Questions and Answers in Community Dentistry

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Questions and Answers in Community Dentistry

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Dedication

This work is a dedication to all our teachers.

Foreword

In today's fast paced world where Perceive…Conceive…Believe…and Achieve are the mantras of success, it is imperative to be using streamlined and consolidated knowledge at every possible step.

This publication is a clear outcome of much deliberation between the authors Dr Pradnya and Dr Mamatha and their senior colleagues who have passionately dedicated themselves to the field of "Community Dentistry". The authors of this book are academicians having an impressive track record and an absolute exposure to the course curriculum as well as examination pattern.

This publication is impressive in terms that, it is systematically handled wherein there are a set of questions followed by the answers for different chapters in the subject. I am sure that this book will certainly help the student community to excel in their internal assessments and examination for the subject of Preventive and Community Dentistry.

I congratulate the authors and wish them all the very best in all their professional endeavors.

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Pune, India

Preface

There exist quite a many comprehensive books in the field of Preventive and Community Dentistry, and more and more published year on year; what is not easily accessible, is in fact a good compilation of the key topics to prepare for taking Under Graduate exam in the subject of Preventive and Community Dentistry.

With this very thought in mind, the journey to publish a good consolidation of the key topics began. The objective was to progress and achieve success on the following two axes—First: Focus on the key topics, filtered and well aligned with the University syllabus. Second: Provide answers to the filtered questions with simplistic precision, making it easy to understand as well as grasp with ease.

We hope that this compilation will provide you as a student, an easy access to informative material useful for the examination. Accept our best wishes and good luck for your examination and future.

Pradnya Kakodkar
Mamatha GS

Acknowledgments

We begin to look back at all the support members who helped us fulfill our noble objective of writing this book in the interest of the students.

At the very beginning, we wish to offer our heartfelt thanks to Dr RS Dolas, Dean, Dr DY Patil College and Hospital, Pimpri, Pune, India for his perennial cooperation and support.

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Special thanks to our dear friend Dr Aswini S (Community Dentist) who was very helpful during the manuscript preparation.

Words fall short when it comes to acknowledging the unceasing support and encouragement of our family members and friends. At every juncture they were there… nothing would have been probably possible without them.

Last but not the least, this book would not have been possible without the support of Shri Jitendar P Vij (Chairman and Managing Director) of M/s Jaypee Brothers Medical Publishers (P) Ltd. and Dr Shekhar Arora who helped us build the collaboration. Also, the efforts of Mr Tarun Duneja (Director Publishing), Mr KK Raman (Production Manager), Mr Pawan Kishor Tiwari (Proof Reader), Mr Abhinay Kumar Nigam (DTP Operator) and the entire dedicated team at the publishing house can simply not be fathomed.

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2. Discuss the changing concepts in public health.
3. Characteristics of public health method.
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5. Characteristics of public health techniques.
6. Define dental public health.
7. Functions of public health dentist.
8. a. Procedural steps in dental public health.
   b. Define community.
9. Tools of dental public health.
10. Similarities between public health dentist and private dentist.
11. Differences between public health dentist and private dentist.

ANSWER 1

Public health is defined as: "The art and science 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 individual in the 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 so as to enable every citizen to realize his birth right of health and longevity."—Winslow (1920).

ANSWER 2

Changing Concepts in Public Health

1. ***Disease control phase (1880–1920):*** Mainly aimed to control man's physical environment, e.g. water supply, sewage disposal, etc. Measures were not aimed to control specific disease but improve the health of the people due to disease and death.
2. ***Health promotional phase (1920–1960):*** It is realized that the public health had neglected the citizen as an individual, to overcome this, one more goal was added, along with disease control activities, i.e. health promotion of individuals. As a beginning, personal health services such as Mother child health services, School health services, and Industrial health services were initiated. This program was further expanded, which included:
   a. Provision of basic health services through Primary Health Centers and sub-centers for rural and urban area.
   b. Community development program to promote village development through the active participation of whole community. However, this failed due to inadequate resources.
3. ***Social engineering phase (1960–1980):*** Many of the acute illness problems were solved but new health problems began to appear, as the preventive medicine and practice of public health advanced. Chronic disease like diabetes, cardiovascular disease, cancer, alcoholism, etc. began to emerge in developed world. These could not be solved by isolation, immunization and disinfections. A new factor "risk factors" as determinants of these diseases came into existence. Social and behavioral aspects of disease and health were given new priority.
4. ***Health for all phase (1981–2000 A.D):*** Most people in the developed countries enjoy all the determinants of good health, in contrast only 10–20% in developing countries have access to health services. It was concluded that the neglected 80% of the world population have an equal claim to health care, protection from killer diseases of childhood and to the primary health care for mothers and children. Against this background, in 1981, the members of WHO pledged themselves to an ambitious target to provide "Health for all by the year 2000;" i.e. attainment for all of a level of health that will permit all people to lead a socially and economically productive life. Here, services were moved from control of communicable diseases to preventive, therapeutic, rehabilitative aspects of chronic disease and behavioral disorders, organization of medical care, safe drinking water, sanitation, nutrition, education, adequate income and comprehensive health care.

The present form of public health is the combination of scientific disciplines [like epidemiology, Social sciences, demography] and skills and strategies (like epidemiological investigations, planning and management, interventions and surveillance evaluation) that are directed to the maintenance and improvement of the health of the people.

ANSWER 3

Characteristics of Public Health Method

1. Group responsibility.
2. Team work.
3. Prevention. (It is a major objective because it is ethical, involves team work and is cost effective).
4. Counteracting medical indigence.
5. Dealing with multifactorial problem (using the science of epidemiology and biostatistical methods).
6. Deals with healthy or apparently healthy people as well as the sick.
7. Health education of the public.
8. Social sciences.
9. Logistics.
10. Insurance/payment.

ANSWER 4

(Same as answer 3).

ANSWER 5

Characteristics of Public Health Techniques

The important techniques are:

1. Use of health center,
2. Case finding and
3. Use of community health council.

1. ***Health center:*** These are community buildings to house health administration and a number of out-patient or preventive services not easily housed in a hospital. Usually each center is for 50,000 to 1,00,000 population. Large cities will have many centers. A variant of this health unit in some countries are school based dental clinics.

2. ***Case finding:*** It is also called "Screening". The objective of this is to search the diseases in the community in their early stage through simple tests.

3. ***Community health council:*** These councils consists of people in the community from both voluntary and government agencies and community at large. These are associated with community fund raising efforts, interaction with various health agencies and public for development of new ideas. These agencies and councils not only serve as media for communication, but also have approval/disapproval power over both new and existing institutional health services in their areas.

ANSWER 6

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

ANSWER 7

Functions of Public Health Dentist

1. Conduct health education programs to create awareness among people.
2. Educating and motivating an individual or community to utilize rendered dental services.
3. To organize dental camps and delivering dental services for the needy like people in rural areas, orphanages, mentally/physically compromised children, etc.
4. Conducting school dental health programs and providing preventive dental care to the school children like topical fluoride applications, pit and fissure sealants.
5. Conducting dental treatment camps and providing treatments like extractions, oral prophylaxis, fluoride applications, simple restorations, ART, etc. in schools or in community for general public.
6. Updating the knowledge of people regarding new dental preventive methods and procedures.
7. Conducting surveys to collect baseline data, know the nature and extent of the diseases in the community and plan programs accordingly, to decrease the incidence of the diseases.
8. Conducting dental public health activities and field experiences for dental students and dental nursing students.

ANSWER 8A

Procedural Steps in Dental Public Health

1. ***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.
2. ***Analysis:*** It is necessary to arrange or organize the data collected from the survey in such a way that meaningful figures are obtained. Analysis can be done manually or using computers.
3. ***Program planning:*** After analyzing the problem, the next step is program planning. The objective is to design the plan so that it is accepted by the community and in which they are interested in, which is comprehensive and cheaper. It has to be ensured that the community is well informed about the program so that they participate in all the steps involved.
4. ***Program operation:*** Execution of the program once the plan has been accepted. A public health team, which constitutes of professionals in various disciplines, has to be employed for executing the program. Example: Water fluoridation, which includes a team of dentists, engineers, chemists, water works department, public health authorities.
5. ***Financing:*** Financing in public health program is usually through the government or by the local or state authorities. Before planning a program, public health personnel should identify the source of funds and also plan for management of the same.
6. ***Program appraisal:*** Final step in any public health program where effectiveness of the program is assessed. The baseline data prior to the introduction of the program serves as an indicator against the effectiveness of the program after the implementation. The criteria for evaluation are appropriateness, adequacy, effectiveness and efficiency.

ANSWER 8B

A community is a definite group of people or population having common organization, living in the same region or area following similar rules and regulations under the same environment.

ANSWER 9

Tools of Dental Public Health

1. ***Epidemiology:*** Epi = upon, demos = people, logos = science.
   Is defined as "the study of the distribution and determinants of health

related states and events in population and the application of the study to the control of health problems". It aims to minimize or eradicate the disease or health problem and its consequences and to minimize the chances of its occurrence in future. It also helps to define the magnitude and occurrence of disease in man, identify the etiologic factors and provide necessary data for planning, implementation and evaluation of programs for preventing, controlling and treating diseases.

2. ***Biostatistics:*** Is a branch of statistics concerned with mathematical facts and data relating to the biological events. It involves compiling, analyzing, tabulating and representing the data in the mathematical or graphical manner. It gives the correlation or association between two attributes.
3. ***Social sciences:*** It includes sociology, cultural anthropology, social psychology, economics and political science. Public health worker when emphasizes on organized community effort, it is necessary to know the group behaviors of individuals, their culture, customs and habits etc. Social scientists are the persons, who play an important role in understanding the group behavior and are necessary to match effort and effect.
4. ***Principles of administration:*** There are two main divisions in administrative work: Organization and Management.
   a. *Organization:* Which deals with the structure of an agency and the way people are arranged into groups within it.
   b. *Management:* Concerned with the handling of personnel and operations in such a way that the work of the agency gets done.
5. ***Preventive dentistry:*** Prevention is better then cure, so prevent the disease before it starts. Different levels of prevention are:
   a. *Primary prevention:* Health promotion (Health education, lobby efforts and research) and Specific protection is protecting the oral cavity from disease before it occurs. (water fluoridation, plaque control, immunization).
   b. *Secondary prevention:* Disease is in its initial stages. Includes Early diagnosis and prompt treatment (simple restorations, scaling).
   c. *Tertiary prevention:* Disease is in advanced stage which includes disability limitation (e.g. Root canal treatment, extractions and rehabilitation, e.g. removable or fixed prosthesis, implants, maxillofacial prosthesis).

ANSWER 10

Similarities Between Public Health Dentistry and Clinical Dentistry

Public health dentistry	*Clinical dentistry*
1. ***Survey:*** Is done to determine the nature and extent of the problem in the community.	1. ***Examination:*** It is done when patient comes to dental clinic with a complaint.
2. ***Analysis:*** It is the procedure of converting collected raw data into meaningful figures using statistical methods to define the characteristics of specific community health problems. Usually professional statistician is involved.	2. ***Diagnosis:*** The information collected by examination guides the clinician to obtain accurate diagnosis.
3. ***Program planning:*** Depending on the problem seen in the community, a program is planned, e.g. to decrease the incidence of dental caries, community water fluoridation can be planned.	3. ***Treatment planning:*** Once the diagnosis is done clinician will proceed to make plans for the treatment.
4. ***Program operation:*** Various groups of disciplines may be needed to be involved to carry out a program and should be accepted by all of them who are involved.	4. ***Treatment:*** Actual treatment is carried out on patient, in complicated cases patient is referred to specialist.
5. ***Program funding:*** Community health programs are financed by local, state or central government or by voluntary organizations, but loss of funds may cause abortment of the plan.	5. ***Payment:*** The patient does payment for the treatment immediately after treatment or on monthly basis.
6. ***Program appraisal:*** Data obtained in the initial survey is used as baseline information followed by observing the efficacy, appropriateness and possible side effects.	6. ***Evaluation:*** Effectiveness of the treatment is assessed by observing the patient during each visit and by recall.

ANSWER 11

Differences Between Private Dental Practice and Public Health Dentistry

	Private dental practice	*Public health dentistry*
Goal	Direct	Indirect
Focus	Individual patient	Whole community
Pathogenesis	Post pathogenesis	Pre and post pathogenesis
Resources	Limited	Unlimited
Care provided	Individual	Community
Finance	Patient	Government or other funding agency
Benefits	Less	More
Intervention	Appropriate dental treatment	Preventive measures
Service provider	Services are provided by dentist alone or sometimes with any dental auxiliaries	By health team professionals and para- professionals, community volunteers
Examination method	ADA Type 1 and Type 2	ADA Type 3 and Type 4
Tools	Clinical examination, investigations like radiography, blood tests, biopsies, etc. and treatment	Epidemiology, biostatistics, social sciences, principles of administration and preventive dentistry

2 Health and Disease

QUESTIONS

1. Define health.
2. Explain the changing concepts of health.
3. Dimensions of health.
4. Spectrum of health.
5. Indicators of health.
6. Determinants of health.
7. Concepts of disease causation.
8. What is meant by tenet of epidemiology?
9. Explain the term "Natural history of disease".
10. What is iceberg of disease?
11. Incubation time.
12. Epidemiological triad.
13. Risk factor.
14. Risk groups/Risk approach.
15. Mortality.
16. Morbidity.
17. Tooth mortality.
18. Spectrum of disease.

ANSWER 1

"Health is a state of complete physical, mental and social well-being and not merely an absence of disease or infirmity" given by WHO in 1948.

ANSWER 2

Changing Concepts of Health

In a world of continuous changes new concepts are bound to emerge based on new patterns of thought. Health has evolved over centuries as a concept

from an individual concern to a world wide social goal. The brief account of the changing concepts of health is as follows.

1. ***Biomedical concept:*** This concept has its basis in the germ theory of diseases which dominated medical thought at the turn of the 20th century. The medical profession viewed the human body as a machine, disease as a consequence of breakdown of the machine and one of the doctors task as repair of the machine. Thus health in this narrow view was termed as absence of disease. This concept minimized the role of environment, social, physiological and cultural determinants of health. Developments in medical and social sciences led to the conclusion that biomedical concept of health was inadequate.
2. ***Ecological concept:*** The ecologists put forward an attractive hypothesis which viewed health as a dynamic equilibrium between man and his environment and disease as maladjustment of the human organism to environment.
3. ***Psychosocial concept:*** Contemporary development in social sciences revealed that health is not only a biomedical phenomenon but one which is influenced by social, psychological, cultural, economic and political factors of the people concerned. These factors must be taken into consideration in defining and measuring health. Thus health is both a biological and social phenomenon.
4. ***Holistic concept:*** It is a synthesis of all the above mentioned concepts. It recognizes the strength of social, economic, political and environmental influences on health. This implies a sound mind in a sound body in a sound family in a sound environment. It implies that all sectors of society have a effect on health.

ANSWER 3

Health is multidimensional. The various dimensions function individually in its own nature and interact with one another and thus constitutes to health. Dysfunction or disturbance in the equilibrium of the various factors will alter the health. The different dimensions of health are:

Physical Dimension

It is probably the easiest to understand. 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. The signs of physical health in an individual are: A good complexion, clear skin, bright eyes, lustrous

hair with a body well clothed with firm flesh not too fat, a sweet breath, good appetite, sound sleep, regular activity of bowel and bladder, smooth and easy coordinated bodily movements and all the organs and other bodily activities are within the range of normality for the individuals age and sex.

Mental Dimension

The mental health has been defined as a state of balance between the individual and the surrounding world, a state of harmony between oneself and others, a co-existence between the realities of the self and that of the other people and that of the environment. The mind and body were considered independent entities but however researchers have discovered that psychological factors can induce all kind of illness, not simple mental ones.

Social Dimension

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. It includes the levels of social skills one possesses, social functioning and the ability to see oneself as a member of the larger society. Social health is routed in "positive material environment" and "positive human environment" which is concerned with the social network of the individual.

Spiritual Dimension

Spiritual health in this context refers to that part of the individual which reaches out and strives for meaning and purpose in life. Proponents of holistic health believe that time has come to give serious consideration to the spiritual dimension and to the role this plays in health and disease. Spiritual health is the intangible "something" that transcend physiology and psychology.

Emotional Dimension

Historically the mental and emotional dimensions have been seen as one element or as two closely related elements. However as more research becomes available, a definite difference is emerging. Mental health can be seen as "knowing" or "cognition" while emotional health relates to feelings.

Vocational Dimension

It is a new dimension. It is part of human existence and plays a role in promoting both physical and mental health. The importance of this dimension

is exposed when individuals suddenly loose their job or is faced with mandatory retirement.

Others

A few other dimensions have also been suggested such as: philosophical dimension, cultural dimension, socio-economical dimension, environmental dimension, educational dimension, nutritional dimension, curative dimension, and preventive dimension.

ANSWER 4

Health and disease lie along a continuum and there is no single cut-off point. The lowest point on the spectrum is death and the highest point is the positive health **(Fig. 2.1)**. The spectral concept of health emphasizes that the health of an individual is not static, it is a dynamic phenomenon and a process of continuous change within a range of optimum well being to various levels of dysfunction, including the state of total dysfunction namely the death. What is considered maximum health today may be considered minimum tomorrow. It implies that health is a state not to be attained once and for all but ever to be renewed.

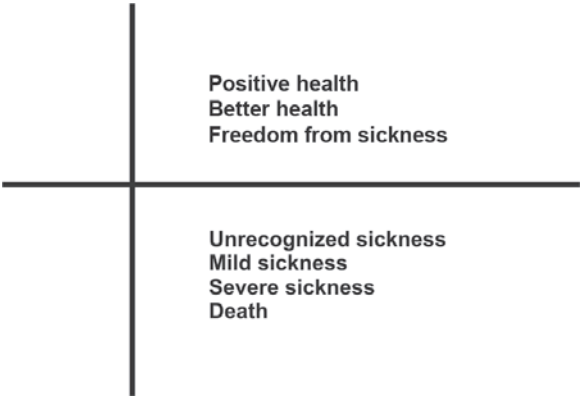


Fig. 2.1: The health-sickness spectrum

ANSWER 5

Indicators of health are required not only to measure the health status of the community but also to compare the health status of one country with that of the another for assessment of healthcare needs, for allocation of scarce resources and for monitoring and evaluation of health services, activities and programs. Since health is multidimensional there are a number of indicators which 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. Socio-economic indicators.
10. Health policy indicators.
11. Indicators of quality of life.
12. Other indicators (e.g. social indicators, basic needs indicators and health for all indicators).

ANSWER 6

Health is multi-factorial. The factors which influence health lie both within the individual and externally in the society in which he or she lives. These factors interact and these interactions maybe health promoting or deleterious. The most important determinants of health are heredity, environment, lifestyle, socio-economic conditions, health and family services and other factors.

1. ***Heredity:*** The physical and mental traits of every human being are to some extent determined by the nature of his/her genes at the moment of conception. The genetic makeup is unique and it can not be altered after conception. A number of diseases are known to be of genetic origin, e.g. chromosomal anomalies, errors of metabolism, mental retardation, some type of diabetes, etc. The state of health therefore depends partly on the genetic constitution of man.
2. ***Environment:*** Environment is classified as internal and external. Internal environment of man pertains to each and every component, part, tissue, organ and their harmonious functioning within the system. The external or "Macro environment" consists of those things to which the man is exposed after conception (all that which is external to the individual human host). These can be divided into physical, biological and psycho-social components all of which can affect the health of man and his susceptibility to illness. There is this other term, "Micro environment" which includes individual's way of living and lifestyle, e.g. eating and other habits. The environmental factors play a very important role in determining health of the individual.

3. ***Lifestyle:*** Lifestyle means the way people live and this reflects the social values, attitudes, activities, culture, behavioral patterns and personal habits. Health requires the promotion of healthy lifestyles. Many current day health problems like obesity, lung cancer, drug addiction, heart disease, diabetes are associated with lifestyle changes.
4. ***Socioeconomic conditions:*** For years health has been a privilege and not a right. Socioeconomic conditions have long been known to influence health.
   a. The per capita GNP is the most widely accepted measure of general economic performance. The economic status determines the purchasing power, standard of living, quality of life, family size, health care and the pattern of disease in the community. Ironically affluence may also be a contributing cause of illness, e.g. coronary heart disease, diabetes and obesity in upper socio economic groups.
   b. *Education:* The second major factor influencing health status is education. The world map of illiteracy closely coincides with the maps of poverty, malnutrition, ill health and high child mortality rates. Studies indicate that education to some extent compensates the effects of poverty on health. Kerala in India is a striking example of highest literacy rate and lowest infant mortality rate.
   c. *Occupation:* The very state of being employed in productive work promotes health. For many, loss of work may mean loss of income and status. It can cause psychological and social damage.
   d. *Political system:* Health is also related to country's political system. The resources allocation, manpower policy, choice of technology and the degree to which health services are made available to different sects of people are governed by the political system. If the health pattern of the community has to be changed, the political as well as social and economical actions are required.
5. ***Health and family welfare services:*** The term "Health and family welfare services" cover a wide spectrum of personal and community services for treatment of diseases, prevention of illness and promotion of health. The purpose of health services is to improve the health status of the population. E.g. immunization of children, safe drinking water, care of pregnant women, etc are all part of health services which must reach the social periphery, should be equally distributed, accessible at a cost which the country and community can afford and socially acceptable. All these are ingredients of what is now termed as primary health care.

6. ***Other factors:*** Other contribution to health of population, derived from systems outside the formal healthcare system, e.g. food and agricultural, industry, rural development and social welfare. These systems would assist in raising the standard of living, would increase the employment opportunities, provide medical programs and support family programs. In short medicine is not the sole contributor to the well being of the population, the potential of intersectoral contribution is the demand of the hour.

