central value

c. Correlation

d. None of the above

55. Standard deviation is also known as:

a. Standard error of proportion

b. Standard error of mean

c. Normal distribution

d. Root mean square deviation

Chapter 23: Behavioural Sciences

1. **Society is a:**
   a. Group with feeling of unity
   b. People gathered together to achieve a goal
   c. Web of social relationships
   d. None
2. **Sociology is mainly dealing with:**
   a. Religion
   b. Caste
   c. Society
   d. Human social behaviour
3. **Culture is not _____ behaviour.**
   a. Learned
   b. Instinct
   c. Acquired
   d. Shared
4. **Race is a _____ concept.**
   a. Cultural
   b. Biological
   c. Sociological
   d. Psychological
5. **Social relations means:**
   a. Psychical feeling
   b. Likeness among people
   c. Reciprocal awareness between people
   d. None of the above
6. **Culture is transmitted through:**
   a. Religion

b. Education
c. Caste
d. Language

7. Culture is:

a. Learned pattern of behaviour
b. Civilized way of life
c. Old way of living
d. Modern way of living

8. A group need not have:

a. ‘We’ feeling
b. A common territory
c. Sense of unity
d. Common goal

9. Membership is voluntary in:

a. Group
b. Community
c. Society
d. Caste

10. In society, membership is:

a. Limited
b. Regulative
c. Compulsory
d. Spontaneous

11. Group is a:

a. Collection of individuals
b. Relationship among human beings
c. Individuals with definite status and role
d. None

12. Group is formed with a _____ purpose.

a. Specific

b. General
c. Limited
d. Voluntary

13. A group is always:

a. Static
b. Dynamic
c. Legal
d. Voluntary

14. In secondary group, membership is:

a. Spontaneous
b. Voluntary
c. Involuntary
d. None of the above

15. Society is marked by:

a. Cooperation
b. Conflict
c. Acculturation
d. Both cooperation and conflict

16. A group is an:

a. Organic whole
b. Artificial formation
c. Organized gathering
d. Spontaneous formation

17. Socialization is a learning process which occurs?

a. Only during childhood
b. Throughout the life
c. In the occupational sphere
d. None

18. _____ first and foremost agency of socialization.

a. School
b. Community
c. Family
d. None

19. Ranking of individuals in society is called:

a. Social system
b. Social hierarchy
c. Social class
d. Social stratification

20. Locating an individual in a position in a society is called:

a. Prestige
b. Role
c. Power
d. Status

21. The obligations and privileges attached to the status of an individual is called his _____

a. Role
b. Personality
c. Privilege
d. None of the above

22. Sex of an individual is an _____.

a. Achieved status
b. Absolute status
c. Ascribed status
d. Integrated status

23. Community exists within _____.

a. Social system
b. Society
c. Social stratification
d. All of the above

24. The behaviours, which are rewarded and considered as principles of life in a society are:

a. Customs
b. Folkways
c. Values
d. Norms

25. Developing good lifestyle is an example of:

a. Value
b. Goal
c. Norm
d. Taboo

26. The ethos of a culture in a community is mainly its _____

a. Norm
b. Belief
c. Value
d. Goal

27. _____ are called standards of an individual in a society.

a. Role
b. Values
c. Customs
d. Norms

28. _____ is the function of an individual in a group.

a. Status
b. Role
c. Social power
d. None of the above

29. When a number of individuals live together in a definite geographical area it is called:

a. Association
b. Society

c. Community

d. Caste

30. Norms give _____ to society:

a. Law

b. Cohesion

c. Belief

d. Ideas

31. The prohibited pattern is called:

a. Sanction

b. Rewards

c. Social control

d. Non-conformity of norms

32. The recognized behaviours in a society are called:

a. Custom

b. Tradition

c. Culture

d. Folkways

33. _____ are spontaneous in their origin and accepted by the community.

a. Fashions

b. Folkways

c. Customs

d. Rules of religion

34. The sanctions of folkways are:

a. Informal

b. Formal

c. Rigid

d. All of the above

35. Putting clove oil for tooth ache is an example of:

a. Folkways

b. Tradition

c. Custom

d. None of the above

36. The practices which are practiced for a long period of time and recognized by a society are called _____ ?

a. Cultural traits

b. Folkways

c. Norms

d. Customs

37. _____ are called rules of in a society.