ANSWER 7

Concepts of Disease Causation

1. ***Germ theory of disease:*** This concept gained momentum during the 19th and the early part of 20th century. The emphasis had shifted from empirical causes (e.g. bad air) to micro organisms as the sole cause of disease. The disease model was referred to as one to one relationship between causal agent and disease.
   Disease agent → Man → Disease
   The realization that disease is rarely caused by a single agent alone and multiple factors are responsible, leads the germ theory of disease to be obsolete.
2. ***Epidemiological triad:*** This encompasses a broader concept of disease causation. It includes factors like the agent, the host and the environment. A new dimension of "time" factor is also included, which makes it an epidemiological tetrad. This model has helped epidemiologists to focus on different classes of factors, especially with regards to infectious disease.
3. ***Multifactorial causation:*** Pettenkofer of Munich was an early proponent of the concept that disease is due to multiple factors. The modern days, diseases like lung cancer, bronchitis, chronic heart diseases, mental illness etc. could not be explained on the basis of the germ theory and that there are often other factors like social, cultural, economical, genetic, psychological, etc. which play a role in disease occurrence. This theory de-emphasizes the concept of disease agent and stresses multiplicity of interactions between host and environment. This multifactorial concept offers multiple approaches for the prevention/control of disease.
4. ***Web of causation:*** This model of disease causation was suggested by Macmohan and Pugh. This model is ideally suited in the study of chronic diseases where the disease agent is often not known but is the outcome of interaction of multiple factors. It considers all the predisposing factors of any type and their complex inter relationship with each other. The web

of causation suggest that removal or elimination of just one link or chain may be sufficient to control disease, provided that link is sufficiently important in the pathogenesis process.

5. ***Seesaw concept (Fig. 2.2):*** Another concept of inter-relationship of factors is the seesaw concept. In this the agent of the disease (A) and the host (H) are at the opposite end of the seesaw and the fulcrum is the environment (E). The health of the individual is a balance between the virulence of the etiological agent and the susceptibility/resistance and the favorability of the environment.

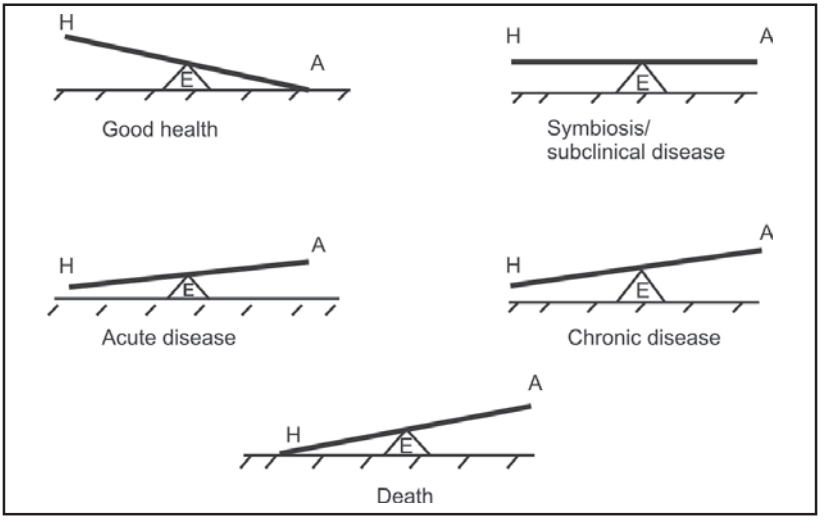


Fig. 2.2: Seesaw concept

ANSWER 8

The basic tenet of epidemiology refers to the study of the clusters of causes and the combination of effects and how they relate to each other.

ANSWER 9

The term ''Natural history of disease" is a key concept in epidemiology. It signifies the way in which disease evolves over the time from the earlier stage of its prepathogenesis phase to its termination as recovery and disability or death. This can be studied under two phases.

1. ***Prepathogenesis phase:*** This refers to the period before the onset of disease in man. The disease agent has not yet entered man but the factors which favor its interaction with the human host are already existing in the environment. This situation is frequently referred to as "Man in the midst of disease" or "Man exposed to the risk of disease".

2. ***Pathogenesis phase:*** This phase begins with the entry of the disease agent in the susceptible human host. The further events in the pathogenesis phase include disease agent multiplication, physiological changes, progression of disease through a period of incubation and later through early and late pathogenesis. The final outcome of the disease may be recovery and disability or death. The pathogenesis phase could be modified by intervention measures such as immunization and chemotherapy.

ANSWER 10

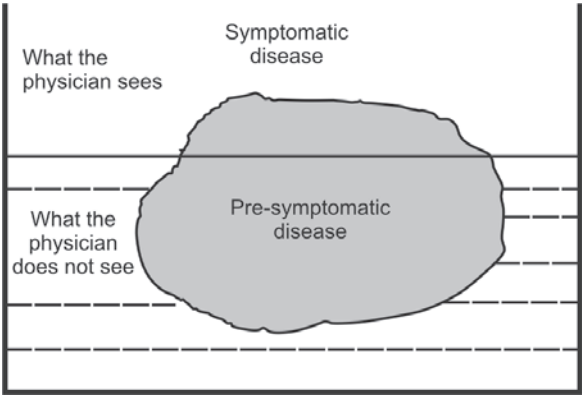


Fig. 2.3: Iceberg phenomenon

According to this concept disease in a community can be compared to an iceberg **(Fig. 2.3)**. The floating 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 the disease, i.e. the latent, in apparent, presymptomatic and undiagnosed cases and carriers in the community. The waterline represents the demarcation between the apparent and the inapparent disease. 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 of prevention. One of the major deterrents in the study of chronic diseases of unknown etiology is the absence of methods to detect the sub-clinical state (bottom of the iceberg).

ANSWER 11

Incubation Period

It is defined as the time interval between invasion by an infectious agent and appearance of the first sign and symptom of the disease in question. The incubation period varies for different infectious diseases and also from one person to another with the same disease. In some, incubation period is very short. The length of incubation period is characteristic of each disease.

Short incubation time: Few hours or 2–3 days (e.g: staphylococci food poisoning, cholera, bacillary dysentery).

*Medium incubation time:*10 days to 3 weeks (e.g: typhoid, viral diseases like chickenpox, mumps).

Long incubation time: Months to years (Hepatitis A,B, rabies, etc.).

Incubation time is of fundamental importance in epidemiological studies:

1. Tracing the source of infection and contacts.
2. To determine the period of surveillance.
3. For immunization.
4. To identify the point source or propagated epidemics.
5. To estimate the prognosis of a disease.

ANSWER 12

Epidemiological Triad (Fig. 2.4)

This encompasses a broader concept of disease causation. It includes factors like the agent, the host and the environment. These factors should interact over a period of time for the disease to occur.

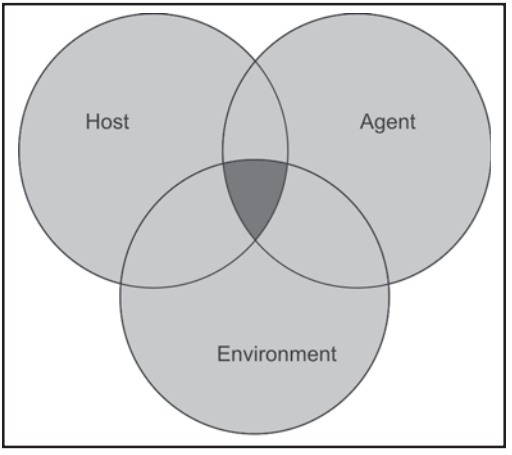


Fig. 2.4: Epidemiological triad

Agent

The disease 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 may be classified broadly into the following groups:

1 ***Biological agents:*** These are living agents of disease—viruses, rickettsiae, fungi, bacteria, protozoa and metazoa. The occurrence of the disease is based on the infectivity, pathogenicity and virulence of the organism.

2. ***Nutrient agents:*** Any excess or deficiency in the intake of proteins, fats, carbohydrate, vitamins, minerals and water may result in nutritional disorders.
3. ***Physical agents:*** Exposure to excess heat, cold, humidity, pressure, radiation, electricity sound, etc. may result in illness.
4. ***Chemical agents:*** Endogenous- some of the chemicals may be produced in the body as a result of derangement of function, e.g. urea (uremia), serum bilirubin (jaundice), ketones (ketosis), uric acid (gout). Exogenous- agents arising outside of human host, allergens, metals, fumes, dust, gases, etc. These may be acquired by inhalation, ingestion or inoculation.
5. ***Mechanical agents:*** Exposure to chronic friction and other mechanical forces may result in crushing, tearing, sprains, dislocation and even death.
6. ***Social agents:*** Poverty, abuse of drugs, unhealthy lifestyles, social isolation, etc.

Host

In epidemiological terminology, the human host is referred to as soil and the disease agent as the seed. The host factors may be classified as:

1. Demographic characteristics—e.g. age, sex, ethnicity, residence, occupation, etc.
2. Biological—e.g. genetic, biochemical, immunological, physiological, etc.
3. Social and economic factors.
4. Lifestyle—e.g. nutrition, personality traits, habits, alcohol, exercise, etc.

The association of a particular disease with a specific set of host factors frequently provide an insight into the cause of the disease.

Environment

The external or the macro-environment is defined as "all that which is external to the individual human host, living and non-living and with which he is in constant interaction.

1. ***Physical environment:*** It is applied to non-living things and physical factors (air, water, soil, housing, etc.)
2. ***Biological environment:*** It is the universe of the living things which surrounds man, including man himself. The living things are the viruses and other microbial agents, insects, rodents, animals and plants . These are constantly working for the survival and in this process, some of them Act as disease-producing agents, reservoirs of infection, intermediate hosts and vectors of disease.
3. ***Psychosocial environment:*** It includes a complex of psychosocial factors which are defined as those factors affecting personal health, health care

and commonly well being that stem from the psychosocial make up of individuals and structure and functions of social groups. They include cultural values, customs, beliefs, attitudes, morals, religion, education, lifestyle, community life, healthcare services, social and political organization.

A stable and a harmonious equilibrium between man and his environment is needed to reduce man's vulnerability to disease and to permit him to lead a more satisfying and a productive life.

ANSWER 13

Risk Factor

When the disease agent is not firmly identified, the etiology of a disease is generally discussed in terms of risk factors. They are often suggestive, but not a absolute proof of cause and effect relation. The risk factors may be truly causative (e.g. smoking and lung cancer), they may be merely contributory to the undesired outcome (e.g. lack of exercise is a risk factor for coronary heart disease), they may have a additive or synergistic effect (e.g. alcohol exerts synergistic effect with tobacco in the occurrence of oral cancer), or they may be predictive in the statistical sense (e.g. illiteracy for perinatal mortality). Some risk factors may be modified and thus can help in the process of prevention, while some cannot be modified (e.g. age, sex, race, family, genetic factors, etc.). Epidemiological methods are needed to identify risk factors and estimate the degree of risk.

Examples of Risk Factors

1. Dental caries—Risk factors: Sugar, malocclusion, poor oral hygiene, xerostomia, etc.
2. Periodontal disease—Risk factors: Plaque, calculus, overhanging restorations, etc.
3. Oral cancer—Risk factors: Tobacco, alcohol, virus, iron deficiency, etc.
4. Heart disease—Risk factors: Obesity, smoking, blood-pressure, elevated serum cholesterol.

The detection of the risk factors should be considered a prelude to prevention or intervention.

ANSWER 14

In "risk approach" strategy the care is first directed towards the identified risk groups or target groups who need more care and attention, unlike the

"population strategy", where the resources are directed towards the whole population. This kind of approach helps in saving the resources and also attending those people who need urgent care. The guidelines for defining "at risk groups" are:

1. ***Biological situation***
   Age groups: Infants, toddlers, geriatric population.
   Sex: Females in the reproductive age.
   Physiological state: Pregnancy, cholesterol levels, high blood pressure.
   Genetic factors: Family history of genetic disorder.
   Other health conditions: Disease, physical malfunctioning, unhealthy behavior.
2. ***Physical situation***
   Unhealthy living conditions, locality (rural, urban slums), overcrowding.
   Environmental conditions: Poor water supply, proximity to industries.
3. ***Socio-cultural and cultural situation***
   Social class: Lower socio-economic class
   Customs: Harmful to health.
   Lifestyles: Consuming high cholesterol diet, increased sugar consumption, etc.
   Habits: Those smoking, chewing tobacco, alcohol users, etc.
   Lack of education and lack of access to healthcare.

ANSWER 15

Mortality (Death)

Mortality indicators represent the traditional measures of health status. They are probably the most often used indirect indicators of health. The mortality indicators are:

- Crude death rate
- Expectation of life
- Infant mortality rate
- Child mortality rate
- Maternal mortality rate
- Disease specific mortality rate
- Proportional mortality rate.

ANSWER 16

Morbidity is defined as any departure, subjective or objective, from a state of physiological well being. According to Dorland, it is the condition of being diseased or morbid. The morbidity indicators are:

- Incidence and prevalence
- Notification rates
- Attendance rate at the out-patient department
- Admission, readmission and discharge rate
- Duration of stay in the hospital
- Spells of sickness or absence from work.

ANSWER 17

Tooth Mortality

It is the number of teeth lost divided by total number of the teeth present.

ANSWER 18

Spectrum of Disease (Fig. 2.5)

It is a graphical representation of variations in the manifestations of disease. It is similar to the spectrum of light where the colors vary from one end to the other, but difficult to determine where one color ends and the other begins. At one end of the disease spectrum are subclinical infections which are not ordinarily identified and at the other end are the 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. In infectious diseases, the spectrum of diseases, is also referred to as the "gradient of infection".

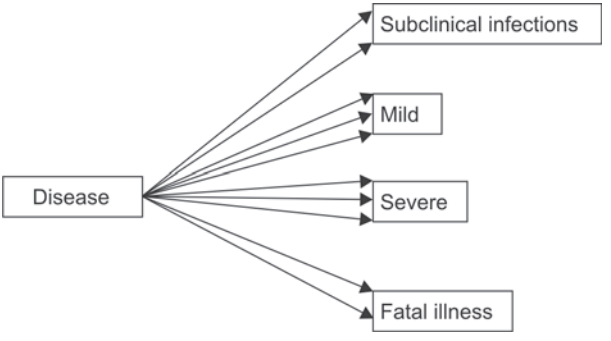


Fig. 2.5: Spectrum of disease

3 General Epidemiology

LONG QUESTIONS

1. Define epidemiology. Aims of epidemiology and uses of epidemiology. What are the different types of epidemiological studies?
2. Describe the procedural steps in descriptive epidemiology.
3. Compare and contrast the retrospective and prospective studies.
4. Experimental epidemiology.
5. How do you design an epidemiological investigation? Write a note on scientific method in epidemiology.

SHORT NOTES

6. Tools of measurements.
7. Incidence.
8. Prevalence.
9. Cross-sectional study.
10. Longitudinal study.
11. Bimodality.
12. Case control study.
13. Cohort study.
14. Bias.
15. Odd's ratio. (Refer Ans 12)
16. Attributable risk. (Refer Ans 13)
17. Relative risk. (Refer Ans 13)
18. RCT (Randomized control trials).
19. Blinding.
20. Analytical studies.
21. Non-randomized control trials.
22. Epidemic.

23. Pandemic.
24. Exotic.
25. Zoonosis.
26. Epizootic.
27. Endemic.
28. Surveillance.
29. Quarantine.
30. Cohort.
31. Principles of epidemiology.
32. Confounding factor.
33. Epidemiologist.

ANSWER 1

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

Aims of Epidemiology

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

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

Uses of Epidemiology

- To study historically the rise and fall of disease in the population
- To identify and quantify the health problems in a community
- The epidemiological data is used for planning, developing and evaluation of the health services
- To evaluate the degree of individual's risk for the disease
- Syndrome identification
- To study the disease pattern in the community
- To identify the cause and the risk factors of the disease.

Different types of epidemiological studies:

1. Descriptive epidemiology.
   - Cross-sectional study
   - Longitudinal study.
2. Analytical epidemiology.
   - Case control study
   - Cohort study.
3. Experimental epidemiology.
   - Randomized controlled trials
   - Non-randomized trials.

ANSWER 2

The procedures involved in descriptive study are as follows:

1. Defining the population to be studied.
2. Defining the disease under study.
3. Describing the disease.
4. Measurement of disease.
5. Comparing with known indices.
6. Formulation of etiological hypothesis.

Defining the Population to be Studied

The first step is therefore to define the population base. Defined population can be the whole population in a geographic area, or specifically selected group such as age, sex, occupational, cultural characters and school children. The community chosen should be stable, without migration. Community participation is essential.

Defining the Disease Under Study

The disease is defined in such a way that it helps in identifying and measuring the disease in the defined population with a degree of accuracy.

Describing the Disease

The occurrence and distribution of disease is described by time, place and person.

Time: Year, season, month, week, day, hour of onset and duration

Place: Climatic zones, country, region, urban/rural, local community, town, cities, institutions.

Person: Age, sex, race, marital status, socio-economic status, occupation, education, dietary habits, personal habits and physical and systemic information.

Time Distribution

The epidemiologists have identified three kinds of time trends or fluctuations in disease occurrence.

1. Short-term fluctuations.
2. Periodic fluctuations.
3. Long-term fluctuations.

1. ***Short-term fluctuations:*** The epidemic is the best known example for short term fluctuation. The three major types of epidemics may be distinguished as:

   a. Common source epidemics
   b. Propagated epidemics
   c. Slow epidemic

   a. *Common source epidemics or point source epidemics:*

      i. Single exposure: These are known as point source epidemics. The exposure of diseased agent is brief and essentially simultaneous; the resultant cases all develop within one incubation period, e.g. food poisoning.

      ii. Continuous or multiple exposures: Some times the exposure from same source may be prolonged, continuous repeated or intermittent-not necessarily at the same time or place, e.g. contaminated well water.

   b. *Propagated epidemics:* It is most often of infectious origin and results from arthropod vector/animal reservoir/person to person transmission of an infectious agent, e.g. epidemics of hepatitis A and polio.

   c. *Slow epidemic:* This is well known for non-communicable diseases which are lifestyle related, e.g. diabetes, ischemic heart disease, obesity, etc. These conditions take a long time to manifest and are slowly progressive in nature.

2. ***Periodic fluctuations***

   a. *Seasonal trend:* It is well known for many communicable diseases. The seasonal variations of disease occurrences may be related to environmental condition, e.g. temperature, humidity, rainfall, overcrowding, life cycle of vectors, etc. which directly or indirectly favor disease transmission, e.g. measles is common in early spring, upper respiratory diseases is common in winter, gastrointestinal infection common in summer.

b. *Cyclic trend:* Some diseases occur in cycles spread over short periods of time which may be days, weeks, months, years, e.g. measles was found to appear in cycles with major peaks every 2–3 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 or time, generally several years or decades, e.g. coronary heart disease, lung cancer, diabetes are increasing in developed countries and TB, typhoid and polio are decreasing in developed countries.

Place Distribution

It is the study of geographical distribution of cases in different population. By studying this variation, the disease pattern has been found. The distribution of diseases according to places can be classified as:

1. International variation
2. National variation
3. Rural/urban differences
4. Local variation.

1. ***International variation:*** Descriptive studies by place have shown that the pattern of disease is not the same everywhere. For example we know cancer exists all over the world, but the incidence of different types of cancer varies with respect to the places. Cancer of the stomach is very common in Japan but unusual in US. Cancers of the oral cavity and uterine cervix are exceedingly common in India as compared to industrialized countries.
2. ***National variation:*** Variation in the prevalence and incidence of the disease occurrence exists within countries or national boundaries. For the example the distribution of endemic goiter, lathyrism, flourosis, guinea –worm disease, leprosy, malaria, nutritional deficiency diseases have all shown variations in their distribution in India, with some parts of the country more affected and others less affected or not affected at all.
3. ***Rural/urban variation:*** Rural/urban variations in disease distribution are well known. Chronic bronchitis, accidents, lung cancer, cardio-vascular diseases, mental illness and drug dependence are usually more frequent in urban than in rural areas. On the other hand skin, zoonotic diseases and soil-transmitted helminths may be more frequent in rural areas than in urban areas.
4. ***Local distribution:*** 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. It was a spot map of fatal cases by John Snow of England in his classic investigation of cholera epidemic in 1854 in the golden square district of London, which could focus attention on the common water pump in board street as the source of infection.

Person Distribution

In descriptive studies, the disease is further characterized by defining the persons who develop the disease by age, sex, occupation, marital status, habits, social class and other host factors. These factors do not necessarily represent etiological factors, but they contribute a good deal to our understanding of the natural history of disease.

1. ***Age:*** Age is strongly related to disease than any other single host factor. Certain diseases are more frequent in certain age groups than in others, e.g. measles in childhood, cancer in middle aged and atherosclerosis in old age.
2. Sex: It is another host characteristic which is often studied in relation to disease. It has been found that certain chronic diseases such as diabetes, hyperthyroidism and obesity are strikingly more common in women than men and diseases such as lung cancer and coronary heart diseases are less frequent in women.
3. ***Ethnicity:*** Differences in disease occurrence have been noted between population subgroups of different racial and ethnic origin. Differences whether they are related to genetic or environmental factors have been a stimulus to further studies.
4. ***Marital status:*** In countries where studies on mortality in relation to marital status have been conducted, it was found that mortality rates were always lower for married males and females than for the unmarried, of the same age and sex.
5. ***Occupation:*** It may alter the habit pattern of employees, e.g. sleep, alcohol, smoking, drug addiction, night shifts, etc. It is obvious that persons working in particular occupations are exposed to particular types of risks. Workers in coal mines are more likely to suffer from **silicosis**.
6. ***Social class:*** Individual in the upper social classes has a longer life expectancy and better health and nutritional status than those in the lower social classes. Certain diseases (e.g. coronary heart disease, hypertension and diabetes) have shown a higher prevalence in upper classes than in lower classes.