a. Norms

b. Mores

c. Law

d. Folkways

38. Behaviour which need not be rational:

a. Folkways

b. Conventions

c. Laws

d. Mores

39. _____ is an acquired pattern.

a. Habit

b. Fashion

c. Civilization

d. Convention

40. _____ is an individual phenomenon.

a. Custom

b. Religion

c. Style

d. Habit

41. Smoking is an example of:

a. Habit
b. Custom
c. Folkways
d. All of the above

42. While smoking, keeping the burning side inside the buccal cavity is an example of:

a. Habit
b. Custom
c. Belief
d. Tradition

43. If the socialization process is improper, it will make an individual to become:

a. Rebel
b. Violent
c. Introvert
d. Deviant

44. Family is:

a. Basic social unit
b. Cultural unit
c. Epidemiological unit
d. All of the above

45. Extended family means:

a. Three generation family
b. A couple with unmarried children
c. A couple with their brothers or sisters
d. All of the above

46. If the place of residence of a woman is in the husband's town or village, then it is called as:

a. Matrilocal
b. Patrilocal

c. Patrilineal

d. Matriarchal

47. Religion mainly consists of:

a. Ritual

b. Magic

c. Belief

d. Belief and ritual

48. Individual with same standard of living belong to one particular:

a. Caste

b. Community

c. Class

d. Party

49. A group of individuals with endogamous marriage and traditional occupation may belong to one particular:

a. Caste

b. Occupation group

c. Status group

d. Community

50. The caste system in India is _____

a. Contradictory

b. Symmetrical

c. Hierarchical

d. Open

51. The status for an individual is _____ in caste.

a. Legal

b. Formal

c. Ascribed

d. Achieved

52. Caste is _____ group.

a. Primary

b. Secondary
c. Exogamous
d. Endogamous

53. Class is _____ caste is _____

a. Open, rigid
b. Legal, religious
c. Rigid, open
d. Formal, informed

54. In class _____ is possible.

a. Horizontal mobility
b. Vertical mobility
c. Migration
d. None of the above

55. The class of an individual is determined by his:

a. Education
b. Occupation
c. Income
d. All of the above

56. _____ is permanent

a. Caste, class
b. Class, caste
c. Community, class
d. Class, community

57. In a village community, contacts among individuals are:

a. More
b. Intimate
c. Rare
d. Formal

58. Village community is not characterized by:

a. 'We' feeling

b. Personal contacts
c. Same kind of occupation
d. Heterogeneous people

59. Urban community is characterized by:

a. Less contacts
b. Dense population
c. Slums
d. All of the above

60. In a village _____ is obvious.

a. Caste system
b. Class system
c. Slums
d. Instrumental relations

61. Urban community develops by:

a. Resources
b. Occupational opportunity
c. Industry
d. All of the above

62. Tribes do not have:

a. Common language
b. Exogamous marriage
c. Endogamous marriage
d. Common dwelling

63. _____ is the main character of tribal group.

a. Heterogeneous groups
b. Impersonal relations
c. Territorial
d. Exogamous marriage

64. Medical sociology deals with:

a. Social response to disease
b. Social factors responsible to disease
c. Social relationship between doctor and patient
d. All of the above

65. Illness depends on mainly the:

a. Severity of symptoms
b. Coping style of the patient
c. Medical authority's recommendations
d. All of the above

66. In rural community, the type of relationship:

a. Emotional
b. Instrumental
c. Both a and b
d. None

67. Taboo is a:

a. Strong social norm
b. Dont's of the society
c. Punishable acts
d. All of the above

68. The functions of family are mainly:

a. Social care
b. Socialization
c. Economic support
d. All of the above

69. Broken family is the one in which?

a. Parents have been separated
b. Death has occurred for one or both parents
c. Both parents live together but have quarrels between them
d. Both a and b

70. Problem family is one which?

a. Cope with development process
b. Lag behind in the development process when compared to other families in a community
c. Complete seclusion from the development process
d. None