7. ***Behavior:*** Human behavior is increasingly looked upon as a risk factor in modern-day diseases such as coronary heart diseases, cancer, obesity and accidents. The behavioral factors which have attracted the greatest attention are cigarette smoking, sedentary life, over-eating and drug abuse.
8. ***Stress:*** Stress has been shown to affect a variety of variables related to patients response, e.g. susceptibility to disease, exacerbation of symptoms.
9. ***Migration:*** In India diseases like **leprosy, filaria** and **malaria** are considered to be rural problems. However, because of the movement of people from rural to urban areas these diseases have created a serious problem in urban areas also.

Measurement of Disease

It is mandatory to have a clear picture of the amount of disease ("disease load") in the population. This information can be available in terms of mortality, morbidity, disability and so on. When calculating morbidity it can be expressed as prevalence and incidence rate.

Comparing with Known Indices

The essence of epidemiology is to make comparisons and ask questions. By making comparison between different population and sub -groups of the same population, it is possible to arrive at clues of disease etiology. It also helps in identifying groups, who are at risk for certain diseases.

Formulation of Hypothesis

By studying the distribution of disease and utilizing the techniques of descriptive epidemiology, it is often possible to formulate hypothesis relating to disease etiology. Hypothesis is a supposition, arrived at from observation or reflection. It can be accepted or rejected, using the technique of analytical epidemiology.

Uses of descriptive epidemiology

1. Provides data towards magnitude of the diseases and type of disease in the community.
2. Provide clues to disease etiology and helps in formulation of etiological hypothesis.
3. Provides data for planning, organizing, evaluating preventive and curative services.
4. Contribute to research by describing variation in disease occurrence by time, place and person.

ANSWER 3

Differences Between Case Control and Cohort Studies

Case control study	*Cohort study*
1. Retrospective	1. Prospective
2. Disease has already occurred	2. Disease is expected to occur in future
3. Presence of exposure in cases and controls compared	3. Development of disease in exposed and non–exposed compared
4. Relatively easy to carry out	4. Time consuming and difficult to carry out
5. Useful for rare cases with smaller number	5. Suitable for common diseases with common exposure
6. Can only have one outcome, but can have multiple exposure	6. Can have multiple outcomes
7. Only derives odds ratio	7. Derives relative risk, attributable risk, etc.
8. Substantial bias can occur	8. Bias is generally lower
9. Relatively less costly and no dropouts	9. Expensive and dropout rate higher

ANSWER 4

Experimental Epidemiology

Experimental or intervention studies are the ones which involve 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 control group and observing and comparing the outcome of the experiment in both the groups. Experimental studies have become major area of epidemiological studies. They may be conducted in animals or human beings.

The Aims of Experimental Studies may be Stated as Follows

- To provide scientific proof of etiological (risk) factor, which may permit the modification or control of those diseases
- 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 community.

There are Two Types of Experimental Epidemiology

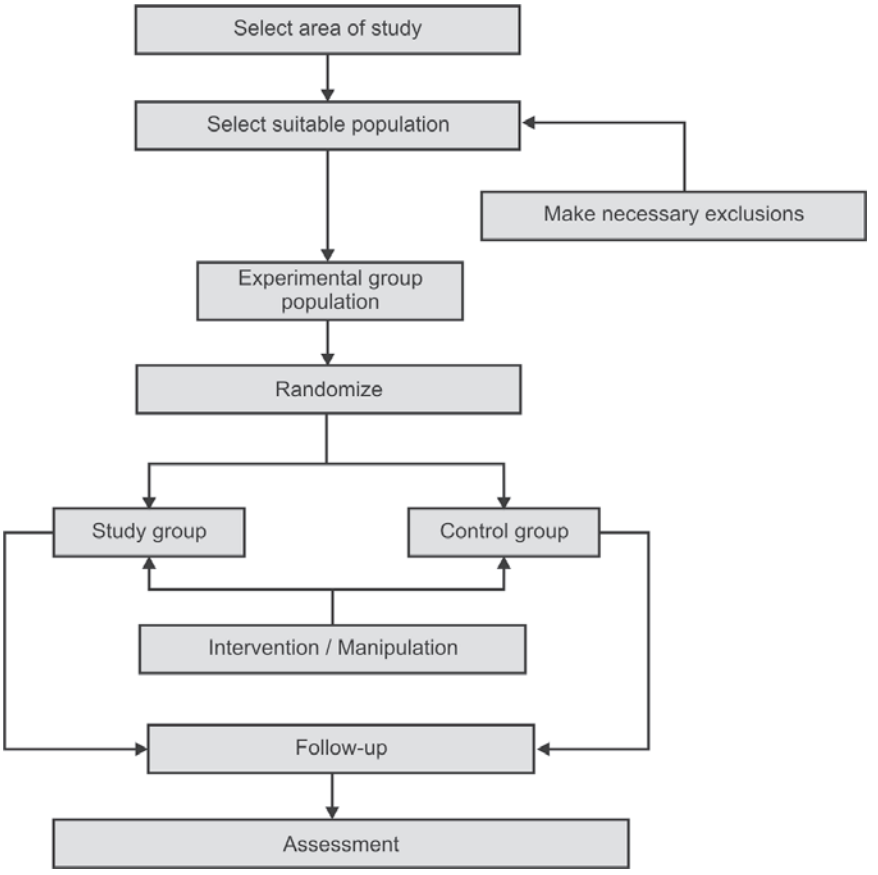
- Randomized controlled trials
- Non-randomized or non-experimental trials.

Randomized Controlled Trials

The basic steps in conducting a RCT **Flow chart 3.1** include the following:

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

Flow chart 3.1: Basic steps in conducting a RCT



The Protocol

The protocol specifies the aims and objectives of the study, questions to be answered, criteria for the selection of study and control group, size of the sample, the procedures for allocation of subjects in to study and control groups, treatment to be applied—when, where, how and 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 and out come of the study.

Selecting Reference and Experimental Populations

1. ***Reference or target population:*** It is the population to which the finding of the trial, if found successful, are expected to be applicable (e.g. a drug, a vaccine or other procedure). Thus the reference population may comprise the population of a whole city, or a population of school children, industrial workers, and obstetric population and so on according to the nature of the study.
2. ***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. The participants or volunteers must fulfill the following three criteria:
   a. They must give "informed consent" (i.e. they must agree to participate in the trial after having been fully informed about the purpose, procedures and possible dangers of the trial
   b. They should be representative of the population to which they belong (i.e. reference population)
   c. They should be qualified or eligible for the trial.

Randomization

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

Manipulation

Having formed the study and control group, the next step is to intervene or manipulate the study (experimental) group by the deliberate application or withdrawal or reduction of the suspected causal factor (e.g. this may be a drug, vaccine, dietary component, habit, etc.) as laid down in the protocol.

Follow-up

This implies examination of the experimental and 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 final assessment of outcome. The follow-up may be short or may require many years depending upon the study undertaken.

Assessment

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

1. ***Positive results:*** Benefits of the experimental measure such as reduced incidence or severity of the disease, cost to the health service or other appropriate outcome in the study and control groups
2. ***Negative results:*** Severity and frequency of side effects and complication, if any, including death.

Non-randomized / Non-experimental Trials

(Refer answer 21)

ANSWER 5

Steps in Designing an Epidemiological Trial / Scientific Method in Epidemiology

1. Establishing the objectives.
2. Designing the investigation.
3. Selecting the sample.
4. Conducting the examination.
5. Analyzing the data.
6. Drawing the conclusion and publishing the results.

Establishing the Objectives

The objectives must be well stated and clear before starting the study. The study may be started with the hypothesis to be proved. Having determined the objectives the study should progress in a way that the objectives are met.

Designing the Investigation

The type of study to be undertaken should be decided. The different kinds of study are:

- Prevalence study
- Incidence study

- Descriptive study
- Analytical study (case control/cohort study).
- Experimental study (randomized/non-randomized).

Selection of Sample should be Done

The sample may be obtained by utilizing sampling methods or the volunteers can be selected or the sample may be recruited as per the eligibility criteria.

Conducting the Examination

Standardized methods for examination and data collection have to be used. The three aspects of great significance are: The examination methods and diagnostic aids, the diagnostic criteria and the indices used for measurement and reporting. Examiner calibration should be done.

Analyzing the Data

The methods of analyzing the data should be decided before the study begins. Level of significance be decided and the data should be statistically analyzed and the results presented.

Drawing the Conclusion and Publishing the Results

After the data is analyzed the conclusion is drawn and the report of the entire study should be presented in a structured format under the headings of:

- Introduction
- Aims and objectives
- Material and Methods
- Results
- Discussion
- Summary/conclusion
- References

ANSWER 6

Tools of Measurements

Rate

It measures the occurrence of some particular event in a population during a given time period, e.g. crude rate, specific rate and standard rate.

$$\text{Death rate} = \frac{\text{Number of deaths in one year}}{\text{Mid year population}} \times 1000$$

Ratio

It expresses a relation in the size between two random quantities. Numerator is not a component of the denominator.

Formula; A:B or A/B

E.g. the ratio of dentist to population in a state in India is 1:1000 or 1/1000, which means for every 1000 people there is one dentist.

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.

$$\text{e.g.}\ \frac{\text{The number of decayed teeth in children}}{\text{Total DMFT in children}} \times 100$$

ANSWER 7

Incidence

The number of new cases occurring in a defined population during a specified period of time. It is given by the formula:

$$= \frac{\text{Number of new cases of specific disease during a given time/period}}{\text{Population at risk during that period}} \times 1000$$

Incidence can be obtained from longitudinal studies.

Uses of Incidence Rate

- It helps in taking action to control the disease
- It gives clues to research into the etiology and pathogenesis of disease
- It helps with the study of distribution of diseases
- It is useful in evaluating the efficacy of preventive and therapeutic measures.

ANSWER 8

Prevalence

Refers to all current cases (old + new) existing at a given point in time, or over a period of time in a given population. It is given by the formula:

$$\text{Number of all current cases (old and new) of a specified} = \frac{\text{Disease existing at a given point in time/period}}{\text{Estimated population at the same point in time}} \times 100$$

Prevalence is of Two Types

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 time for all practical purposes consist a day, several days, or even a few weeks depending upon the time it takes to examine the population sample.
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.

Relationship between prevalence (P) and incidence (I).

P = I × D
I = Incidence
D = Duration

Prevalence can be obtained from cross- sectional studies

Uses of Prevalence

1. Helps to estimate the magnitude of health/disease problems in the community and identify high risk population
2. Useful for administrative and planning purposes.

ANSWER 9

Cross-sectional study is also known as prevalence study. It is based on a single examination of a cross- section of population at one point in time—the results of which can be projected on the whole population provided the sampling has been done correctly. This studies are more useful for chronic than short-lived diseases. Such a study tells us about the distribution of a disease in a population rather than its etiology. It provides information about disease prevalence; it provides very little information about the natural history of disease or about the rate of occurrence of new cases.

ANSWER 10

Longitudinal study also called as incidence study. There is an increasing emphasis on the value of longitudinal studies in which observations are repeated in the same population over a prolonged period of time by means of follow-up examinations. Cross-sectional studies have been likened to a photograph and longitudinal studies to a cine film. Longitudinal studies are useful:

1. To study the natural history of disease and its future outcome.
2. For identifying the risk factors of the disease.
3. For finding out incidence rate or rate of occurrence of new cases of disease in the community.

Longitudinal studies provide valuable information which the cross-sectional studies may not provide, but longitudinal studies are difficult to organize and more time consuming than cross-sectional.

ANSWER 11

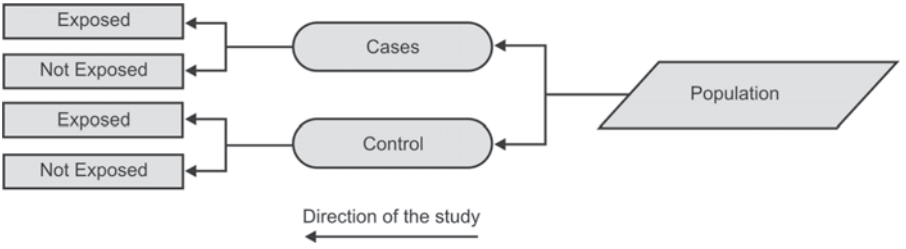
Sometimes there may be two separate peaks instead of one in the age incidence curve of a disease. Such phenomenon is referred to as bimodality, e.g. as in the case of *Hodgkin's* disease, the curve is bimodal with an initial peak between the ages 15 and 35 years, and a later peak starting at age 50. Bimodality of age curve is also seen in tuberculosis, pneumonia, leukemia, etc. The occurrence of two or more peaks in an age curve suggests that different etiologic factors may be involved in the disease, as it occurs at different ages.

ANSWER 12

Case Control Study (Flow chart 3.2)

These studies are often called retrospective studies or *Trohoc* studies, used to test hypothesis. The case control studies have the following distinct features:

Flow chart 3.2: Case control study



1. Both exposure and outcome of the disease have occurred before the start of the study.
2. The study proceeds backwards from effect to cause.
3. It uses a control or comparison group to support or refute an influence.

Basic Steps in Case Control Study

1. Selection of cases and controls
2. Matching

3. Measurement of exposure
4. Analysis and interpretation.

Selection of Cases and Controls

Selection of Cases

a. Defining the case to be included in the study is a crucial step and it includes two important specifications: **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) and the **Eligibility criteria** (Only newly diagnosed cases within a specified period of time are eligible than old cases or cases in advanced stages of disease).
b. *Source of cases:* Cases may be drawn from hospitals and general population
   - Hospitals: It is often convenient to select from hospitals. The cases may be drawn from a single hospital or a network of hospitals admitted during a specified period of time.
   - 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 random sample of it is selected for the study.

Selection of Controls

a. 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 been studied.
b. *Sources of Controls*
   - Hospital controls: Controls may be selected from the same hospital as the cases, but with different illness other than the study disease.
   - Relatives: The controls may also be taken up from relatives (spouses and siblings). Sibling controls are unsuitable where genetic condition are under study.
   - Neighborhood controls: Controls may be people living in same locality of cases, persons working in the same factory, children attending same school.
   - General population: Population control can be obtained from defined geographic areas, by taking a random sample of individuals free of the study disease.

Matching

The controls may differ from the cases in a number of ways such as age, sex, occupation, social status etc. To ensure comparability between the cases and the control a process what is called as matching is involved by which we select controls in such a way that they are similar to cases with regards to certain pertinent selection variables which is known to influence the outcome of disease. While matching it should be borne in mind that the suspected etiological factor or variable we wish to measure should not be matched, because by matching, its etiological role is eliminated in that study.

Measurement of Exposure

Information about exposure should be obtained in precisely the same manner for both cases and controls. This may be obtained by interviews, questionnaires and past records of cases and controls (hospital records, employment records, etc).

Analysis and Interpretation

The analysis is done to find out:

1. Exposure rates among the cases and controls to suspected factors.
2. Estimation of disease risk associated with exposure (Odd's ratio).

	Cases (Oral cancer)	*Control (Without oral cancer)*
Tobacco chewers.	125 (a)	347 (b)
Non-tobacco chewers.	5 (c)	219 (d)

1. ***Exposure rates***

Cases: $$\frac{a}{(a+c)} = \frac{125}{(125+5)} = \frac{125}{130} \times 100 = 96.1\%$$

Controls: $$\frac{b}{(b+d)} = \frac{347}{(347+219)} = \frac{347}{566} \times 100 = 61.3\%$$

Interpretation: The frequency rate of oral cancer was definitely more in those chewing tobacco compared to the non-chewers.

2. ***Odd's ratio (Cross product):*** It is the measure of the strength of the association between the risk factor and outcome. It is calculated by taking the cross product of the entries.

$$OD = ad/bc = \frac{125 \times 219}{347 \times 5}$$

OD = 15.7

Interpretation: The people chewing tobacco showed 15.7 times more risk of developing oral cancer as compared to the non-tobacco chewers.

Advantages of Case Control Study

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 etiological factors.
7. Risk factor can be identified.
8. No attrition problems.
9. Ethical problems are minimal.

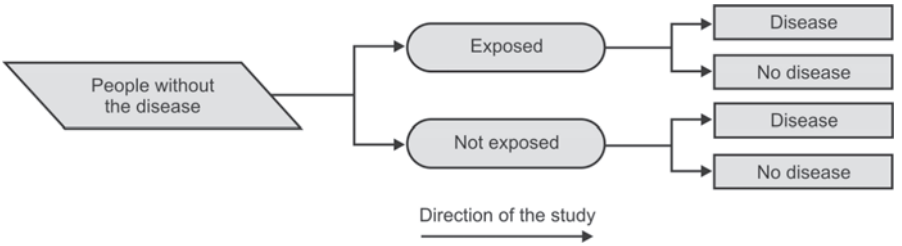
Disadvantages of Case Control Study

1. Problems of bias.
2. Selection of appropriate control group.
3. Incidence cannot be measured.
4. No distinction between causes and associated factors.
5. Not suited to the evaluation of therapy.

ANSWER 13

Cohort study **Flow chart 3.3** also known as prospective study, longitudinal study, incidence study, forward- looking study.

Flow chart 3.3: Cohort study



Types of Cohort Study

Three types of cohort studies have been distinguished on the basis of the time occurrences of the diseases in relation to time at which investigation is initiated and continued.

Prospective Cohort Study

In this study the outcome (disease) has not yet occurred at the time the investigation begins. This study begin in the present and continue into the future, e.g. long term effects of exposure to uranium was evaluated by identifying a group of uranium miners and a comparison group of individuals not exposed to uranium mining and by assessing subsequent development of lung cancer in both the groups.

Retrospective Cohort Study

In this study the outcomes have all occurred before the start of the investigation. The investigator goes back in time, sometimes 10–30 years, to select the study group from the past records and traces them forward through time from a past day fixed on the records up to the present. This study is known by a variety of names like 'historical' cohort study, prospective study in retrospect and non-concurrent prospective study.

Combination of Prospective and Retrospective Study

The cohort is identified from past records and is assessed to date for the outcome. The same cohort is then followed up prospectively into future for further assessment of outcome.

Elements of a Cohort Study

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

Selection of Study Subjects

Study subjects may be selected from:

a. The general population.
b. Special groups like select groups or exposure groups.
   i. ***Select groups:*** They may be professional groups (doctors, nurses, lawyers, leachers)
   ii. ***Exposure groups:*** Cohort may be selected from persons exposed to the physical, chemical and other disease agents, e.g. radiologists, workers in industry.

Obtaining Data on Exposure

Information about exposure may be obtained through survey, interviews, questionnaires, medical records or environmental surveys.

Selection of Comparison Group

a. ***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.
b. ***External comparisons:*** Here controls can be selected which are similar to the demographic of the study group but differ with respect to the exposure under the study, e.g. smokers and non-smokers.
c. ***Comparison with general population rates:*** If none is available, the mortality experience of the exposed group is compared with the mortality experience of the general population in the same geographic area, e.g. comparison of frequency of lung cancer among uranium mine workers with lung cancer mortality in the general population where the miners resided.

Follow-up

Regular follow-up is required which comprises of periodic medical examination, reviewing hospital records, surveillance of death records, mailed questionnaires, telephone calls, periodic home visits- preferably on an annual basis.

Analysis

The data is analyzed in terms of:

1. Incidence rates of outcome among exposed and non-exposed
2. Estimation of risk.

Example

Sugar consumption	*Developed dental caries*	*Not developed dental caries*
Yes (5000)	250 (a)	4750 (b)
No (2000)	2 (c)	1998 (d)

1. ***Incidence rates:*** It can be directly determined in a cohort study.
Incidence rates:

$$\text{Among those consuming sugar} = \frac{a}{a+b} = \frac{250}{250+4750} = \frac{250}{5000} = 50 \text{ per } 1000$$

Among those not consuming sugar = $\frac{c}{c+d} = \frac{2}{2+1998} = \frac{2}{2000} = 1$ per 1000

2. ***Estimation of risk:*** This is done in terms of two indices.
   a. Relative risk
   b. Attributable risk

   a. *Relative risk:* Relative risk is the ratio of incidence of the disease or death among exposed and the incidence among non exposed .

$$RR = \frac{\text{Incidence of disease among exposed}}{\text{Incidence of disease among non-exposed}}$$

   As per above mentioned example

   From the above hypothetical example, the relative risk is 50. It implies that the people consuming sugar are 50 times at greater risk of developing dental caries than the non-consumers.

   Relative risk is a direct measure of the "strength" of the association between the suspected cause and effect.

   b. ***Attributable risk:*** Attributable risk (AR) is the difference in incidence rates of disease (Death) between an exposed group and non-exposed group. AR is often expressed as percentage. This is given by the formula:

$$AR = \frac{\text{(Incidence of disease rate among exposed – Incidence of rate among non-exposed)}}{\text{Incidence of disease rate among exposed}} \times 100$$

   As per above example:

$$AR = \frac{(50-1)}{50} \times 100 = 98\%$$

   AR indicates to what extent the disease under study can be attributed to the exposure. AR is 98%, means 98% of dental caries is because of consumption of sugar.

Advantages of Cohort Study

1. Incidence can be calculated.
2. Several possible outcomes 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 of Cohort Study

1. Involves large number of study subjects.
2. Longer time needed to complete the study.
3. Attrition problem among the study population.
4. Selection of groups is a limiting factor.
5. Diagnostic criteria can change over prolonged follow-up.
6. Extensive record keeping is needed.
7. Study is expensive.

ANSWER 14

Bias is any systematic error in the determination of the association between exposure and diseases.

Bias in Case Control Study

1. ***Memory or recall bias:*** When cases and controls are asked questions about 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.
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:*** A special example of bias is Berkesonian bias. It is termed after Dr. Joseph Berkson who recognized this problem. This bias arises because of the different rates of admission to hospitals among people with different diseases.