71. Diarrhoea in children during teething is considered as normal phenomenon. It is a kind of:

a. Belief
b. Custom
c. Taboo
d. None of the above

72. Papaya fruit is forbidden to pregnant woman. It is an example of:

a. Belief
b. Folkway
c. Social norm
d. More

73. Women serve the food to all in the family and eat last, is an example of:

a. Belief
b. Folkway
c. Taboo
d. Social norm

74. Fasting on auspicious day by orthodox Hindus is an example of:

a. Tradition
b. Social norm
c. Ritual
d. Custom

75. Chewing pan is an example of:

a. Folkway
b. Customs

c. Habit
d. Tradition

76. Using charcoal powder as cleaning material is leading to:

a. Enamel abrasion
b. Dentin sensitivity
c. Gingival recession
d. All of the above

77. Hindus are not allowed to eat pork. It is an example of:

a. Custom
b. Taboo
c. Food habit
d. None

78. Reverse smoking leads to:

a. Gingival bleeding
b. Enamel abrasion
c. Cancer of hard palate and tongue base
d. All of the above

79. Tattooing of lower lip is a kind of practice seen in people of:

a. North Africa
b. North America
c. South America
d. India

80. Smoking among pregnant women increases the incidence of:

a. Cleft lip and cleft palate foetus
b. Low birth weight babies
c. Oral cancer for child
d. Both a and b

Chapter 24: Behaviour Management

1. **As per Sigmund Freud, phallic stage extends between:**
   a. Birth to 3 years
   b. 3 to 5 years
   c. 5 to 7 years
   d. 7 to 9 years
2. **Which of the following is NOT among the principles involved in the process of classical conditioning?**
   a. Rationalization
   b. Generalization
   c. Extinction
   d. Discrimination
3. **Which of the following refers to the removal of the pleasant response after a particular response?**
   a. Positive reinforcement
   b. Negative reinforcement
   c. Omission
   d. Punishment
4. **A child will be able to think more abstractly during:**
   a. Sensorimotor stage
   b. Preoperational stage
   c. Concrete operation stage
   d. Formal operation state
5. **‘Self-actualization theory’ refers to:**
   a. Psychosocial theory
   b. Social learning theory
   c. Cognitive theory
   d. Hierarchy of needs theory

6. Reaction of a person to known danger is referred to:

a. Anxiety
b. Fear
c. Terror
d. Startle

7. The most feared event in dental office by a child is:

a. Drilling the tooth
b. Injection of local anaesthesia
c. Gagging while impression taking
d. Extraction of tooth

8. Fear of closed space is known as:

a. Agoraphobia
b. Necrophobia
c. Claustrophobia
d. Cymophobia

9. Fears transmitted to individual from peers are:

a. Subjective fears
b. Objective fears
c. Transmission fears
d. Innate fears

10. Fear may cause:

a. Rapid breathing
b. Pupillary dilatation
c. Bladder contraction
d. All of the above

11. Anxiety is a response to:

a. Known danger
b. Unknown danger
c. Dental operatory
d. None of the above

12. School phobia occurs during:

a. 2–4 years
b. 4–6 years
c. 11–12 years
d. 12–13 years

13. Which of the following is TRUE?

a. Boys are more fearful than girls
b. Girls are more fearful than boys
c. There is no gender difference for fear
d. Gender difference for fear is based on age

14. Oedipus complex refers to:

a. Young boys attached to mother
b. Young girls attached to father
c. Young boys attached to father
d. Young girls attached to mother

15. Aggressive behaviour in a child is usually due to parents who are:

a. Over protective
b. Over indulgent
c. Under affectionate
d. Authoritarian

16. Maternal influence on child's mental, physical and emotional development begins:

a. Before birth
b. At birth
c. After birth
d. At puberty

17. A child who is shy, but cooperative to dental procedures is called:

a. Whining
b. Tense
c. Timid

d. Obstinate

18. For best results in behaviour shaping of young child is:

a. Appointments should be short
b. Appointments should be long
c. Appointments should be during nap time
d. Do invasive techniques at the first visit

19. Expression of anger in a child is less during:

a. 15 months
b. 2 years
c. 3 years
d. 5 years

20. Piaget's cognitive theory emphasizes that:

a. Environment shapes the child's behaviour
b. Child seeks to understand the environment
c. Child shapes his own environment
d. None of the above

21. Maturation of ego occurs in:

a. Oral stage
b. Anal stage
c. Phallic stage
d. Latency stage

22. 'Modelling' is developed from:

a. Psychosocial theory
b. Psychoanalytical theory
c. Social learning theory
d. Cognitive theory

23. 'Electra complex refers to':

a. Young boys attached to mother
b. Young boys attached to father

c. Young girls attached to mother

d. Young girls attached to father

24. Negative oedipus complex refers to:

a. Male child having murderous wishes about mother

b. Female child having murderous wishes about mother

c. Male child having murderous wishes about father

d. Female child having murderous wishes about father

25. Oedipus complex in male child is resolved by:

a. Penis envy

b. Castration complex

c. Electra complex

d. None of the above

26. Child observational research suggests that both sexes become aware of anatomical genital differences at approximately:

a. 6 to 12 weeks of age

b. 16 to 18 weeks of age

c. 24 to 36 weeks of age

d. At puberty

27. Freud described which of the following as "the dark inaccessible part of our personality":

a. Id

b. Ego

c. Super ego

d. Ego-ideal

28. Which of the following is not a mature defense?

a. Sublimation

b. Humour

c. Suppression

d. Somatization

29. According to Thomas and Chess (1977), how many basic

temperaments are there in children that influence later personality:

a. Two
b. Three
c. Four
d. Five

30. Which of the following is TRUE regarding child patients?

a. Conducting less invasive procedures first will usually be more tolerable for the child
b. Children acquire some of their parents' fear and anxiety about dental treatment
c. Never greet a child wearing a face mask and gloves
d. All of the above

31. Which of the following was described by Eric Erickson?

a. Psychosocial theory
b. Social learning theory
c. Cognitive theory
d. Hierarchy of needs

32. Wright's clinical classification of child's behaviour has:

a. 2 categories
b. 3 categories
c. 4 categories
d. 5 categories

33. Children with specific debilitating or disabling conditions are classified as:

a. Cooperative
b. Lacking in cooperative ability
c. Potentially cooperative
d. None of the above

34. According to Frankly behavioural rating scale a sullen withdrawn child, reluctant to accept dental treatment can be classified as:

a. Definitely negative
b. Negative
c. Positive
d. Definitely positive

35. The oedipus complex is one of the modes of reaction according to theory:

a. Freud
b. Sullivan
c. Erikson
d. Piaget

36. A young child's fear of dentistry is mainly:

a. Objective in nature
b. Subjective in nature
c. Equally subjective and objective
d. Introspective in nature

37. According to Freud's psychoanalysis theory, the aggregate of the basic, primitive impulses which dominate the psychic existence of the infant is called:

a. Id
b. Ego
c. Super ego
d. Oedipus complex

38. According to Massler, the best age for introducing the child to the dental office is:

a. Infancy (0–2 years)
b. Early childhood (2–4 years)
c. Preschool child (4–6 years)
d. School going child (6–9 years)

39. The behaviour modification technique employed in the case of a highly uncooperative child, e.g. HOME, is also known as:

a. Aversive conditioning

b. Modelling
c. Behaviour shaping
d. Voice control

40. Addelston gave a component of behaviour shaping that should be used routinely by dentists. It is called:

a. HOME
b. S-R theory
c. TSD
d. Multisensory communication

41. The IQ range of 110–119 is classified as:

a. Average
b. High average
c. Superior
d. Very superior

42. Psychoanalysis, the concept of unconscious process is given by:

a. Ginnot
b. Piaget
c. Eriksson
d. Freud

43. The 8 stages of emotional development of man have been given by:

a. Freud
b. Ginnot
c. Piaget
d. Eriksson

44. According to the Frankl rating system for child behaviour, rating 3 is:

a. Definitely negative
b. Negative
c. Positive
d. Definitely positive

45. The IQ of an average individual ranges from:

a. 70–79
b. 90–109
c. 120–139
d. Above 140

46. A newborn child is called neonate up to the age of:

a. 1 week
b. 2 weeks
c. 4 weeks
d. 8 weeks

47. The period of infancy is:

a. 0–6 months
b. 0–12 months
c. 6–18 months
d. 12–24 months

48. During which stage of development is the peer group identity strongest?

a. Latency
b. Pre-puberty
c. Teenager
d. Toddler

49. A child is always fearful of the dental situation. The pedodontist decides to permit the child to observe his working with a cooperative youngster during an operative procedure. The behaviour modification technique being used is:

a. Modelling
b. Contracting
c. Reinforcement
d. Sensitization

50. Which type of fear is usually the most difficult to overcome?

a. Long-standing objective fears
b. Long-standing subjective fears
c. Short-term objective fears
d. Short-term subjective fears