Bias in Cohort Studies

1. ***Selection bias:*** Selection bias occurs when the group actually studied does not reflect the same distribution characteristics like age, sex, occupation, race, etc. as occurring in the general public.
2. ***Follow-up bias:*** If the loss to follow-up occurs equally in the exposed and unexposed groups the internal validity should not be affected. If however, the rate of disease is different among those lost to follow-up, then internal

validity of the study may be affected, that is the relationship between exposure and out come may be changed.

3. ***Information bias:*** Occurs when there is an error in the classification of individuals with respect to the outcome variable. This may result from measurement errors, imprecise measurements and misdiagnosis of cases; also called as "Misclassification bias" as it occurs due to misclassification in sub-groups.
4. ***Confounding bias:*** Arises due to confounding factor, confounding factor can be defined as the factor associated with both the exposure and the disease.
5. ***Post Hoc bias:*** This arises due to the use of data from a cohort study to make observations which were not part of the original study intent.

ANSWER 18

Types of Randomized Controlled Trials (RCT)

1. ***Clinical trials:*** Have been concerned with evaluating therapeutic agents, e.g. evaluation of a new toothpaste, restorative material, etc.
2. ***Preventive trials:*** Implies trials of primary preventive measures. Trials of vaccines, pit and fissure sealants, fluoride mouthwashes, etc.
3. ***Risk-factor trials:*** A trial of risk factors in which the investigator intervenes to interrupt the usual sequence in the development of disease for those individuals who have "risk factor" for developing the disease; often this involves risk factor modification. Risk factor trials can be 'single factor' or 'multifactor' trials.
4. ***Cessation experiments:*** Another type of preventive trial is the cessation experiment. In this type of study, an attempt is made to evaluate the termination of a habit (or removal of suspected agent) which is considered to be causally related to a disease . If such action is followed by a significant reduction in the disease, the hypothesis of cause is greatly strengthened.
5. ***Trial of etiological agents:*** Here trial is conducted to confirm or refute an etiological hypothesis. Since most diseases are fatal, disabling or unpleasant, human experiments to confirm an etiological hypothesis are rarely possible.
6. ***Evaluation of health services:*** Randomized controlled trials have been extended to assess the effectiveness and efficiency of health services.

ANSWER 19

In order to reduce the bias in the experimental trial a procedure is followed what is known as blinding. 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 investigator 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.

ANSWER 20

Analytical studies are one of the major type of epidemiological studies. The subject of interest in analytical studies is the individual within the population. Although individuals are evaluated in analytical studies, the inference is not to the individuals, but the total population from which they are selected. The starting point for analytical studies is descriptive study findings suggesting further investigations. Hypothesis developed by descriptive findings are tested by analytical methods to find out, whether an association exits between two categories of events. Analytical studies comprise of two distinct types of observational studies.

1. Case control study
2. Cohort study

From each of these studies, one can determine:

- Whether or not a statistical association exists between a disease and a suspected factor
- The strength of the association between a disease and the suspected factor **(Also refer Ans 12 and 13).**

ANSWER 21

Non-randomized Trials / Non-experimented Trials

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

can be used. The approach is crude in non-radomized trials as against the randomized trials. As there is no randomization in non-experimental trials the degree of comparability will be low and the chances of a spurious result will be higher.

Types of Non-randomized Trials

1. Uncontrolled trials
2. Natural experiments.
3. Before and after comparison studies

ANSWER 22

Epidemic

The level of disease that is substantially above the usual for the population or community.

ANSWER 23

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 of the world.

ANSWER 24

Exotic

Diseases which are imported into a country in which they does not otherwise occur.

ANSWER 25

Zoonosis

An infection or infectious disease transmissible under natural conditions from vertebrate animals to man.

ANSWER 26

Epizootic

An outbreak (epidemic) of disease in an animal population often with the implication that it may also affect human population.

ANSWER 27

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.

ANSWER 28

Surveillance has been defined as "the continuous scrutiny of the factors that determine the occurrence and distribution of disease and other conditions of ill health". It is essential for effective control and prevention and includes the collection, analysis, interpretation and distribution of relevant data for action. The ultimate objective of surveillance is prevention. Surveillance may comprise:

1. ***Individual surveillance:*** This is surveillance of infected person until they are no longer a significant risk to other individuals.
2. ***Local population surveillance,*** e.g. surveillance of malaria.
3. ***National population surveillance,*** e.g. surveillance of small pox after the disease has been eradicated.
4. ***International surveillance,*** e.g. at international level WHO maintains surveillance of important disease (Sars, influenza, malaria, etc).

ANSWER 29

Quarantine

The limitation of freedom of movement of such well persons or domestic animals exposed to communicable diseases for a period of time longer than the usual incubation period for the disease in such a manner as to prevent effective contact with those not so exposed.

ANSWER 30

Cohort is defined as a group of people who share common characteristic or experience within a defined time period (e.g. age, sex, occupation, etc).

ANSWER 31

Principles of Epidemiology

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).

ANSWER 32

Confounding factor is defined as "one which is associated both with exposure and disease, and is distributed unequally in study and control groups".

ANSWER 33

The epidemiologist goes into the community to find the persons who have the disease or experience of the suspected causal factor. The epidemiologist is essentially a planner who is familiar with the statistical and epidemiological techniques, he has a good knowledge of bacteriology, immunology, physiology, well grounded in the diagnosis of disease and particularly relationship of various environmental factors that may influence health of individuals. The epidemiologist considers the community as a unit rather then the individual. He is confronted with relevant data derived from a particular epidemiological study. He seeks to identify a particular source of infection, mode of spread or an etiological factor in order to determine a future trend and recommend specific control measures. The epidemiologist concentrates more on the prevention and control of future disease then about the cure of current disease.

4 Biostatistics

QUESTIONS

1. a. Define biostatistics and write a note on the uses of biostatistics.
   b. Role of biostatistician. (Refer Ans 1a)
2. Define data and different types of data.
3. Sampling methods.
4. Stratified sample. (Refer **2** in Ans 3)
5. Cluster sampling. (Refer **4** in Ans 3)
6. Measures of central tendency.
7. Measures of dispersion.
8. Standard deviation. (Refer Ans 7)
9. Data presentation.
10. Histogram. (Refer Ans 9)
11. Normal distribution/Normal curve/Gaussian distribution.
12. Test of significance.
13. Chi-square test.
14. 't' test.
15. Correlation.
16. Regression.
17. Hypothesis.

ANSWER 1

Biostatistics

It is a method of collection, organizing, analyzing, tabulating and interpretation of data related to living organisms and human beings.

Uses of Biostatistics

- To define normalcy (To define what is normal or healthy in a population and to find the limits of normality).
- To test whether the difference between two populations regarding a particular attribute is real or a chance occurrence
- To study the correlation or association between two or more attributes in the same population
- To evaluate the efficacy of an agent in the field
- To assess the state of oral health in the community and to determine the availability and utilization of dental care facilities
- To determine the success or failure of specific oral health programs or to evaluate the program action.

ANSWER 2

A collective recording of observation either numerical or otherwise is called as data.

Data can be classified as:

1. Qualitative data.
2. Quantitative data.
   - Discrete
   - Continuous.
3. Primary data.
4. Secondary data.

Qualitative Data

Here the data is collected on the basis of qualities or attributes, e.g. sex, malocclusion, character of the persons etc.

Quantitative Data

Here the data is collected through measurements.

- ***Discrete data:*** Here the variable takes only whole value, e.g. DMFT
- ***Continuous data:*** Here the variable is in the range, decimal or fraction, e.g. height, age, arch length.

Primary Data

Here the data is obtained by the investigator himself. It is the first hand data. The data may be obtained by direct personal interview, oral health examination and questionnaire method, e.g. results obtained from a survey or an epidemiological study.

Secondary Data

The data already recorded is utilized to serve the purpose of the objective of the study, e.g. hospital records, results of the previously done survey.

ANSWER 3

Sampling

The word sample means a group of individuals who are actually available for the investigation. It is not possible to include each member of the population in the study as it is not feasible in terms of time, money and manpower. The sample thus selected should be representative of the entire population such that the inferences drawn from the sample are applied to the whole population or universe. The different sampling methods are:

Probability sampling	**Non-probability sampling**
1. Simple random	1. Accidental/incidental/ convenience
2. Stratified random	2. Judgment/purposive
3. Systematic random	3. Quota
4. Cluster	4. Sequential
5. Multiphase	5. Snowball
6. Multistage	

Probability Sampling

Here every individual in the community has an equal chance of been selected. It is a representative sample and the inferences drawn can be generalized to the whole community.

1. ***Simple random sampling:*** Here the sample unit is selected in such a way that every unit of the population has an equal chance of been selected. The sampling units are the individuals from a community or group and the sampling frame is the community or group from where the sample will be drawn. The word "random" indicates "haphazard" which seems to be misnomer in this sampling context, but instead here each unit in the community has a equal chance. The sample can be drawn using a random number table or the lottery method. Every individual is given a serial number.

   In the lottery method, numbered paper slips are used, they are shuffled and a blind fold selection is done to pick up desired number of the sample.

   The table of random number consists of numbers arranged in column and rows. You can choose any page and start selecting the number in a systematic manner, i.e. the row, column or diagonally till your desired sample is reached.

The simple random sampling assures randomness and eliminates personal bias. Sometimes in large surveys this method takes lot of time.

2. ***Stratified random sampling:*** The population under the study is first divided into homogeneous groups/classes/ strata and the sample is drawn from each sub-groups.

   Here the sampling unit is the individual and the sampling frame consists of many small homogeneous groups or strata from where the sample is to be obtained. This sampling technique gives more accurate and representative sample than simple random sampling. The limitation of this method is that care should be taken while dividing the population into strata regarding the homogeneity in each stratum to study the caries prevalence among children of different socio-economic status. First divide the population into different groups according to the socio-economic status and then using simple random sampling select the desired number of sample from each group.

3. ***Systematic random sampling:*** A systematic random sampling is formed by selecting one unit at random and then selecting additional units at evenly spaced intervals till the required sample size has been reached. This method is used when complete list of population is available. This method can be adopted as long as there is no periodicity of occurrence of any particular event in the population select a sample of 15 dentists from a list of 300 dentists representing different states.

   Step1: First obtain the kth value by dividing total number by the required number of sample (300/15 = 20).

   Step 2: The quotient forms the kth value (here the kth value is 20).

   Step 3: From numbers 1 to 10 select any number randomly (suppose number selected is 6).

   Step 4: The first sampling unit will be 6, second will be 6 + kth value, continue the series by adding kth value to the previous number till 15 units are selected. Hence the serial number of the sample units will be 6, 26, 46, 66, 86, 106, 126, 146, 166, 186, 206, 226, 246, 266, 286.

4. ***Cluster sampling:*** This method is used when the population forms natural groups or clusters such as villages, wards, blocks, children in school, etc. Here the sampling units are the clusters and the sampling frame is the group of clusters from which the clusters are to be selected. First using simple random sampling the clusters are selected and than all the units in the clusters form the sample. This method is simple and takes less time and cost, but gives a higher standard error, e.g. to find out the prevalence

of dental fluorosis in rural community. First make a list of the villages in the rural community and then using simple random sampling method select villages and than survey all the people from the selected villages. Here, note that the sampling of the villages is done and not of the persons.

5. ***Multiphase sampling:*** In this method a part of the information is collected from the whole sample and a part from the sub-sample. This method may be adopted when there is interest in any specific disease. Survey by this procedure is less costly, less laborious and more purposeful, e.g. draw a sample of children needing root canal treatment from Navodaya English school.
   Step 1: Survey all the children in the school.
   Step 2: Keep aside only those children with dental caries.
   Step 3: Keep aside only those children who gives symptoms of irreversible pulpitis.
   Step 4: From these children, select only those who need root canal treatment.
6. ***Multistage sampling:*** This method refers to the sampling procedures carried out in several stages using random sampling techniques. This is employed in large country surveys. In the first stage, using simple random sampling, the random number of states are chosen, in the second stage the districts are selected, third stage selection of talukas, fourth stage villages and smaller units are selected respectively.

Non-Probability Sampling

Here, there may not be representation to the whole community. All the units do not stand a fair chance of selection. When the inferences are generalized to the whole community it may not be true.

1. ***Accidental/incidental/convenience:*** Here sample is selected by the convenience of the situation for the examiner.
2. ***Purposive/judgment /deliberate sampling:*** The sample is selected by the judgment of the person entrusted with the job. The knowledge and attitude of the person will decide the effectiveness of the sample. It is easy to carry out and does not require preparation of any sampling framework. The limitation is that it may substantially under-represent the rates of the population in the study.
3. ***Quota sampling:*** The sample drawn is in accordance with the ratio of the existing quota. e.g: The ratio of boys: girls is 1:2, then the sample selected should maintain the ratio (a sample of 250 boys and 500 girls).

4. ***Sequential sampling:*** Here number of sequential lots are drawn one after another from a universe depending on the results of earlier samples. So this sample is based on quality control. If the first sample is clearly acceptable, no new sample is needed to be drawn. If it is unacceptable the lot is rejected, if the initial sample is doubtful the next sample may be drawn.
5. ***Snowball sampling (Chain referral sampling):*** Here the sample is selected by asking the people who meet the criteria for inclusion in the study to suggest other people who would meet those criteria. This is a useful and a easy way to identify hard to find individuals.

ANSWER 6

Measures of Central Tendency

When the data is collected, there should be a single estimate so that it summarizes the observations, which also enables comparison of two or more data series. This single estimate of a series of data that summarizes the data is known as the parameter and one such parameter is the measure of central tendency. The most commonly used measures of central tendency are:

1. Mean (mathematical estimate)
2. Median (positional estimate)
3. Mode (based on frequency)

Mean (Arithmetic Mean)

It is the simplest measure of central tendency.
Formula:

$$\text{Mean} = \frac{\text{Sum of all the observation in the data}}{\text{Number of observations in the data}},$$

Σ = Sigma (Sum of X_1)
X_1 = Value of each observation
n = Frequency

1. ***For ungrouped data***

   For example 5, 7, 6, 4, 1, 3, 0, 5, 2, 3.

$$\overline{X} = \frac{5+7+6+4+1+3+0+5+2+3}{10} = \frac{36}{10} = 3.6$$

When observation are many, the above method is tedious and hence frequency distribution tables are formed.

2. ***Grouped data with single value for class interval***

$$\text{Mean} = \frac{\sum X_1 f_1}{f_1}$$

For example

No. of decayed teeth (X_1)	*Frequency* (f_1)	*Product* ($X_1 f_1$)
0	16	0
1	28	28
2	10	20
3	5	15
4	10	40
5	5	25
Total	74	128

$$\text{Mean} = \frac{\sum X_1 f_1}{f_1} = \frac{128}{74} = 1.72$$

3. ***Group data with range for class interval***

For example, fluoride concentration (ppm) in water supply of 41 communities

Class interval (I)	*Frequency* (f_1)	*Mid point* (X_1)	*Product* ($X_1 f_1$)
0.2-0.3	11	0.25	2.75
0.4-0.5	10	0.45	4.50
0.6-0.7	1	0.65	0.65
0.8-0.9	5	0.85	4.25
1.0-1.1	2	1.05	2.10
1.2-1.3	3	1.25	3.75
1.4-1.5	5	1.45	7.25
1.6-1.7	2	1.65	3.30
1.8-1.9	1	1.85	1.85
2.0-2.1	1	2.05	2.05
	41		32.45

$$\text{Mean} = \frac{\sum X_1 f_1}{f_1} = \frac{32.45}{41} = 0.79$$

Arithmetic mean in the simplest measure, but this measure is highly influenced by extreme values. Hence, in such cases, it is better to use median.

Median

If is the middle value in a distribution such that one half of the units in the distribution have a value smaller than or equal to the median and one half has a value higher than or equal to the median.

Steps

1. First arrange the data in the order of magnitude.
2. If the number of observation is odd than (n+1)/2 will be a single value and this center value will be the median.
3. If the observation is even, the mean of the middle values may be taken as the median.

For example

If the series is even: 1, 4, 2, 7, 8, 4, 3, 8, 10, 12.

1, 2, 3, 4, 4, 7, 8, 8, 10, 12,

$\frac{4+7}{2} = \frac{11}{2} = 5.5$ ..... is the median

If the series is odd: 1, 2, 3, 4, 7, 8, 8, 10, 12.

The median here is 7.

Mode

The mode or the modal value is that value in a series of observation that occur with the greatest frequency,

For example: 6, 6, 1, 13, 12, 5, 6, 5, 7, 8, 6, 7, 5.

Six would be the mode as it occurs more than any other number. When the mode is ill defined and there are many modes for a series then it can be calculated using the relation.

MODE = 3 median – 2 mean.

ANSWER 7

Measures of Dispersion

Central tendency gives us a single value that represents the entire data, but this does not adequately describe the data and it is necessary to know how widely the observations are spread on either side of the average. The measures of dispersion help us to study the spread of values about the central value. It is mainly used to:

1. Determine the reliability of an average
2. Sum as a basis for control of variability
3. Compare two or more series in relation to their variability
4. Facilitate further statistical analysis.

The most common measures of dispersion used in dental science are:

1. Range
2. Standard deviation
3. Coefficient of variation.

1. ***Range:*** It is the simplest method defined as the difference between the value of the smallest item and the value of the largest item. This measure gives no information about the values that are between the extreme values. Though this measure is simple to calculate it is not based on all the items and is subject to fluctuations of considerable magnitude from sample to sample.

2. ***Standard deviation:*** It is the most important and widely used measure of studying dispersion. It is also known as root mean square deviation. Greater the standard deviation, greater will be the magnitude of dispersion from the mean. A small standard deviation means a higher degree of uniformity of the observations.

   Computation of standard deviation for ungrouped data

   a. Calculate the mean (X) of the series
   b. Take the deviations $\bar{d}$ of the items from the mean, i.e. $d = X - X_1$
   c. Square these deviations (d^2) and obtain the total Σd^2
   d. Divide Σd^2 by the total number of observation, i.e. (n-1) and obtain the square.

   This gives the standard deviation.

$$S = \sqrt{\frac{\sum d^2}{(n-1)}}$$

For grouped data $$S = \sqrt{\frac{\sum (X_1 - X)^2 f_1}{(n-1)}}$$

X_1= midpoint of CI

X = mean

f_1= frequency

n = total number of observations.

3. ***Coefficient of variation:*** Standard deviation is used to measure the deviation of observations within a series and it depends on the size of the mean and the units of measurement of the observations. In order to compare two or more series of data with *either* different units of measurement and marked difference in mean a relative measure of dispersion known as coefficient of variation is used.

$$CV = \frac{S \times 100}{\bar{X}}$$

S = Standard deviation.

$\bar{X}$ = Mean.

ANSWER 9

Presentation of Data

The data can be presented in different types:

1. Tabulation
   - Simple table
   - Frequency distribution table
2. Charts and diagrams:
   - Bar diagram
     - Simple bar diagram
     - Multiple bar diagram
     - Component bar diagram
     - Proportional bar diagram
   - Histogram
   - Frequency polygon
   - Line chart/diagram
3. Pie diagram
4. Pictogram.
5. Cartograms or spot diagram.
6. Scatter diagram.

Simple (Table 4.1)

A self-explanatory table giving information about the variable and the frequency. It is the record of the fixed characteristic under the observation.

Table 4.1: Yearwise distribution of boys and girls in the dental school

Years	*Boys*	*Girls*
2003	23	37
2004	35	35
2005	20	50

Frequency Distribution (Table 4.2)

It records how frequently the characteristic reoccurs in persons of the same group.

Steps involved:

1. See the largest and the smallest value in the data series.
2. Divide the group in small group or class interval of same size.

3. Find out the observation in each class interval .
4. This table can be prepared manually using tally marks or can be computed using the computer.

Data showing systolic blood pressure of 35 industrial workers.

120, 144, 152, 164, 160, 120, 124, 126, 128, 130, 142, 132, 134, 136, 138, 132, 150, 142, 144, 146, 120, 90, 112, 110, 108, 124, 90, 92, 90, 104, 100, 100, 90, 92, 168.

Table 4.2: Distribution of the industrial workers according to their systolic blood pressure

Class interval	*Tally marks*	*Frequency*
90-98	𝍸 I	6
100-108	IIII	4
110-118	II	2
120-128	𝍸 II	7
130-138	𝍸 I	6
140-148	𝍸	5
150-158	II	2
160-168	III	3
Total		35

Bar Diagram

1. ***Simple bar diagram (Fig. 4.1):*** It is used to represent qualitative data. It represents only one variable. It is represented in the form of the bars. The width of the bars remains the same and only the length changes depending on the frequency.

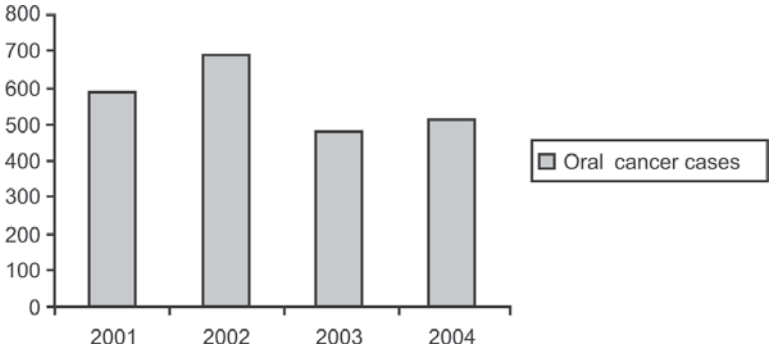


Fig. 4.1: Yearwise distribution of oral cancer cases reported to OPD

2. ***Multiple bar diagram (Fig. 4.2)*:** This diagram is used to represent qualitative data Subgroups of a single variable is represented in the form of a set of bars of equal width and the length is represented by the frequency.