51. What is the usual behaviour characteristic of a child who has Down's syndrome?

a. Smiling, affectionate and easily distracted
b. Crying and stubborn
c. Fearful and unresponsive to verbal communication
d. Hyperactive

52. A child's mother be allowed to remain in the operatory for:

a. A crying 10-year-old
b. An apprehensive 2-year-old
c. A fearful 5-year-old
d. An over protected 7-year-old

53. Toys can be used in child management as:

a. A bribe
b. A gift
c. A reward
d. An incentive

54. Familiarization can be the solution of a child's behaviour problem in the clinic, if the basis of the problem is:

a. Pain
b. Fear
c. Anxiety
d. Attitude of the parents

55. Hand over mouth exercise technique of guiding behaviour should be used:

a. When a child is slightly uncooperative
b. When a child is crying hysterically

c. Routinely

d. Only for children above 11 years

56. A child with an IQ score of 50 would be classified as:

a. Genius

b. Superior

c. A verage

d. Mentally retarded

57. When visiting a dentist for the first time the strongest fear that children have is fear of:

a. Needles

b. Pain

c. The dentist

d. The unknown

58. In managing a 7-year-old child, the dentist should keep in mind that a child of this age is:

a. Frequently negative

b. Susceptible to praise

c. Extremely afraid of strangers

d. Prone to separation anxiety

59. A child patient who demonstrates resistance in the dental office is usually manifesting:

a. Anger

b. Anxiety

c. Immaturity

d. Parental permissiveness

60. Which of the following patterns of behaviour is most likely to be exhibited by a young child on his first visit to a dentist?

a. Fear

b. Aggression

c. Regression

d. Acceptance

Answers

CHAPTER 1

1. c
2. d
3. d
4. a
5. c
6. b
7. c
8. d
9. a
10. d
11. c
12. a
13. b
14. c
15. a
16. c
17. c
18. c
19. b
20. a

CHAPTER 3

1. c
2. a
3. d
4. d
5. a
6. d
7. c
8. b
9. b
10. b
11. a
12. d
13. c
14. c
15. a
16. c
17. d
18. d
19. a
20. d
21. d
22. d
23. b
24. c
25. d
26. b
27. b

28. d
29. c
30. d
31. c
32. c
33. a
34. a
35. b
36. d
37. d
38. c
39. a
40. b
41. b
42. b
43. c
44. b
45. d
46. c
47. a
48. c
49. a
50. b
51. c
52. d
53. d
54. a
55. c
56. d
57. b

58. c
59. d
60. c
61. d
62. b
63. a
64. b

CHAPTER 4

1. d
2. a
3. d
4. a
5. b
6. c
7. a
8. d
9. c
10. d
11. d
12. d
13. d
14. d
15. b
16. d
17. a
18. b
19. a
20. d
21. d
22. d
23. d
24. d
25. d
26. d
27. d

28. c
29. c
30. a
31. c
32. c
33. b
34. c
35. b
36. a
37. c
38. b
39. d
40. d

CHAPTER 5

1. d
2. b
3. d
4. c
5. d
6. a
7. a
8. a
9. b
10. d
11. b
12. b
13. d
14. c
15. a
16. c
17. c
18. c
19. c
20. c
21. b
22. d
23. d
24. a

CHAPTER 6

1. a
2. d
3. d
4. a
5. d
6. d
7. d
8. c
9. a
10. b
11. d
12. a
13. d
14. d
15. d
16. d
17. d
18. a
19. a
20. c
21. b
22. a
23. d
24. b
25. c
26. a
27. b

28. a
29. a
30. b
31. d
32. c
33. a
34. a
35. b
36. b
37. d
38. a
39. a
40. d
41. a
42. a
43. c
44. a
45. d
46. c
47. a
48. d
49. c
50. d
51. b
52. b
53. d

CHAPTER 7

1. b
2. c
3. a
4. a
5. b
6. c
7. c
8. d
9. c
10. b
11. a
12. d
13. b
14. d
15. d
16. a
17. d
18. a
19. c
20. d
21. b
22. b
23. c
24. d
25. b
26. d
27. b

28. d
29. d
30. b
31. a
32. a
33. d
34. d
35. c
36. c
37. b
38. b
39. d
40. a
41. a
42. b

CHAPTER 8

Aetiology, Prevention and Epidemiology of Periodontal Disease

1. c
2. a
3. d
4. a
5. a
6. b
7. a
8. d
9. c
10. b
11. c
12. a
13. b
14. d
15. a
16. c
17. c
18. d
19. a
20. b
21. d
22. d
23. c
24. b
25. d

26. b
27. a
28. b
29. d
30. d
31. d
32. d
33. d
34. b
35. d
36. d
37. d
38. a
39. c
40. d
41. d
42. a
43. c
44. b
45. d
46. d
47. d
48. d
49. b
50. d
51. d
52. a
53. b
54. c

Etiology, Prevention and Epidemiology of Dental Caries

1. **c**
2. **a**
3. **b**
4. **c**
5. **b**
6. **d**
7. **b**
8. **b**
9. **a**
10. **b**
11. **a**
12. **d**
13. **b**
14. **d**
15. **d**
16. **d**
17. **c**
18. **a**
19. **b**
20. **c**
21. **b**
22. **d**
23. **b**
24. **a**
25. **d**
26. **c**
27. **b**
28. **d**

29. c
30. c
31. a
32. d
33. a
34. b
35. b
36. a
37. c
38. d
39. d
40. a
41. c
42. b
43. c
44. a
45. b
46. b
47. a
48. c
49. a
50. b
51. b
52. b
53. d
54. b
55. d
56. d
57. d
58. d

59. d
60. b
61. c
62. c
63. c
64. c
65. a
66. a
67. b
68. d
69. c
70. c
71. b
72. c
73. a
74. a
75. b
76. b
77. a
78. b
79. b
80. c
81. c
82. b
83. a
84. b
85. a
86. b
87. a

Etiology, Prevention and Epidemiology of Oral Cancer

1. **a**
2. **a**
3. **b**
4. **a**
5. **b**
6. **a**
7. **b**
8. **a**

CHAPTER 10

1. b
2. c
3. b
4. d
5. a
6. d
7. a
8. a
9. b
10. d
11. c
12. d
13. d
14. d
15. b
16. b
17. b
18. a
19. a
20. a
21. c
22. c
23. c
24. b

CHAPTER 12

1. b
2. d
3. b
4. a
5. d
6. c
7. c
8. c
9. a
10. d
11. c
12. b
13. c
14. a
15. c
16. d
17. c
18. b
19. a
20. b
21. c
22. a
23. c
24. c
25. c
26. b
27. d

28. b
29. b
30. a
31. c
32. b
33. b
34. d
35. d
36. b
37. d
38. a
39. d
40. c
41. a
42. c
43. b
44. a
45. d
46. b
47. d
48. c
49. d
50. b
51. b
52. c
53. d
54. c
55. b
56. c
57. b

58. d
59. c
60. c
61. c
62. b
63. a

CHAPTER 13

1. d
2. d
3. d
4. a
5. d
6. b
7. d
8. c
9. c
10. a
11. b
12. c
13. d
14. c
15. d
16. b
17. a
18. d

Survey Procedures

1. **a**
2. **d**
3. **b**
4. **a**
5. **b**
6. **d**
7. **c**
8. **d**
9. **c**
10. **d**
11. **d**
12. **a**

CHAPTER 14

1. a
2. c
3. a
4. c
5. d
6. b
7. b
8. d
9. a
10. d
11. b
12. d
13. d
14. d
15. d
16. d
17. d

CHAPTER 16

1. **d**
2. **b**
3. **a**
4. **c**
5. **a**
6. **b**
7. **a**
8. **b**
9. **a**
10. **a**