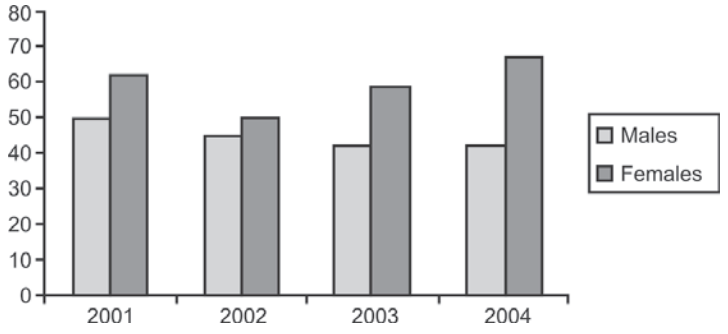


Fig. 4.2: Yearwise distribution of admissions of males and females in dental school

3. ***Proportional bar diagram (Fig. 4.3):*** This diagram is used to represent qualitative data. When it is desired to compare only the proportion of subgroups between different major groups of observations, then bars are drawn for each group and the subgroup proportion are divided in the bar. All the bars are of equal length and are equated as 100% and each bar is divided into subgroups respectively.

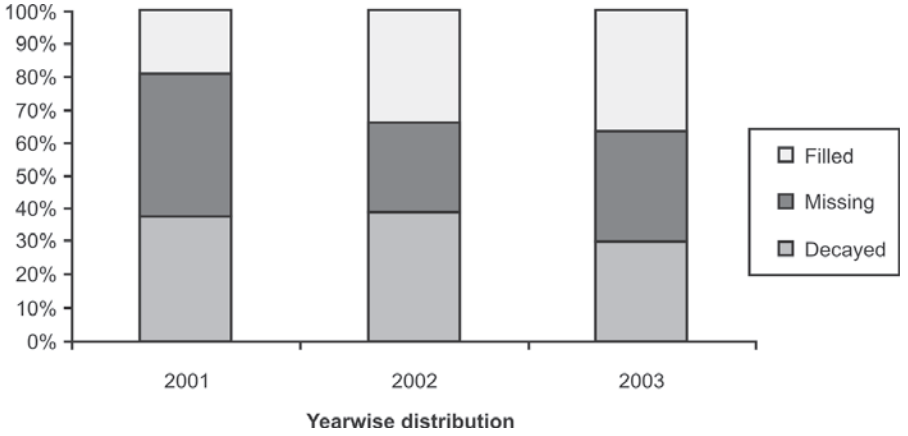


Fig. 4.3: Distribution of children according to the number of D, M, F teeth

4. ***Component bar diagram (Fig. 4.4):*** This diagram is used to represent qualitative data. When it is desired to compare only the proportion of subgroups between different major groups of observations, then bars are drawn for each group and the subgroup proportion are drawn. Here the different bars are of different sizes (unlike the proportional bar diagram) and will depend on the frequency.

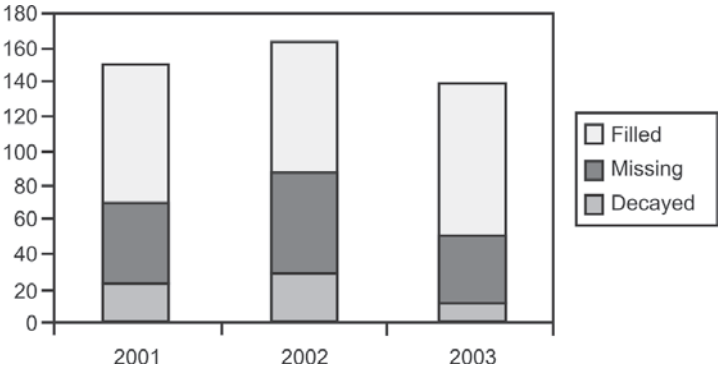


Fig. 4.4: Yearwise distribution of the children according to the prevalence of D, M, F teeth

5. ***Histogram (Fig. 4.5):*** This diagram is used to represent quantitative data of continuous type. A histogram is a bar diagram without gap between the bars. It represents the frequency distribution. The histogram is constructed by marking the limit of each class interval on the X-axis starting from 0. On the Y-axis the frequency are marked. The width of the bar represents the class interval and the height of the bar represents the frequency.

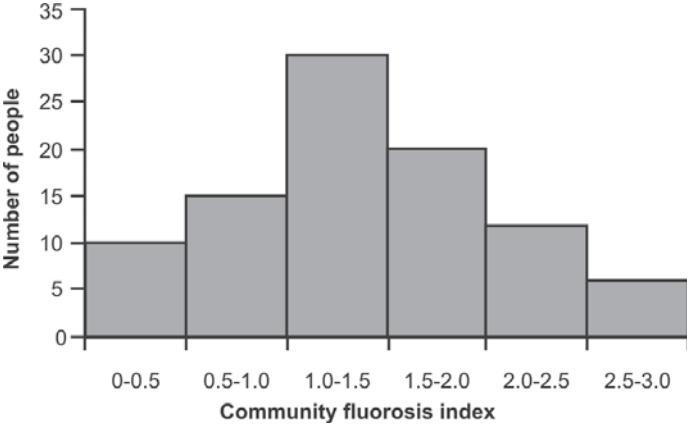


Fig. 4.5: Distribution of people according to fluorosis index

6. ***Frequency polygon (Fig. 4.6):*** This is used to represent frequency distribution of quantitative data and is useful to compare two or more frequency distributions. To draw a frequency polygon, a point is marked over the mid-point of the class interval corresponding to the frequency (join the mid-points of the bars in the histogram). Then these points are connected by a straight line.

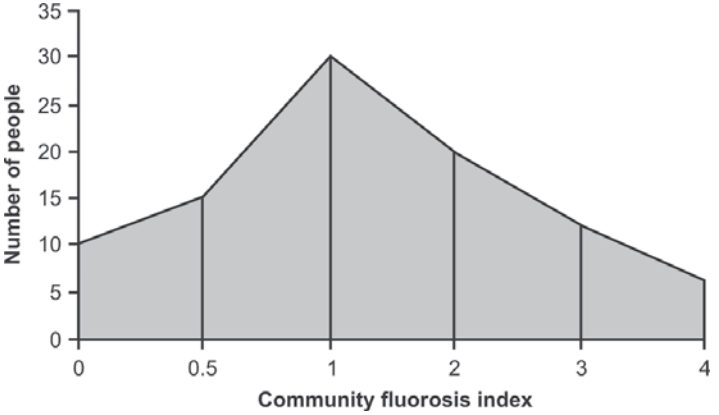


Fig. 4.6: Distribution of people according to fluorosis index

7. ***Line diagram (Fig. 4.7):*** This is used to represent quantitative data and to compare between two or more variables. The line diagram is drawn by first plotting the data on the graph sheet and then connecting all the dots to form the line.

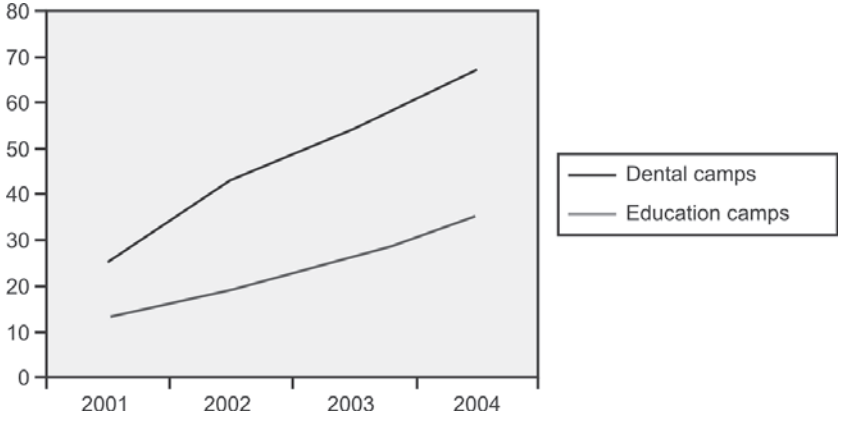


Fig. 4.7: Yearwise presentation of the number of dental and education camps

8. ***Pie diagram (Fig. 4.8):*** This is used to represent qualitative data and single variable. The data is represented as the segments of a circle. To calculate the angle of the segment, divide the observation by the total observations and multiply by 360°.
9. ***Cartogram/Spot map:*** These maps are used to show geographical distribution of frequencies of a characteristic, e.g. John Snow's spot map which shows the distribution of the water source and the spread of cholera epidemic.

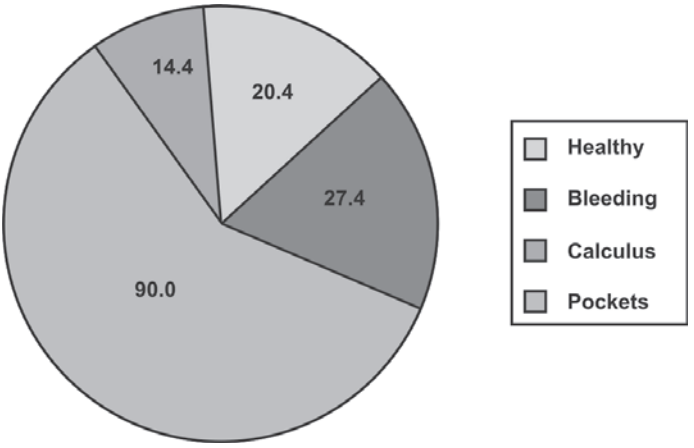


Fig. 4.8: Distribution of workers according to the CPI variables

10. ***Pictogram:*** Here the data is represented in the form of pictures.
11. ***Scatter diagram (Fig. 4.9):*** Here two variables are represented and the data is numerical. This also helps in studying the correlation between the variables.

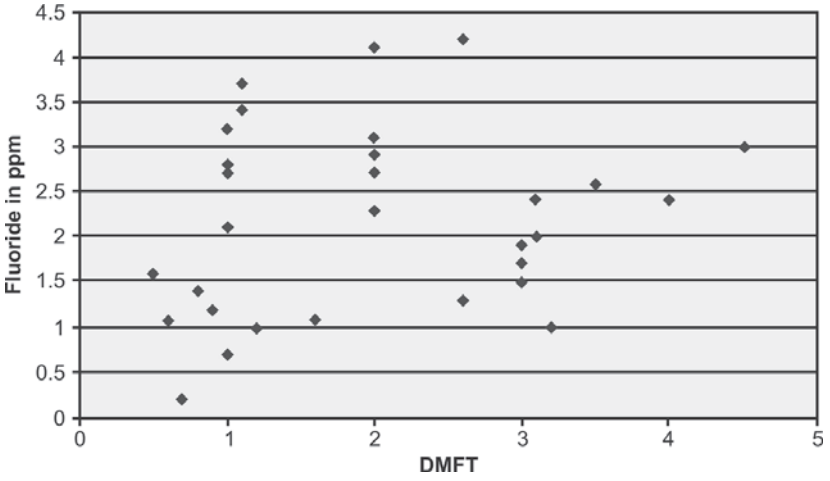


Fig. 4.9: Correlation of DMFT and fluoride concentration in drinking water

ANSWER 11

The Normal Curve (Fig. 4.10)

It is also called as normal distribution/bell shaped curve/Gaussian distribution.

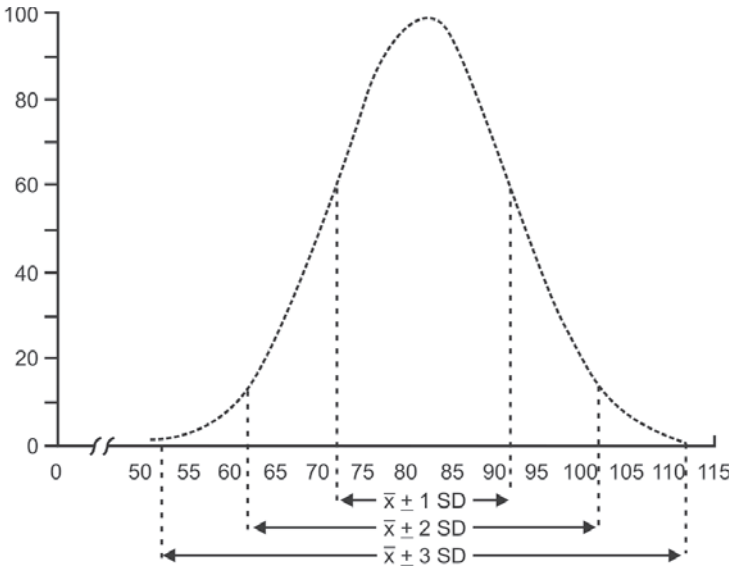


Fig. 4.10: Normal curve

When the frequency is large and class interval is reduced, the frequency polygon tends to lose its angulation giving rise to a smooth curve known as frequency curve or normal curve.

Properties of the Curve

1. It is a bell shaped curve.
2. The curve is symmetrical about the middle point.
3. The height of the curve is maximum at the mean and all the three measures of central tendency viz. the mean, median and mode coincide.
4. The base of the curve does not touch the axis.
5. The area under the curve between any two points which corresponds to the number of observations between any two values of the variant can be found out in terms of a relationship between the mean and the standard deviation which is as follows:
   a. Mean ± 1 SD covers 68.3% of the observations.
   b. Mean ± 2 SD covers 95.4% of the observations.
   c. Mean ± 3 SD covers 99.7% of the observations.

ANSWER 12

Test of Significance

It is natural for sample estimates to vary from sample to sample. It is necessary to find out whether the differences are true or by a chance. The tests of

significance are statistical tests or mathematical methods which measure the probability of chance occurrence. There are two types of tests:

Parametric	*Non parametric*
• 't' test	• Chi-square test (χ^2 test)
• 'Z' test	• Fishers exact test
• ANOVA (Analysis of variance)	• Binomial test
• Correlation	• Mann-Whitney U test
• Regression	• Kruskal-Wallis test
• Time series analysis	• Wilcoxan test
	• Sign test

The interpretation of confidence limit and level of significance is as follows:

Confidence limit	*Level of significance*	
95%	$p < 0.05$	chance of occurrence is 5%
99%	$p < 0.01$	chance of occurrence is 1%
99.9%	$p < 0.001$	chance of occurrence is 0.1%

Types of error which can be encountered during testing.

1. Type I (α error) when the null hypothesis is true, but is rejected gives rise to α error.
2. Type II (β error) when the null hypothesis is false and is accepted, gives rise to β error.

ANSWER 13

Chi-square Test (χ^2 Test)

It is pronounced as Kye square test.

The χ^2 statistic is calculated as $\chi^2 = \sum \frac{(O-E)^2}{E}$

O = Observed frequency
E = Expected frequency

$$\text{Expected frequency} = \frac{\text{Row total} \times \text{Column total}}{\text{Grand total}}$$

Degree of freedom = (r – 1) x (c – 1)
r = number of rows
c = number of column

This test is used to check whether there exists any difference for the qualitative data.

After calculation, the χ^2 value is compared with the table with respect to the degree of freedom and if the p value is lesser than the calculated χ^2 value then the null hypothesis is rejected.

Limitations in the Application of χ^2 Test

This test will not give reliable result if the expected frequency in any one cell is less than 5. In such cases, to apply χ^2 test "Yates correction" is necessary. The formula is then given by

$$\chi^2 = \sum \frac{[(O-E)-0.5]^2}{E}$$

The χ^2 test, tells the presence or absence of an association between two events but does not measure the strength of association.

ANSWER 14

't' test (Students 't' Test)

WS Gossett gave the 't' distribution analysis. His pen name was student and hence his work was called as Student's 't' test.

There are two types of 't' test: Paired 't' test and unpaired 't' test

When each individual gives a pair of observations, to test for the difference in the pair of values, paired 't' test is utilized.

When sample in 2 groups give individual values, to test for the difference in between the groups, unpaired 't' test is used.

The test procedure for testing the significance of difference using paired 't' test is as follows:

a. The null hypothesis is stated, as there is no difference in the pairs of observations
b. The difference in each set of paired observation is obtained as $d = X_1 - X_2$
c. Compute mean of the differences, $d = \Sigma d/n$ where, n is the number of pairs
d. Calculate standard deviation of the difference and standard error of difference SD/
e. The test statistic 't' is calculated from t = d/SD/
f. Find the degree of freedom. The degree of freedom is $n - 1$, since mean of difference of n pairs of observations are obtained.
g. Compare the calculated 't' value with the table value for $(n - 1)$ degree of freedom to find the p value

h. If the calculated 't' value is higher than the 't' value at 5% or 1% level of probability, then the mean difference is significant. If 't' value is less than the value at 5% level, then the mean difference or null hypothesis is not significant or is accepted.

ANSWER 15

Correlation

When dealing with measurements on two sets of variables in the same person, one variable may be related to the other in some way, e.g. level of fluoride in drinking water and community fluorosis. Change in value of one variable result in a change in the value of the other variable. The relationship between two such variables is correlation. The magnitude or degree of relationship between two variables is called correlation coefficient and is denoted by 'r'. The correlation coefficient ranges from $-1 \leq r \leq +1$.

The formula for computation of correlation coefficient of two variables is given as

$$r = \frac{N\Sigma XY - (\Sigma X \Sigma Y)}{\sqrt{N\left[\Sigma X^2 - (\Sigma X)^2\right]\left[\Sigma Y^2 - (\Sigma Y)^2\right]}}$$

X and Y are 2 variables and N is the frequency .

Interpretation of correlation coefficient.

a. If $r = 0$, there is no correlation between the two variables.
b. When there is complete relationship, then r is +1 or –1
c. If $0 < r < +1$, then there is positive correlation and if $-1 < r < 0$, there is negative correlation.

ANSWER 16

Regression

Correlation coefficient only measures the degree of relationship between X and Y variable but does not give an idea about the changes in which variable results in the change of the other. This is done in regression. The variable which causes the change is called the independent variable. The variable which changes in same manner with a change in the independent variable is called dependent variable. The change of the dependent variable with respect to a change in the independent variable is called regression. This regression is measured through regression coefficient, which gives the amount of increase or decrease, in the dependent variable for an unit of change in the independent

variable. This is represented in the form of a mathematical equation

$Y = a + b X$

Y = Dependent variable

X = Independent variable

a = Value of Y for X = 0

b = Regression coefficient.

Therefore the regression coefficient of Y on X can be computed using the correlation coefficient and the standard deviations of X and Y (Sx and Sy).

$b = r \times (Sx/Sy)$.

ANSWER 17

A hypothesis is a supposition, arrived at from observation or reflection.

To test statistical significance about the population parameters or true value of universe, 2 hypothesis or presumptions are made

1. Null hypothesis (H_0) = Hypothesis of no difference. It asserts that there is no real difference in the samples and the particular matter under consideration.
2. Alternative hypothesis (H_1) = Stating that the sample result is different (greater or lesser).

5 Levels of Prevention

QUESTION

Write a note on levels of prevention.

ANSWER

In modern day, the concept of prevention has become broad-based. It has become customary to define prevention in terms of four levels:

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

Primordial Prevention

It is a new concept, receiving special attention in the prevention of chronic disease. This is primary prevention in its purest sense, that is, prevention of the emergence or development of risk factors in countries or population groups in which they have not yet appeared. For example, many adult health problems (e.g. obesity, hypertension) have their early origins in childhood, because this is the time when lifestyles are formed (for example smoking, eating pattern, physical exercise). In primordial prevention, efforts are directed towards discouraging children from adopting harmful lifestyles. The main intervention in primordial prevention is through individual and mass education.

Primary Prevention

Primary prevention can be defined as "action taken prior to the onset of disease, which removes the possibility that a disease will ever occur". It signifies intervention in the prepathogenesis phase of a disease or health problem (e.g. low birth weight) or other departure from health. It includes the concept of

positive health. It may be accomplished by measures designed to promote general health and well being. The concept of primary prevention is now being applied to the prevention of chronic disease such as coronary heart disease, hypertension and cancer based on elimination or modification of "risk factor" of disease. The WHO has recommended the following approaches for the primary prevention of chronic disease where the risk factors are established:

1. Population (mass) strategy
2. High risk strategy.

Population (Mass) Strategy

It is prevention approach which is directed at the whole population irrespective of individual risk levels.

High-risk Strategy

It aims to bring preventive care in individuals at special risk. This requires detection of individuals at high risk by the optimum use of clinical methods.

In summary primary prevention is a "holistic" approach. The mode of intervention here is through health promotion and specific protection.

Secondary Prevention

Secondary prevention can be defined as "action which halts the progress of a disease at its incipient stage and prevents complications". The mode of intervention is early diagnosis (e.g. screening tests, case finding programs) and adequate treatment. By this an attempt is made to arrest the disease process, restore health and prevent any irreversible pathological changes to take place. Secondary prevention is largely a domain of clinical practice. Though it will prevent the people in the community from acquiring the disease. Secondary prevention is an imperfect tool in the control of transmission of disease. It is often more expensive and less effective than primary prevention.

Tertiary Prevention

When the disease process has advanced beyond its early stages, it is still possible to accomplish prevention by what might be called " tertiary prevention". It signifies intervention in the late pathogenesis phase. Tertiary prevention can be defined as "all measures available to reduce/limit impairments and disabilities, minimize suffering caused by existing departures from good health and to promote the patient's adjustments to irremediable condition". Tertiary prevention extends the concept of prevention into fields of rehabilitation. The mode of intervention here is disability limitation and rehabilitation.

6 Epidemiology of Dental Caries

QUESTIONS

1. Define dental caries. Discuss the epidemiology of dental caries.
2. Describe the role of host and agent factor in the epidemiology of dental caries. (Refer Ans 1)
3. Agent factor in dental caries/micro-organisms in the causation of dental caries. (Refer Ans 1)
4. Rainfall and dental caries.(Refer Ans 1, Environment factors)
5. Diet and dental caries. (Refer Ans 1, Non-climatological environment factors)
6. Trace elements and dental caries.
7. Selenium and dental caries.
8. Nursing bottle caries.
9. Studies on sugar and dental caries.
10. Vipeholm study. (Refer Ans 9)
11. Hopewood house study. (Refer Ans 9)
12. Turku sugar study. (Refer Ans 9)
13. Stephan's Curve.