CHAPTER 17

1. **c**
2. **d**
3. **a**
4. **b**
5. **c**

CHAPTER 18

1. **b**
2. **b**
3. **d**
4. **b**

CHAPTER 21

1. c
2. b
3. d
4. a
5. c
6. a
7. a
8. d
9. d
10. d
11. a
12. c
13. a
14. d
15. d
16. d
17. d
18. c
19. a
20. b
21. a
22. d
23. a
24. b
25. c
26. d
27. c

28. b
29. c
30. a
31. c
32. c
33. d
34. d
35. b
36. b
37. d
38. d
39. a
40. c
41. a
42. b
43. d
44. a
45. a
46. d
47. d
48. d
49. d
50. c
51. b
52. d
53. b
54. d
55. b
56. c
57. d

58. b
59. a
60. b
61. d
62. d
63. a
64. a
65. b
66. a
67. d
68. c
69. a
70. c
71. a
72. a
73. b
74. c
75. a
76. b
77. a
78. b
79. b
80. b
81. d
82. a
83. d
84. c
85. a
86. d

87. d
88. a
89. b
90. b
91. a
92. a
93. a
94. b
95. c
96. d
97. c
98. a
99. b
100. a
101. b
102. a

CHAPTER 22

1. d
2. b
3. c
4. a
5. a
6. d
7. c
8. a
9. b
10. d
11. a
12. a
13. d
14. d
15. b
16. a
17. b
18. c
19. b
20. c
21. a
22. d
23. d
24. b
25. a
26. a
27. c

28. c
29. c
30. b
31. b
32. a
33. d
34. a
35. a
36. b
37. a
38. a
39. d
40. b
41. d
42. b
43. b
44. b
45. b
46. a
47. c
48. c
49. b
50. d
51. b
52. b
53. b
54. a
55. d

CHAPTER 23

1. c
2. d
3. b
4. b
5. c
6. d
7. a
8. b
9. a
10. c
11. a
12. a
13. b
14. b
15. d
16. b
17. b
18. c
19. d
20. d
21. a
22. c
23. b
24. c
25. a
26. c
27. d

28. b
29. c
30. b
31. a
32. d
33. b
34. a
35. c
36. d
37. b
38. d
39. a
40. d
41. a
42. b
43. d
44. d
45. a
46. a
47. d
48. c
49. a
50. c
51. c
52. d
53. a
54. b
55. d
56. a
57. b

58. d
59. d
60. a
61. d
62. b
63. c
64. d
65. d
66. a
67. d
68. d
69. d
70. b
71. a
72. a
73. b
74. d
75. c
76. d
77. b
78. c
79. a
80. d

CHAPTER 24

1. b
2. a
3. c
4. d
5. d
6. b
7. b
8. c
9. a
10. d
11. b
12. c
13. b
14. a
15. b
16. a
17. c
18. a
19. d
20. b
21. d
22. c
23. d
24. a
25. b
26. b
27. a

28. d
29. b
30. d
31. b
32. b
33. b
34. b
35. a
36. a
37. a
38. b
39. a
40. c
41. b
42. d
43. d
44. c
45. b
46. c
47. b
48. c
49. a
50. b
51. a
52. b
53. b
54. b
55. b
56. d
57. d

58. b

59. b

60. a

Appendix

WORLD HEALTH DAY THEMES

Year	*Theme*
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
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	Active aging makes the difference
2000	Safe blood starts with me
2001	Mental health: Stop exclusion: Dare to care
2002	Move for health
2003	Healthy environments for children
2004	Road safety

2005	Make every mother and child count: Healthy mothers and children
2006	Working together for health
2007	International health security
2008	Protecting health from the adverse effects of climate change
2009	Save lives, make hospitals safe in emergencies
2010	Urbanization and health: Make cities healthier
2011	Antimicrobial resistance: No action today, no cure tomorrow
2012	Good health adds life to years
2013	Healthy heart beat, healthy blood pressure
2014	Vector-borne diseases: Small bite, big threat
2015	Food safety
2016	Halt the rise: Beat diabetes

WORLD HEALTH—DAYS OF IMPORTANCE

Day	*Importance*
30th January	Antileprosy day
22nd March	World water day
24th March	World TB day
7th April	World health day
22nd April	World habitat day
31st May	World no-tobacco day
1st July	Doctor’s day
11th July	World population 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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Joseph John