ANSWER 1

Dental caries is defined as a chronic infectious disease which results from the demineralization of the inorganic portion and destruction of the organic portion of the tooth.

Epidemiology of Dental Caries

Dental caries is an ancient disease; paleontological evidence shows that it has afflicted mankind since the time that agriculture replaced hunting and gathering as the principal source of food.

Global Distribution of Dental Caries

During the 20th century caries prevalence was high in the developed countries, but by the late 20th century the caries pattern has reversed and higher prevalence is seen in the developing countries and lower in the developed countries.

Epidemiology of dental caries can be studied under the following heading: Host, agent and environment **(Fig. 6.1)**. All these factors should react over a period of time for dental caries to occur.

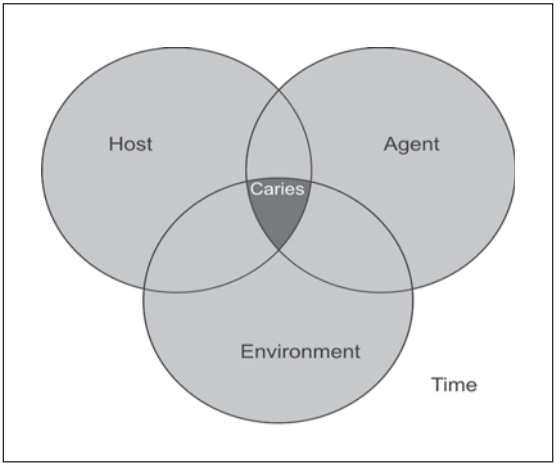


Fig. 6.1 : Keyes circle

Host Factors

1. *Age:* Caries used to be considered as the disease of the childhood. The older teenagers were found to have more DMFT compared to the younger teenagers. (Caries immediately after teeth eruption were lower and then after few years carious lesion were seen to develop). According to Hollander and Dunning greatest intensity of caries process lies in 15–25 years of age, decrease occurring in 25–35 years and an increase seen after 60 years (root caries).
2. *Sex:* Females generally demonstrate higher DMFT scores than do the males. This difference is small enough to be explained by the early eruption of teeth in females (i.e. they are in contact with the environment for a longer period of time). Few studies show higher caries status in males, while few studies show no difference. The impact of this determinant has never been well quantified.
3. *Race and ethnicity:* Contentions that certain race enjoy a high degree of resistance to dental caries have been around for a long time now.

They probably stemmed from the early observations that some races in Africa and India enjoyed more freedom from caries compared to Europeans. In the US, in 1970, the whites had greater DMFT compared to the African Americans but around 1986–87 the situation reversed completely.

4. ***Socioeconomic status (SES):*** Education, income and occupation govern the SES of the individual which also reflect the attitude and values. Studies have shown more disease prevalence in the lower SES. Lower SES groups had more D and M component and higher SES had more of F component. Overall the difference could be attributed to the difference in the access and affordability for dental care in different SES groups.
5. ***Emotional disturbances:*** There is a widespread clinical impression that emotional disturbance, particularly transitory anxiety status influence the incidence of dental caries. Salivary changes have been shown to occur in connection with changes in the mental health. Four major diagnostic groups were considered for the study: Primary behavior disorders, psychopathic personality, *schizophrenia, and manic* depressive psychosis and alcoholism without psychosis. Statistical analysis demonstrated a higher dental caries experience at all ages among the manic depressive group than in the baseline hospital population. A correlation between mental stress and caries has also been demonstrated in a study.
6. ***Familial heredity:*** There is a widespread clinical impression that dental caries varies considerably from family to family and that inheritance of a characteristic tooth structure either good or poor is common. There are a few genetic studies and in such studies it is difficult to distinguish between true inheritance through the chromosomes and the transmission of dietary and other habits through family indoctrination. However in a study by MANSBRIDGE , finds a greater resemblance in caries experience between identical twins than between fraternal twins, while unrelated pairs of children show less resemblance than either type of twins.
7. ***Tooth:***
   a. Composition
   b. Morphologic characteristics
   c. Position

   a. *Composition:* Tooth is a calcified tissue, with its different parts made up of differing concentration of inorganic, organic components and water. Evidences indicate that alteration of tooth by disturbances in the composition is of secondary importance in dental caries. The rate of caries progression may be influenced but initiation is altered little.

b. *Morphologic characteristic of the tooth:* The morphologic feature which might predispose to the development of caries is the presence of deep, narrow, occlusal fissures, buccal and lingual pits. Such pits and fissures tend to trap the food, bacteria and debris and since defects are common in the base of the fissures, caries may develop rapidly in these areas.

c. *Tooth position:* It may play an important role in dental caries in circumstances, where the teeth are malaligned, out of position, rotated or otherwise not normally situated may be difficult to cleanse and tends to favor the accumulation of food and debris. This, in susceptible person would be sufficient to cause caries in tooth, which under normal circumstances of proper alignment, would conceivably not develop caries.

d. *Caries susceptibility of the individual teeth and surface:* Brekhus 1931, studied a group of students at the university of Minnesota and reported the following caries susceptibility incidence of the teeth:

Upper and lower first molar	95%
Upper and lower second molar	75%
Upper second bicuspids	45%
Upper first bicuspids	35%
Upper central and lateral incisor	30%
Upper cuspids and lower 1st bicuspids	10%
Lower central and lateral incisor	3%
Lower cuspids	3%

Hyatt and Lotka, 1929 studied that the occlusal surfaces are the most commonly affected, followed by the mesial, buccal and the lingual surfaces.

8. ***Saliva:*** The fact that teeth are in constant contact with and are bathed in saliva, would suggest that this factor would profoundly influence the dental caries process.

a. *Salivary constituents studied in relation to dental caries*

i. Inorganic constituents
- Positive ions: Calcium, hydrogen, magnesium, potassium.
- Negative ions: Carbon dioxide, carbonate, chloride, fluoride, phosphate and thiocynate

ii. Organic constituents
- Carbohydrate, glucose
- Lipids: Cholesterol, lecithin
- Nitrogen—Protein: Globulin, mucin, total protein
- Nitrogen—Non protein: Ammonia, nitrates, urea and amino acids

- Miscellaneous: Peroxide
- Enzymes: Carbohydrases, proteases, oxidases.

Other properties of saliva:

b. *Flow rate:* It is determined by the amount of saliva secreted for a period of time. The flow rate is directly proportional to the dental caries. Increased flow rate, greater oral clearance and flushing of the oral cavity, thereby reduced risk of caries. Rampant caries is typically a result of reduced flow rate.

c. *pH of saliva:* It is mainly determined by the bicarbonate concentration. The pH increases with the flow rate. Studies have shown an inverse relation of pH and dental caries.

d. *Buffering capacity:* It determines the ability of the saliva to neutralize the acids. Studies have shown an inverse relation between buffering capacity and dental caries.

e. *Viscosity of saliva:* It is due to the mucin content in the saliva. Few studies have reported that a high caries incidence is associated with thick mucinous saliva.

f. The antibacterial properties of saliva have been investigated by numerous researchers to explain wide variation in caries incidence among different people.
   i. Lactoperoxidase: These enzymes participate in killing micro-organisms by catalyzing the hydrogen peroxide mediated oxidation of a variety of substances in the microbes. It has a high affinity for the enamel surface and it forms an important defense mechanism, limiting early microbial colonization of tooth surfaces.
   ii. Lysozyme: It is a small, highly positive, enzyme that catalyzes the degradation of the negatively charged peptidoglycan matrix of microbial cell walls. There is strong evidence that it binds to hydroxyapatite and maintains its activity after binding.
   iii. Lactoferrin: It is an iron binding protein in the saliva and plays an important role in host defense mechanism. It binds and limits the amount of free iron, which is essential for the microbial growth.
   iv. IgA: It is a predominant immunoglobulin in the saliva. Secretory IgA is an effective agglutinin because each molecule possesses four antigen binding sites. It inhibits adherence and thereby prevents colonization of mucosal surfaces and teeth by organisms facilitating their disposal by swallowing.

g. *Other salivary components with protective function:*
   i. Proline rich protein-mucins and glycoproteins: Because of their high proline content, these are rigid collagen like molecules designed to

form a pseudo-membranous layer on the hard and soft oral surfaces as well as on the oral flora.

ii. Aromatic rich proteins: It helps in remineralization.

Agent Factor

The association of micro-organism to tooth decay goes back a long way to about 5000 BC. According to the Sumerian text, tooth decay was caused by a worm that drank the blood of the teeth and fed on the roots of the teeth. Also, since the days of WD Miller, who proposed the *Chemico-parasitic theory*, dental research has been directed towards the identification of microbial agent for the disease. In 1915, Kligler became the first to associate lactobacilli as the causative organism. Later, in working with germ-free rats, Orland et al., found that they were unable to produce caries in the presence of a highly cariogenic diet. In 1924, Streptococcus mutans was detected by Clark which was considered the main etiological agent for dental caries. Studies report that, the Streptococcus mutans is responsible for the initiation and lactobacilli for the progression of the caries. The Actinomyces strains are linked with the root caries. In the case of caries, it has long been recognized that carbohydrates residues are essential for the organisms to produce caries.

Role of micro-organism in caries: Micro-organisms are a prerequisite for the caries initiation.

The sucrose consumed is fermented by the streptococcus mutans to produce intracellular and extracellular polysaccharides, further on lactic acid is produced which causes the demineralization of the tooth.

Environment Factors

1. ***Climatological (Geographical trends):*** Study of variation in dental caries with respect to the latitude and distance from the seacoast. Low caries was observed near the equator. A perfect progression of caries prevalence with variation in latitude has been reported.
2. ***Sunshine:*** A study by BR East, who compared dental caries among rural children with the mean annual sunshine of the place where they lived, reveals an inverse relation which is highly statistically significant. Also in a study by Ockerse, a high correlation of –0.879 between sunshine and dental caries in certain areas of South Africa has been documented.
3. ***Temperature:*** It varies almost entirely with the latitude. Temperature in turn, acts to vary the calorie requirement and water intake of the individual. The food pattern is affected by the temperature that is probably how caries seem to vary with respect to the temperature.

4. ***Relative Humidity:*** This is the ratio of the amount of moisture in the atmosphere to the maximum amount that can occur without the precipitation at a given temperature and barometric pressure. The data from the Australian states show a higher correlation between caries and relative humidity.
5. ***Rainfall:*** It leaches mineral from the soil and blocks sunlight. Though no latitude relation is evident, there is a regular decrease in rainfall as one proceeds inshore. Only on the Atlantic coast is this pattern at variance with the one for prevalence of dental disease. Rainfall though decreasing inland is greater in the south than in the north. The mechanism by which relative humidity and rainfall might be linked to dental caries, either together or separately need further study.

Non-climatological

1. *Total water hardness:* Usually measured in terms of calcium carbonate, total water hardness is an etiological factor in caries. An inverse relation has been reported in the study of Rose, Mills and Ockerse.
2. *Trace elements:* A marked reduction in caries in areas of fluoride has been confirmed by several studies and an increase in caries in areas where selenium was high both in water and foodstuffs has been observed.
3. *Oral environment:* Much has been written about the influence upon caries of conditions external to teeth but inside the mouth. This includes saliva, substrate/diet, oral hygiene and microbiota (although these factors are actually host factors but can be considered under environmental factors).
   a. Oral hygiene: A famous slogan "A clean tooth never decays" paved way to realizing the importance of good oral hygiene. The Miller chemico-parasitic theory focused upon the oral environment by emphasizing the importance of acid formation under mucinous plaque upon the teeth and thus started large scale efforts to control caries through improving the oral hygiene.
   b. Diet/substrate: Diet exerts a pre-eruptive and post-eruptive action on the teeth.

      Protein energy malnutrition, Vitamin D, Vitamin A, Calcium and Phosphorus deficiency have shown to result in hypoplasia and development of dental caries.

      - Carbohydrate diet: Carbohydrate, especially the sucrose has been universally accepted as one of the most important factor in the dental caries process. Sugar frequency appears to be more cariogenic then the amount. Cooked staple starchy foods such as rice, potatoes, pasta and bread are of low cariogenicity in man, but refined ground and heat treated starch with sugar can cause increase in cariogenicity.

- Vitamins: Vitamin K has been tested as a possible anticaries agent by virtue of its enzyme-inhibiting activity in the carbohydrate degradation cycle. Vitamin B-6 has been proposed as an anticaries agent on the hypothetical grounds that it selectively alters the oral flora by promoting the growth of non-cariogenic organism's which will suppress the cariogenic flora.
- Fat diet: There is indirect evidence that dietary fats may help prevent caries in humans.
  - It acts by coating the surface of the tooth with an oily substance, which could mean that food particles will not be so readily retained on the tooth surface
  - A fatty protective layer over the plaque would prevent fermentable sugar substrate from being reduced to acids
  - A high concentration of fatty acids may interfere with the growth of cariogenic bacteria
  - Increased dietary fat will decrease the amount of dietary fermentable carbohydrate necessary for organic acid formation.
- Milk: Lactose is least cariogenic.
- Cocoa factor and liquorice: It reduces enamel dissolution and inhibits glycolysis and increase plaque buffering power.
- Fruit juices: Fresh fruit, dried fruits and fresh fruit juices are capable of causing caries. Fruit flavoured drinks are more risky.
- Physical nature of the food: The physical nature of the food may be significant by affecting food retention, food clearance, solubility and oral hygiene. Physical properties of food, particularly those that improve the cleansing action and reduce the retention of food within the oral cavity and increase salivary flow, are to be encouraged.

ANSWER 6

Trace Elements and Dental Caries

Trace element is essential for humans when it has a vital function and is required to avoid a deficiency state. These elements do have an effect on the prevalence of dental caries. Navia has suggested a classification of trace elements into 5 groups depending on the caries promoting or inhibiting property.

1. ***Caries promoting elements:*** Selenium, magnesium, cadmium, platinum, lead, silicon.
2. ***Elements that are mildly cariostatic:*** Molybdenum, vanadium, strontium, calcium, boron, lithium, gold.

3. ***Elements with doubtful effect on caries:*** Beryllium, cobalt, manganese, tin, zinc, bromine, iodine.
4. ***Caries inert elements:*** Barium, aluminum, nickel, iron, palladium, titanium.
5. ***Elements that are strongly cariostatic:*** Fluoride, phosphorus.

The probable mechanism by which the trace elements are found to act: by altering the resistance of the enamel (like change in the morphology of the tooth, change in the character of the appetite crystals or disorganize the protein matrix) or by altering the intra oral environment.

ANSWER 7

Selenium and Dental Caries

Persons who consume food that are rich in selenium have higher than usual dental caries. In a survey of teeth of children reared in seleniferous area west of the Cascade Mountains in Oregon, it was found that these children experienced a higher incidence of caries than did the children reared in east of the Cascades, where there is no selenium in the soil. The findings were corroborated by the other study in Wyoming. It is speculated that the incorporation of selenium during the tooth development changes the protein components of the enamel and makes it more prone to caries.

ANSWER 8

Nursing Bottle Caries/Baby Bottle Decay/ Baby Bottle Tooth Syndrome.

This is particularly, a distressing caries syndrome related to dietary habit. It is characterized by rampant caries in the primary anterior teeth of the infants, typically 1 to 3 years old, where teeth are often decayed to the gingival level. The condition is attributed to the practice of putting an infant to bed with a bottle of sweetened drink (pacifier- juice, water or milk, sweetened with syrup or honey), usually to ensure that the child goes to sleep quickly and remains pacified should it wake during the night. When the child lies with the bottle in the mouth, the tongue extends slightly outside and covers the lower anterior teeth. As the child falls asleep sucking stops, such that the movement of the jaw which normally stimulates the saliva no longer takes place. In short the problem is compounded by low salivary flow rate during sleep. The beverage spreads over the upper teeth and the lower posterior teeth and is constantly bathed in sugary solution for hours at a time, often everyday soon leading to rampant caries. There is evidence however that the condition is widespread and usually prevalent in the lower SES groups or where infants have been cared by persons with little education.

ANSWER 9

Studies on Sugar and Dental Caries

Vipeholm Study (Gustafsson et al-1954)

It was a 5 year investigation of 436 adult inmates in a mental institution at Vipeholm Hospital near Lund, Sweden. The main purpose of the study was to investigate how the caries activity is influenced by:

1. By ingestion at meals refined sugar (non-sticky form)
2. By ingestion at meals of sugar (sticky form).
3. By ingestion between meals of sugar (sticky form)

The design of the study divided the inmates in 7 groups:

1. A control group.
2. A sucrose group (300 gms of sucrose given in solution, but reduced to 75 gms during the last 2 years).
3. A bread group (345 gms of sweet bread containing 50 gms of sugar daily).
4. A chocolate group (65 gms of milk chocolate daily between meals during last 2 years).
5. A caramel group (22 caramels = 70 gms of sugar in 4 portions between meals).
6. An 8 toffee group (8 sticky toffees = 60 gms of sugar daily for 3 years).
7. A 24 toffee group (24 sticky toffees = 120 gms of sugar for 18 months).

The main conclusions of the study were:

1. An increase in carbohydrate (mainly sugar) definitely increases the caries activity.
2. The risk of sugar increasing caries is greater if the sugar is consumed between meals.
3. The risk of sugar increasing caries is greater if the sugar is consumed in a form that will be retained on the surfaces of the teeth.
4. The increase in caries activity varies widely between individuals.
5. Upon withdrawal of caries rich foods, the increased caries activity rapidly disappears.
6. Caries lesions may continue to appear despite the avoidance of refined sugar and maximum restrictions of natural sugars dietary carbohydrates.
7. A high concentration of sugar in solution and its prolonged retention on tooth surfaces leads to increased caries activity.
8. The clearance time of sugar correlates closely with caries activity.

The study showed that the physical form is much more important in cariogenicity than the total amount of sugar ingested.

Hopewood House Study (Sullivan-1958, Harris-1963)

The dental status of children between 3-14 years of age residing at Hopewood House, Bowral, South Wales, was studied longitudinally for 10 years. Almost

all the children had lived from infancy at Hopewood House. All lived on a strict institutional diet, that, with the exception of an occasional serving of egg yolk, was entirely vegetable in nature and largely raw. The absence of meat and a rigid restriction of refined carbohydrate were the two principal features of the Hopewood House diet. The meals were supplemented by vitamin concentrates and a occasional serving of nuts and a sweetening agent such as honey. The fluoride content of water and food was insignificant and no tea was consumed.

At the end of 10 year period, the 13 year old children had a mean DMFT per child of 1.6.

Fifty three percentage of the children at the Hopewood House were caries free whereas only 0.4% of the 13 year old state schoolchildren were caries free.

The children's oral hygiene was poor, calculus uncommon, but gingivitis was prevalent in 75% of children. This work shows that, in institutionalized children, at least, dental caries can be reduced by a Spartan diet, without the beneficial effects of fluoride and in the presence of unfavorable oral hygiene.

Follow-up examination of the children who had left the school at the age of 13 years, revealed a steep increase of dental caries and this concludes that teeth do not acquire permanent resistance to dental caries.

Turku Sugar Study

This study was carried out in Turku, Finland by Scheinin, Makinen et al in 1975, to test the effects of consumption of sucrose, fructose and xylitol on dental caries increment. In a 2 year study, 125 young adults divided into three groups consumed diet entirely containing exclusively these sugars.

1. Sucrose group—35 people.
2. Fructose group—38 people.
3. Xylitol group—52 people.

In the xylitol group—A dramatic reduction in the caries increment was found. Ninety percentage less caries compared to the sucrose group. Also, less plaque and less streptococcus mutans in the plaque was detected. The least cariogenic was xylitol followed by fructose.

Hereditary Fructose Intolerance (HFI)

It is caused by the body's inability to produce fructose-1-phosphate aldolase (aldolase B) which is required for absorption of fructose. Persons affected with this rare metabolic disorder have learned to avoid any food containing fructose and sucrose, because the ingestion of these foods causes symptoms of nausea,

vomiting, malaise, tremor, excessive sweating and even coma due to fructosemia. Newbrun in 1969 tabulated the caries prevalence of 31 people with HFI and found that the dental caries prevalence was extremely low.

Tristan-da-Cunha Study

It is a rocky island in the south Atlantic 1500 miles west-south-west of Cape Town. The inhabitants approximately 200 were mostly of European origin and had only occasional contact with the outside world. Because of a volcanic eruption the islanders were evacuated to England between 1961 and 1963. Prior to 1940 their diet was very low in sugar but since 1940 the island shore had solid sugar and sugar containing foods. The dental health of the islanders has been recorded many times before and after the sugar trading started. In 1937 the dental caries experience was very low but a steady deterioration in the dental health since then, faster in children than the adults has been observed. The study is valuable in that it shows an increase in caries experience paralleling an increase in sugar consumption in the same population.

ANSWER 13

Stephan conducted a laboratory investigation with sugared rinses. He found that the ingestion of sugar caused the immediate sharp drop in plaque pH followed by a gradual return to a normal pH from salivary buffer action. This data was plotted on a graph which was demonstrated in the form of a curve, called as Stephan's curve **(Fig. 6.2)**. Of the various sugared rinses that is sucrose, fructose, glucose and starch; sucrose showed the highest pH drop.

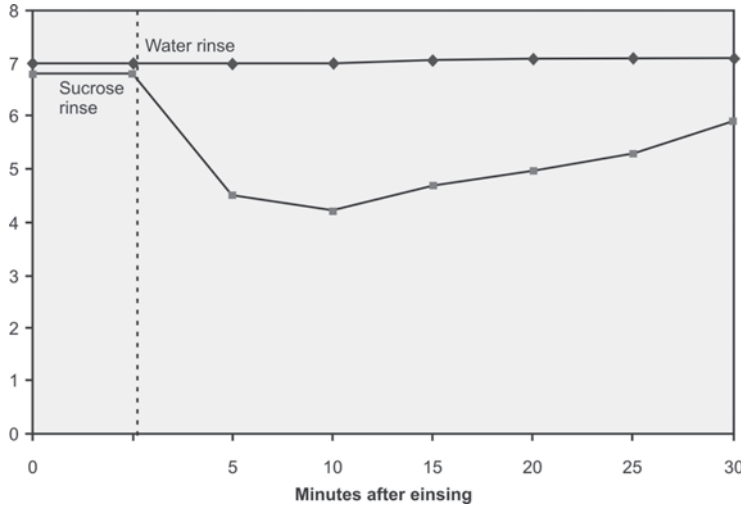


Fig. 6.2: Stephan's curve: The group with the sucrose rinse showed a sharp and immediate drop in plaque pH; the control group with a water rinse showed no change

7 Prevention of Dental Caries

QUESTIONS

1. Define preventive dentistry.
2. What are the different preventive measures for dental caries.
3. Discuss in detail the levels of prevention for dental caries.
4. Diet counseling. (Refer Ans 1)
5. Sugar substitutes.
6. Xylitol.

ANSWER 1

Preventive dentistry – It is the procedure employed in practice of dentistry and community dental health program which prevent occurrence of oral disease and oral abnormalities.

ANSWER 2

Prevention of Dental Caries

The methods of caries control can be studied under the following 3 types:

- Chemical measures
- Nutritional measures
- Mechanical measures.

Chemical Measures

A vast number of chemical substances have been proposed for the purpose of controlling caries. The use of some of these has been based upon sound experimental evidence the use of others has been purely empiric and without any scientific foundation. These chemicals include:

- Substances which alter the tooth surface or tooth structure: Fluoride, bisbiguanides, silver nitrate, zinc chloride and potassium ferocyanide

- Substances which interfere with carbohydrate degradation through enzymatic alteration: Vitamin K, sarcoside
- Substances which interfere with bacterial growth and metabolism: Urea, ammonia compounds, chlorophyll, nitrofurans, antibiotics (pencillin, tetracycline, vancomycin), caries vaccine.

Nutritional Measures

This can be achieved by doing alteration in the diet of the individual which is best described through **Diet Counseling.**

Diet refers to the food that we intake in-order to maintain our body. The diet what the mother takes during pregnancy or falls short to take certain foods show its effects on the foetus, while what the individual takes during its life time also shows its effects on the body, which can be classified as pre-eruptive and post-eruptive effects. The undesirable dietary effects on the body can be nullified through diet alteration or modification which can be sought through diet counseling.

Who Require Diet Counseling?

- Anybody whose eating pattern is not correct
- Anybody who requires dietary guidance
- Anybody who does not consume a balanced diet
- People in the old age.

Eligibility Criteria for Diet Counseling

The person should be willing, co-operative and show a sincere attitude.

Counselor: Anybody with the knowledge of nutrition and disease can be a counselor (dietician, dentist, dental hygienist). He/she should have good listening, guiding, promoting and motivating quality.

Procedures in Counseling

The complete case-history should be recorded which includes the socio-demographic variables, chief complaint, medical and dental history, history of medication, habits and other relevant history about the case.

- Diet diary is to be maintained by the patient in which he/she records all that is consumed in the day. This diary is maintained for 1, 3, 5 or 7 day.
- The diet diary is collected and analyzed for the four food groups and the sugar consumption
- After analyses, the dietary modification prescribed and the patient is on follow-up

- The changes are in moderation and gradual
- Recall and reinforcement are very necessary
- At the follow up, evaluation of pre and post counseling diet diary should be done.

Stages in Motivating the Patient during Diet Counseling

- Awareness
- Interest
- Involvement
- Action
- Maintenance.

Diet Counseling for Dental Caries

- Increase use of fibrous foods (cleansing and protective foods)
- Restrict the carbohydrate diet to 30–50% of total calorie requirement
- Select soluble form of carbohydrate that clears from the mouth easily
- Avoid excessive use of sugar and other refined carbohydrate. Eliminate eating sticky food, if not completely then as much as possible
- Eat nutritious food rich in minerals, vitamins, proteins and less fat
- Avoid carbohydrate snacking in between meals. Take high protein snack and fibrous fruits
- Modifying the sugar intake by use of sugar substitute like: Xylitol, aspartame, sorbitol, mannitol, saccharin.

Mechanical Measures

The control of dental caries by mechanical measures refers to procedures specifically designed for and aimed at removal of plaque from tooth surfaces. The different methods are:

- Prophylaxis by the dentist
- Toothbrushing
- Mouth rinsing
- Use of interdental aids
- Incorporation of detergent food in the diet
- Pit and fissure sealant
- Use of chewing gum.

Preventive measures can be prescribed based on the results of caries activity test.

Caries Risk Profile and Preventive Measures

Clinical findings	*Targeted actions*	*Recall intervals*	*Caries risk*
Healthy No incipient lesions. No cavities DMFT= 0 **Flow rate** > 0.7 ml/min **Buffering capacity-** High **Streptococcus mutans** <10^5 **Lactobacilli** <10^4	Explain the test results. Continue individual hygiene practices as in the past. Use of fluoride toothpaste	6 months	Low
Proven susceptibility No incipient lesions. No cavities DMFT > 0	Explain the test results. Improve individual hygiene practices. Oral Hygiene Instruction use of fluoride toothpaste	6 months	Low
Caries present Few cavities / incipient lesions.	Explain the test results.Visit to the dentist. Restorations of the carious lesions, removal of retentive sites, oral prophylaxis, Pit and Fissure sealants. Educational reinforcement. Diet counseling and sugar discipline. Improve individual hygiene practices, Oral Hygiene Instruction, topical fluoride application and use of fluoride toothpaste.	6 months	High
Several cavities / incipient lesions.	Same as above and frequent use of fluoride and home fluoride supplements	3 months	High
Flow rate < 0.7ml/min **Buffering capacity** Low/intermediate	Explain the test results. Obtain history of medication and illness. Prescribe saliva stimulating products. Diet counseling and sugar discipline. Improve individual hygiene practices, Oral Hygiene Instruction, topical fluoride application and frequent use of fluoride and home fluoride supplements	3 months	High
Streptococcus mutans >10^5 **Lactobacilli > 10^4**	Remove retentive sites. Diet counseling and sugar discipline. Fluoride supplementation.	3 months	High

ANSWER 3

Levels of Prevention for Dental Caries

Levels of prevention	*Primary prevention*		*Secondary prevention*	*Tertiary prevention.*	
Preventive services.	Health promotion	Specific protection	Early diagnosis and prompt treatment	Disability limitation	Rehabilitation.
Services provided by individual patient	Diet planning; demand for preventive services; periodic visit to dental office	Appropriate use of fluoride, fluoridated water, fluoridated dentifrice, fluoride supplements, oral hygiene practices.	Self examination and referral; use of dental services.	Use of dental services	Use of dental services
Services provided by the dental professional	Patient education; plaque control program, diet counseling, recall reinforcement, dental caries activity test.	Topical application of fluoride; fluoride supplements/ rinse prescription; pit and fissure sealants	Complete examination; prompt treatment of incipient lesions; preventive resin restoration; simple restorative dentistry; pulp capping.	Complex restorative dentistry; pulpotomy, root canal therapy; extraction.	Removable and fixed prosthodontics; minor tooth movement; implants.
Services provided for community	Dental health education programs; promotion of research, policy and legislation.	Community or school water fluoridation; school fluoride mouth rinse program; school fluoride tablet program; school sealant program.	Periodic screening and referral; provision of dental services.	Provision of dental services.	Provision of dental services.

ANSWER 4

Refer answer 1 (Diet counseling).

ANSWER 5

Sugar Substitutes

The sugar substitutes are generally sweeter than sucrose and hence only small quantity is required. Some of the sugar substitutes which are shown to be safe for the teeth are:

- Sorbitol
- Xylitol
- High fructose corn syrup
- Coupling sugar: Glycosylsucrose
- Aspartame
- Saccharin
- Acesulfame-K
- Cyclamate
- Dulcin.

These have been used in chewing gums, mouthwashes, toothpaste, diet drinks, dietetic foods and for table top use. However sucrose cannot be replaced by these substitutes completely like in the baked products because it becomes hard and tough and lacks bulk.

ANSWER 6

Xylitol

Xylitol can be used as a sugar substitute and is found to be safe for the teeth. It is a pentose alcohol found naturally in variety of fruits and vegetables and obtained commercially from birch trees, cottonseed husk and coconut shells. Mechanism of action of xylitol:

- Short term chewing of the gum significantly reduces salivary levels and plaque proportions of streptococcus mutans
- Because of its organoleptic property it stimulates salivation, thereby increasing plaque pH and thus promotes remineralization.

Turku sugar study in Finland (1975) confirmed that xylitol is noncariogenic in humans.

Most commonly used in chewing gums, mouthwashes, toothpaste, candies and soft drinks.

8 Fluorides

LONG QUESTIONS

1. Give a brief chemical description of fluoride and discuss the availability and pharmacokinetics of fluorides.
2. History of fluoridation.
3. Describe in brief the importance of fluoride in dentistry. What are the different types of fluorides used for local application in children? Write the merits and demerits of each.
4. Describe the different uses of fluoride in dentistry. What is the mode of action of fluoride in the prevention of dental caries? Which are the common fluorides used in dentistry, mention advantages and disadvantages of each.
5. a. Define water fluoridation.
   b. Describe in detail the procedural steps taken in planning a water fluoridation program in a city.
6. You have been appointed as a community inspector and are posted in a city which has reported cases of fluorosis. Give your plan to solve this health problem.

SHORT NOTES

7. Mechanism of action of fluoride.
8. 21 city study.
9. Shoe leather survey.
10. Knutson's technique.
11. Stannous fluoride topical application (Muhler's technique).
12. APF gel (Brudevold's technique).
13. Fluoride mouth rinses.
14. 0.2% sodium fluoride mouth rinse. (Refer Ans 13)

15. Fluoride varnish.
16. Duraphat. (Refer Ans 15)
17. Fluoride dentifrice.
18. Topical fluorides.
19. Fluoride tablets.
20. Salt fluoridation.
21. Milk fluoridation.
22. School water fluoridation.
23. Defluoridation.
24. Nalgonda technique.
25. Fluoride toxicity.
26. Intra-oral slow release device.
27. Dietary fluorides.
28. Systemic fluorides.
29. H Trendly Dean. (Refer Ans 2)
30. Halo effect of fluoride
31. Probably toxic dose (PTD).
32. Certainly lethal dose (CLD).
33. Safely tolerated dose (STD).

ANSWER 1

Fluorine is the member of the halogen family with a relative atomic weight of 19 and an atomic number 9. The word fluorine is derived from the latin term "Fluore" meaning "to flow". At room temperature fluorine is a pale yellow green gas. It is the most electronegative and reactive of all elements and thus, in nature, is rarely found in its elemental form. The WHO expert committee on trace elements has included fluorine as one among the 14 physiologically essential elements for normal growth and development of human beings.

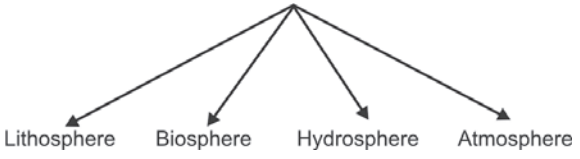


Fig. 8.1: Availability of fluoride in the environment

Fluorine in the Environment (Fig. 8.1)

Lithosphere

Fluoride is widely distributed in the earth's crust where it averages to 300 ppm. Concentration of fluoride is increased in highly siliceous igneous rocks,

alkali rocks in geothermal waters and hot springs and volcanic gases. Examples of minerals containing fluoride are:

- Fluorspar (principle fluoride containing mineral) Fluorapatite and Cryolite.

Biosphere

The normal level of fluoride in plants is about 2–20 mg/gm of dry weight. Leafy vegetables such as cabbages, lettuce and Brussel sprouts contain about 11–26 mg fluoride on dry weight basis. Tea plants have found to accumulate high concentration of fluoride. Washing leafy vegetables reduces fluoride by about 1/3 to 1/2. Plants growing in acidic solids, in vicinity of industries show elevated fluoride concentration. The concentration of fluoride in various animal products is approximately in the same range as the plants, e.g. sardines, salmon, mackerel and other fishes contain 20 ppm of fluoride (High fluoride level in fish is attributed to skin and bones).

Hydrosphere

Water contains fluoride in varying concentration. Highest of about 2800 ppm is found in Lake Nakura in Kenya. Surface water has less fluoride compared to ground water.

Atmosphere

Fluoride emissions are heaviest in the vicinity of industries in the production of aluminum from cryolite, fertilizers, fluorinated hydrocarbons, etc.

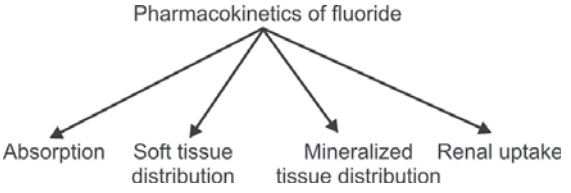


Fig. 8.2: Pharmacokinetics of fluoride

Pharmacokinetics of Fluoride (Fig. 8.2)

The absorptive process occurs by passive diffusion from both the stomach (mainly) and the intestine (GI tract). The ionic fluoride which enters the acidic environment of the stomach is largely converted into HF (undissociated weak acid hydrogen fluoride) which readily passes through the biologic membrane of the stomach.

$$(H^+ + F^- \rightarrow HF)$$

The fluoride which is not absorbed from the stomach will be readily absorbed through the microvilli in the intestine. The plasma peak usually occurs in 30 mins. Half life is 4–10 hours.

Absorption—distribution—elimination is studied under the 2 compartment open model (Fig. 8.3).

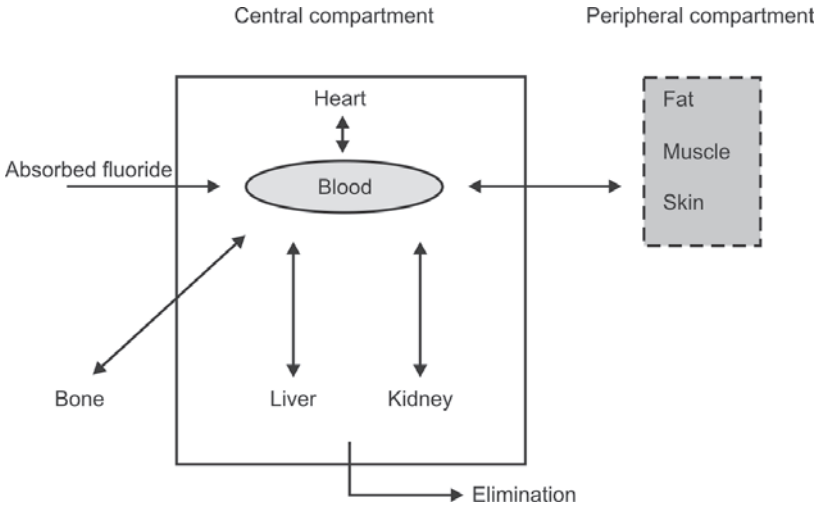


Fig. 8.3: Two compartment open model

Distribution to Mineralized Tissue

Bone

Approximately 99% of all the fluoride in the human body is found in calcified tissues. Mature bones take up less fluoride compared to younger ones. Cancellous bone incorporates more than cortical bone. Fluoride is reversibly bound to the bone.

Enamel

The enamel which is porous absorbs fluoride. The accumulation of fluoride by enamel seems largely restricted to the surface than the interior.

Dentin

Dentin is like bone and cementum, it is a mesenchymal derivative unlike enamel which is ectodermal in origin. Mesenchymal tissues have collageneous matrix, increased surface area of the crystals, tubular structure and high degree of tissue hydration which succumb to high fluoride absorption (fluoride concentration is highest towards the pulpal surface).

Cementum

Greater tissue porosity and poor crystallinity facilitate increased fluoride uptake in cementum.

Absorption of fluoride in ascending order:

Cementum > bone > dentine > enamel

Distribution to the Fetus

Some authors have said that placenta acts as a complete barrier to fluoride, while others have said that the placenta barrier is partial (Primary dentition exhibits less severe degree of dental fluorosis, then permanent dentition).

Excretion of Fluoride

Fluoride is excreted in urine, feces and is lost through sweat. It also occurs in traces, in breast milk, saliva, hair and tears. About 10–25% of the daily intake of fluoride is excreted. Renal clearance is 35 ml/min and it is pH dependent.

ANSWER 2

Historical Evolution of Fluoridation

The history of fluoridation is more than 70 years old. It started with the arrival of Dr Fredrick Mckay in Colorado springs, Colorado, USA in 1901, the year following his graduation from the University of Pennsylvania Dental School. He soon noticed that many of his patients had an apparently permanent stain on their teeth, which was known to the local inhabitants as "Colorado brown stain".

1902: The first systematic endeavor to investigate this lesion was made by the Colorado Springs Dental Society.

1905: Mckay moved to St. Louis to practice orthodontics. There he never saw a case of mottled enamel and when he returned in 1908, the stain problem struck him with more force than ever.

1908: El Paso county Odontological Society sent him, together with the patients to the annual meeting for the state Dental Association in Boulder. Here he learned of similar conditions in several other towns. The dentists here had not bothered to report the stain. Dr Mckay approached Dr. G.V.Black for help and he agreed to attend the Colorado state Dental Association meeting in July 1909 and promised to spend some time in Colorado Springs.

In preparation for this visit and 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. 2945 children were examined. 87.5% of the children native to the area had mottled teeth. For the first time the investigator had statistical data. This information was given to Dr. Black when he arrived.

1912: Mckay found an article written by Dr J.M Eager in 1902 reporting the unusual occurrence of brownish colored stains among majority of the residents in Naples. Eager had termed these brownish discolorations as "denti di chiaie".

1916: Mckay and Dr Black conducted studies on individuals living in 26 different communities in various parts of USA and they concluded that an unidentified factor was responsible for the mottling of enamel. They assumed that this unknown factor might has been present in the water consumed by the individuals during the period of tooth calcification. They based this assumption from the observation that the water supply of Britton was changed from shallow wells to deep wells after 1898 and those people who were born prior to 1898 had normal appearance of teeth while those born after 1898 had enamel mottling.

1918: Mckay confirmed the presence of an unknown element in the water supply to be the definite causative factor for enamel mottling. Similar findings were reported in Bauxite with regard to change in water supply. In Oakley and Idaho, Mckay found, the children living on the outskirts of the city, using water from a private spring, were free of mottling. He advised the people of Oakley to abandon their old water supply and tap their spring for a new source, which the community did in 1925. Children born in Oakley, subsequent to the change were free of mottled enamel.

1928: Mckay observed that in areas where the mottled enamel conditions were found, the prevalence of dental caries appeared lower than would be expected.

1931: Mckay sent several samples of suspected water to Churchill H V, a chemist employed with an aluminum company Alcoa. Spectrographic analysis was done. The mysterious factor responsible for mottled enamel was thus identified as "Fluoride". The fluoride levels ranged from 13–17 ppm.

Other important studies carried out were the "21 city study" and the "Shoe Leather survey".

1931: US National Institute of Health appointed Dr, H. Trendly Dean, the first dentist to study the fluoride-caries-mottled enamel relation. The term "mottled enamel" was replaced to "Fluorosis". Dean conducted a survey among 22 cities in ten states of USA on a total population sample of 5824 children and gave the following report on mottling of enamel at various concentration of fluoride:

1. A high concentration of fluoride in water is directly related to the severity of enamel mottling

2. Enamel mottling was widespread in areas with water having fluoride content of 3 ppm.
3. Mottling with discrete pitting of enamel was noticed at fluoride levels of 4 ppm
4. Mottling was less in case of fluoride levels of 2.5–3 ppm with a dull chalky white appearance of teeth.
5. No mottling or any other enamel changes were observed in areas with water containing 1 ppm fluoride.
6. Dental caries experience in different communities dropped sharply as fluoride concentration rose towards 1 ppm and then leveled off. Beyond ppm endemic fluorosis became unacceptable and it became established that the experiment could be conducted safely, the hypothesis was ready to be tested and the first artificial project of water fluoridation thus began.

1934: Trendly H Dean introduced the mottling index which is popularly known as Dean's Index of fluorosis.

1942: The important milestone discovery was made by Dean et al that at 1 ppm fluoride in water, 60% reduction in caries experience was observed.

1945: World's first artificial fluoridaton plant at Grand Rapids, USA began and thus started water fluoridation.

ANSWER 3

Fluoride is used as a cariostatic substance. Depending on the fluoride delivery method used it can be divided into two types:

1. Systemic fluorides
2. Topical fluorides

1. Different types of systemic fluoride supplementation:
   - Community water fluoridation
   - School water fluoridation
   - Dietary fluoride supplementation
   - Milk fluoridation
   - Salt fluoridation.
2. Different types of topical application:

Professionally applied	***Self applied***
Topical fluoride application.	*Fluoride mouthwash*
• Knutson's technique.	• Sodium fluoride.
• Muhler's technique.	• Stannous fluoride.
• Brudevold's technique.	• Acidulated phosphate flouride (APF)

Dental varnishes. • Duraphat. • Fluroprotector • Carex.	*Fluoride dentifrices* Sodium-monofluorophosphate. Sodium fluoride. Stannous fluoride, amine fluoride.
Fluoridated prophylactic pastes.	Dental floss impregnated with fluoride.
Restorative material containing fluoride.	Individual gel tray application.

Also refer Answer: 5, 10, 11, 12, 13, 14, 15, 17, 19, 20, 21, 22, 27.

ANSWER 4

Refer answers 3 and 7.

ANSWER 5A

Water Fluoridation

This may be defined as the upward adjustment of the concentration of fluoride ion in a public water supply in such a way that the concentration of fluoride ion in the water may be consistently maintained at one part per million (1 ppm) by weight to prevent dental caries with minimum possibility of causing dental fluorosis.

It has been found to be the least expensive and most effective way of providing fluoride to large groups of people of all ages. The first community water fluoridation scheme began in Grand Rapids, USA in 1945. This was followed by other large scale studies in several countries in the world. 50–60% caries reduction in permanent teeth and 40–50% reduction in deciduous teeth is earlier, not now observed by water fluoridation. 90% smooth surfaces are the most benefited and the occlusal surfaces at 35%.

Important Studies on Water Fluoridation

Experiment city	*Control city*	*Time of fluoridation*	*Caries reduction*
Grand-Rapids in Michigan	Muskegon	6 ½ years	Half that in Muskegon
Newburg in New York	Kingston	10 years	23.5% dropped to 13.9%
Evanston in Illinois	Oak park	17 years	55%
Brantford in Ontario	Sarnia	14 years	49%
Tiel in Netherlands	Culemborg	13 years	58%

Mandatory laws for water fluoridation have been enacted in Brazil, Bulgaria, Ireland, Greece and six states of USA and Washington. Singapore and Hong Kong began fluoridation in early 1960's and have 100% fluoridated areas.

In 1958, the WHO produced first report by an expert committee on water fluoridation and concluded that drinking water containing about 1 ppm fluoride had marked caries preventive action and that controlled fluoridation of drinking water was a practicable and effective public health measure.

ANSWER 5B

Planning a Water Fluoridation Program

1. ***Collect baseline information:***
   Conduct the survey:
   - To find out the number of people in the city
   - The water source used by them
   - Analyze the water to estimate the fluoride concentration
   - Find out whether there is centralized water facility.
2. ***Permission:***
   - To be obtained from the higher authority.
   - Governmental clearance.
3. ***Resources:*** Funds for installation, maintenance, monitoring of water fluoridation plant and other expenses.
   - *Location:* Place for installing the water fluoridation plant.
   - *Personnel:* Intersectoral co-ordination between the government, community leaders, doctors, health authorities, engineer, scientific workers, nutritionist, public health personnel, grass root level worker.
4. ***Type of method to be used and the chemical used:***
   Different types of equipments for water fluoridation: Three types of fluoridation equipments are commonly used:
   a. Saturator system
   b. Dry feeder system
   c. Solution feeder system.

   The different fluoride compounds which can be used in water fluoridation are fluorspar, Sodium fluoride (expensive), Silico-fluorides, Sodium silico- fluorides(economical, low cost), Hydrofluosilic acid.
5. ***Estimation of the quantity of fluoride to be added to the water:*** (Depends on the climatic condition) The empiric formula for estimating the fluoride in water is given by Galagon and Vermillion in 1957.

ppm fluoride = 0.34/E Where E= – 0.038 + 0.0062 × Temperature of the area in Fahrenheit

6. Promoting the use of fluoridated water by the community.
7. ***Evaluation:***
   a. Continuous monitoring of the quality of water, fluoride level and safety of health.
   b. Continuous monitoring of the working conditions and the technical aspects.

Practical Aspects of Water Fluoridation

1. There should be presence of centralized water supply.
2. People should not drink water from other sources like wells or tanks.
3. Suitable equipment and continuous supply of chemical should be assured.
4. Sufficient money should be available for initial installation and running cost.

ANSWER 6

Collecting Necessary Information

1. Identifying the water source in the community and estimation of water fluoride concentration.
2. ***Decide on the type of the water sample whether:*** Grab or catch sample, composite sample or integrated samples. Also decide the sampling frequency.
3. To decide on the defluoridation method to be employed in the community baseline information needs to be collected regarding the physico-chemical property of water (turbidity, hardness, alkalinity, chloride and sulphate concentration).
4. Home to home survey to identify the cases of fluorosis (examine only those who are residents of the city by birth).
5. ***Manpower planning:*** For the survey, the community leader can be made use of selection of a fluorosis index for estimating the dental fluorosis. Intersectoral co-ordination with a medical professional to examine skeletal fluorosis is required. Arrangement for instruments, its sterilization, recording proforma, traffic arrangements, schedules, examiners and recording clerk need to be planned and made available in advance.

Analyze the Data

1. To identify whether dental or skeletal fluorosis
2. To find out the prevalence of fluorosis and severity
3. Preparing a spot map identifying the water source and the fluorosis cases.

Establishing the Objectives and Select the Target Groups

Depending on the data obtained and the severity of the condition the objectives have to be planned and the target group needs to be selected who require any urgent care.

Mode of Action

Prepare report of the survey to be submitted to the higher authority explaining the problem. Include all the activities which need to be done at the individual level and also at the governmental level.

At the Individual Level

Educating the people about the prevalent problem and suggesting ways of preventing further damage by asking them to change the water source. If change of water source is not possible then alternative method would be to make them aware and teach them the defluoridation method at the household level.

At the Governmental Level

Implementing a defluoridation plant for the whole community will require intervention by the government which will start its proceedings after the report has been submitted to them.

Referral Services

Provision has to be made so that the people are referred to the medical or dental center for the treatment of the severe form of fluorosis.

ANSWER 7

Mechanism of Action of Fluoride

A number of proposed mechanisms have been identified which are assumed to work simultaneously and can be grouped as follows:

1. Increase the enamel resistance (reduced enamel solubility)
2. Increase the rate of post eruptive maturation
3. Remineralization of incipient lesions
4. Interference with Plaque Micro-organisms
5. Modification in tooth morphology.

Increased the Enamel Resistance / Reduction in Enamel Solubility

It has been well established that dental caries involves dissolution of enamel by acids from bacterial plaque and that dissolution is inhibited by the presence

of fluoride, because fluoride forms fluorapatite which is less soluble compared to hydroxyapatite. Fluoride acts as an inhibitor of demineralization.

$$Ca_{10}(PO_4)_6(OH)_2 + 2F \longrightarrow Ca_{10}(PO_4)_6F_2 + 2OH$$

(HAP) (fluorapatite crystal)

Increased Rate of Post-Eruptive Maturation

The greatest importance of fluoride to the maturation process lies in its ability to increase the rate of mineralization of hypo-mineralized areas. Newly erupted teeth often have hypo-mineralized areas that are prone to dental caries. In addition, the entire enamel surface is at its maximum degree of susceptibility to caries as soon as it appears in the mouth. Fluoride increases the rate of mineralization or post eruptive maturation of these areas.

Remineralization of Incipient Lesions

Fluoride plays a critical role in reducing dental caries by enhancing remineralization. It is the process of depositing minerals into previously damaged areas of the tooth. The crystals deposited are larger than those in either demineralized or sound enamel. These large crystals are more resistant to acid attack.

Interference with Micro-organisms

Fluoride has been known to inhibit bacterial enzymatic process involved in carbohydrate metabolism. Fluoride interferes in 2 ways: In high concentration, it is bactericidal and in low concentration, it acts as bacteriostatic.

Modification in Tooth Morphology

If fluoride is ingested during tooth development there is some evidence to suggest the formation of a more caries resistant tooth. The diameter and cusp depth of teeth are smaller, the fissures are shallow thus making them self cleansing.

ANSWER 8

"21 City Study"

To test the hypothesis that an inverse relationship exists between endemic dental fluorosis and dental caries, a survey of four Illinois cities was planned. Altogether 885 children, aged 12–14 years, were examined. The results were clear: Caries experience in Macomb and Quincy was more than twice as high as that in Galesburg and Manmoth. This study paved way for a much larger

investigation of caries experience of 7257, children 12–14 years old from 21 cities in 4 states. The cities were: Galesburg, Elmhurst, Colorado Springs, Maywood, Aurora, East Molene, Joliet, Kewanee, Pueblo, Elgin, Marion, Evanston, Middletown, Quincy, Oak park, Zanesville, Portsmouth, Waukegan, Linia, Elkhart and Michigan. The results depict with startling clarity the association between increasing fluoride concentration in the drinking water and decreasing caries experience in the population. Furthermore, the study showed that near maximal reduction in caries experience occurred with a concentration of 1 ppm fluoride in the drinking water, at this concentration fluoride caused only sporadic instances of the mildest forms of dental fluorosis of no practical significance.

ANSWER 9

Shoe Leather Survey

Dr. H. Trendly Dean, first dental officer to pursue full time research on mottled enamel was appointed for the research unit within the US Public Health service. His first task was to continue McKay's work and to find the extent and geographical distribution of mottled enamel in the USA. He sent a questionnaire to the secretary of every local and state dental society in the country, asking if mottled enamel existed in their area and if so how extensive was it and from what source was the drinking water obtained. In all 1197 of individual questionnaires were sent and 632 replies were received. As a result, Dean reported that there were 97 localities in the country where mottled enamel was said to occur and this claim had been confirmed by a dental survey. There were further 28 areas referred to in the literature where mottled enamel was said to be endemic, but no confirmatory dental survey had yet been carried out and there were 70 areas which had been reported by questionnaire but which had yet to be confirmed by extensive surveys. Many of the confirmatory surveys were carried out by Dean himself. He started in Courtland, Virginia and then followed with examinations in North Carolina, Tennesse and Illinois. Dean and his colleague referred to the investigations as "Shoe Leather epidemiology". His travel gave, Dean a very clear picture of the variation in mottling which could occur. He developed a standard of classification of mottling in order to record quantitatively the severity of mottling within a community, in 1934.

ANSWER 10

Knutson's Technique

It is a professionally applied topical fluoride.

Name of the fluoride agent used: Sodium fluoride.

Concentration of fluoride: 2% (9040 ppm fluoride).

Recommended age groups: 3, 7, 11, 13 years.

Recommended practice: 4 times at the recommended age at an interval of 1 week.

Method of Preparation

20 gms of sodium fluoride is dissolved in 1 litre of distilled water to obtain 2% concentration. The resultant solution is stored in plastic container and not in glass container because fluoride reacts with silica to form silico-fluoride and reduces the availability of active fluoride ions required for anti-caries mechanism.

Method of Application

Firstly oral prophylaxis is carried out. Isolation of the teeth quadrant or half mouth using cotton rolls. Dry the teeth by using compressed air. Required quantity of fluoride solution is taken in the plastic container. Apply solution on the teeth using an application brush (Paint on technique) quadrant-wise or half mouth. Repeat application every 15–30 seconds so as to keep the teeth moist with the fluoride solution. Solution is applied on the teeth for 4 minutes. Procedure is repeated on all the other isolated segments until all the teeth are covered. The 2nd, 3rd and 4th application is not preceded by oral prophylaxis and the flouride application is done at an interval of one week.

Mechanism of Action

When sodium fluoride is applied on the tooth surface, it reacts with hydroxyapatite crystals to form a thick layer of calcium fluoride. This calcium fluoride will react with hydroxyapatite to form fluorapatite which is more stable, less soluble, increases the rate of post-maturation of enamel and interferes with microorganism's enzymatic action and, increases remineralization of incipient lesion. The solution is applied for only 4 minutes. If applied for more than 4 minutes, a thick layer of calcium fluoride is formed which does not allow the diffusion of fluoride ions from the topical solution to react with hydroxyapatite. This phenomenon is called **choking mechanism**.

Advantages

- Both the dentitions are benefited.
- Chemically stable(fresh solution need not be prepared every time)
- Acceptable taste.
- Non-irritant to oral tissues.
- Does not discolor the restoration.

Disadvantages

- Time consuming and longer visits (total of 16 visits).

ANSWER 11

Muhler's Technique

Name of the fluoride agent used: Stannous fluoride.

Concentration of fluoride: 8–10 % (19,500 ppm fluoride).

Recommended age groups: Children and adults.

Recommended practice: Annual or semi-annual.

Method of Preparation

0.8 gms of stannous fluoride containing capsule is dissolved in 10 ml of distilled water in a plastic container and shaken briefly. The solution is not chemically stable, hence it requires fresh preparation every time. The solution becomes cloudy and instable because of the formation of tin hydroxide.

Method of Application

Firstly, oral prophylaxis is carried out. Isolation of the teeth quadrant or half mouth using cotton rolls. Dry the teeth by using compressed air. Required quantity of fluoride solution is taken in the plastic container. Apply solution on the teeths using an application brush (Paint on technique) quadrant-wise or half mouth. Repeat application every 15-30 seconds so as to keep the teeth moist with the fluoride solution. Solution is applied on the teeth for 4 minutes. Procedure is repeated on all the other isolated segments until all the teeth are covered. The patient is instructed to avoid eating or rinsing the mouth for 30 minutes.

Mechanism of Action

The stannous fluoride reacts with the enamel to form a new compound which is tin-tri-fluorophosphate which is responsible to make the tooth structure more stable and resistant to caries. The reaction of stannous fluoride with hydroxyapatite shows that mainly 4 end products are formed. Tin hydroxyphosphate is formed when stannous fluoride is applied in low concentration and the second end product is tin–tri-fluorophosphate. At very high concentration of stannous fluoride, calcium tri-fluoro-stannate gets formed along with tin–tri-fluorophosphate. Calcium fluoride in low quantity is also the end product in both low and high concentration. It further reacts with hydroxyapatite and fluorhydroxyapatite gets formed. The other

end product tin hydroxy phosphate which gets dissolved in oral fluid and is responsible for the metallic taste in the mouth following the application of stannous fluoride.

Advantages

- Less time consuming.
- Can be applied annually or semi-annually.

Disadvantages

- Chemically instable (Fresh solution has to be prepared every time).
- Metallic taste after application.
- Discolor the restoration.
- Irritant to the tissues.

ANSWER 12

Brudevold Technique

The disadvantages of the stannous fluoride application resulted in search of a new compound which will have more anti-cariogenic property and which can be applied annually. As a result of this, Brudevold dissolved sodium fluoride in acid media and added phosphorus to it. The resulting solution was acidulated phosphate fluoride. The objective of dissolving acid in fluoride was that the enamel can absorb more fluoride in acid media.

Name of the fluoride agent used: Acidulated phosphate fluoride (APF).

Concentration of fluoride: 1.23% (12,300 ppm fluoride).

Recommended age groups: Children and adults.

Recommended practice: Annual or semi-annual.

Method of Preparation

20 grams of sodium fluoride is dissolved in 1 litre of 0.1 M phosphoric acid to which 50% hydrochloric acid is added to adjust the pH to 3 and the fluoride ion concentration to 1.23%. For preparing acidulated phosphate fluoride gel a gelling agent is added methylcellulose or hydroxyethyl cellulose and the pH is adjusted between 4–5.

Method of Application

Firstly oral prophylaxis is carried out. Isolation of the teeth quadrant or half mouth using cotton rolls. Dry the teeth by using compressed air. The solution

is applied by paint on technique. A cotton applicator is dipped in the solution and is applied on the teeth for 4 minutes. Repeat application every 15–30 seconds so as to keep the teeth moist with the fluoride solution.

The acidulated phosphate fluoride gel is applied by a tray technique. Select the foam tray that fit the patients upper and lower arch. Patient is made to sit upright in the chair. Load the tray with the gel (2 gm/tray, 40% of the tray). Gel is thixotrophic and will only flow under pressure and hence, full mouth is treated simultaneously. The tray is placed in the mouth for 4 minutes. After the trays have been positioned in the mouth the saliva ejector is used to evacuate the stimulated saliva. The patient is asked to expectorate the excess fluoride and not to eat or drink for 30 minutes.

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 ion and starts forming immediately when APF is applied. Fluoride penetrates into the crystals more deeply through the opening produced by shrinkage and leads to formation of fluoroapatite. The principal products formed are DCPD and calcium fluoride. The calcium fluoride formed is partly lost by dissolution in the saliva and substantial amount is retained by transformation to fluoroapatite.

Advantages

- Less time consuming
- Requires only two applications per year.
- More effective.

Disadvantages

- It is acidic, sour and bitter in taste.
- Prolonged exposure of APF gel to composites and porcelain can result in surface changes.

ANSWER 13

Fluoride Mouthrinses

The use of fluoride mouthrinse was first described by Bibby in 1946. The clinical trials have shown that daily rinsing with fluoride mouthwash reduces the caries by 35%. The different compounds used for mouthrinsing are:

Compound	*Concentration*	*Duration of rinsing*
Sodium fluoride	0.2% (900 ppm)	Weekly
Sodium fluoride	0.05% (225 ppm)	Daily
APF	0.1% (1000 ppm)	Weekly
APF	0.02% (200 ppm)	Daily (Rinse and swallow)
Stannous fluoride	0.1% (100, 200 and 250 ppm)	Daily

Daily rinsing with low concentration of fluoride gives more cariostatic action as compared to rinsing with high fluoride concentration less frequently.

Daily rinsing is most appropriate for individual home use and weekly regimen to be the most convenient in school based public programs.

Mechanism of Action

Caries is prevented or arrested by an efficient delivery of ionic fluoride to the site in adequate concentration and duration.

ANSWER 15

Dental Varnishes

With all the currently used topical fluoride reagents, about 2/3rd of the fluoride acquired after treatment is lost within days. To prevent the immediate loss of fluoride, fluoride was added to a varnish like coating material which has the ability to adhere to the enamel surface for a longer period of time. There is a slow release of fluoride and varnish acts as a fluoride depot. The dental varnish can form an important and feasible element in school based preventive program. For example, of varnishes:

1. Duraphat
2. Fluor protector
3. Carex

Duraphat

Duraphat is the first fluoride varnish introduced in Germany. It is a viscous yellow material containing 22,600 ppm of fluoride as sodium fluoride in a neutral colophonium base (2.265% fluoride in organic lacquer).

Fluor Protector

Fluor protector is a clear polyurethane based product containing 7000 ppm fluoride from an organic compound diflurosilane (Polyurethane lacquer dissolved in chloroform and difluorosilane at a concentration of 2% weight equivalent to 0.32% fluoride in the liquid).

Carex

Carex is another fluoride varnish similar to duraphat but contains lower fluoride concentration of 1.8% fluoride.

Method of Application

After prophylaxis the teeth are dried, not isolated with cotton as varnish sticks to cotton. A total of 0.3–0.5 ml of varnish equivalent to 6.9–11.5 mg fluoride is required to cover the full dentition. Application is done on the lower arch then on the upper arch . After application patient is made to sit with mouth open for 4 minutes. Fluoroprotector sets faster than duraphat. Patient is asked not to rinse or drink anything at all for one hour and not eat anything solid but take liquid and semi-solid till next morning.

ANSWER 17

Fluoride Dentifrices

Toothpastes are valuable adjuncts to oral hygiene which makes toothbrushing more pleasant. Attempts have been made from various times to add therapeutic agents with a objective of interfering with bacterial flora and limiting the plaque formation and making the tooth more resistant to initial caries. However fluoride dentifrices with varying concentration have been used since 1945. The caries reduction is upto 30%. In 1955 stannous fluoride dentifrice became the first dentifrice recognized by the FDA.

The fluoride agents which are used in the dentifrices are: Sodium fluoride, stannous fluoride, sodium monofluorophosphate and amine fluoride.

Composition of Dentifrice

Abrasive	***Calcium pyrophosphate, sodium metaphosphate, silica gels.***
Humectant	Glycerol, sorbitol
Detergent	Sodium lauryl sulphate
Flavoring agent	Spearmint, peppermint, clove oil
Sweetner	Saccharin
Binder	Xantham gum
Vehicle	Water

Mechanism of Action

- ***Physico-mechanical:*** It is the combined effect of the toothbrush and the dentifrice which is responsible for removing the plaque from the toothsurfaces and thus reducing the cariogenicity.

- ***Chemical action:*** It is observed that the fluoride in the dentifrice is taken up readily by the demineralized enamel and also there is increase of fluoride in the dental plaque, where it acts as a depot of fluoride which is available for remineralization.

Fluoride Dentifrice Recommendation

Below 4 years: Fluoride dentifrice not recommended.

4–6 years: Brushing once with Fluoride dentifrice and twice with non-fluoridated.

6–10 years: Brushing twice with Fluoride dentifrice and once with non-fluoridated.

Above 10 years: Brushing thrice with Fluoride dentifrice.
For children peanut size of Fluoride dentifrice is recommended.

ANSWER 18

Topical Fluoride Application

These are developed on the basis that fluoride will react with enamel to form fluoroapatite crystals which makes the tooth more resistant to acid attack, increases the rate of postmaturation of enamel and interferes with enzymatic action, increases remineralization of early carious lesions and thus helps to prevent new dental caries. Substances used for topical application contain high fluoride concentration. Bibby in 1941 was the first one to use fluoride solution on the teeth. He applied 0.1% of sodium fluoride solution 8 times in a year and caries reduction was 15–20%.

Different Types of Topical Application

Professionally applied	***Self applied***
Topical fluoride application • Knutson's technique • Muhler's technique • Brudevold's technique	*Fluoride mouthwash* • Sodium fluoride • Stannous fluoride • APF (Acidulated phosphate fluoride)
Dental varnishes • Duraphat • Fluoroprotector • Carex	*Fluoride dentifrices* • Sodium-monofluorophosphate • Sodium fluoride • Stannous fluoride, Amine fluoride
Fluoridated prophylactic pastes. Restorative material containing fluoride.	Dental floss impregnated with fluoride Individual gel tray application

Also refer Answers 10, 11, 12, 13, 14, 15 and 17.

ANSWER 19

Fluoride tablets are recommended for the infants and children residing in the area with inadequate water fluoridation. The tablets are prescribed by the dentist or pediatrician and are not available over the counter. Fluoride supplement is usually available in the form of sodium fluoride, acidulated phosphate fluoride, Potassium fluoride or Calcium fluoride. It is available as 0.25, 0.5 and 1 mg tablet. The 2.2 mg sodium fluoride tablet contains 1.0 mg fluoride, and 1.1 mg sodium fluoride tablet contains 0.5 mg fluoride.

Fluoride Dosage

The correct dosage of fluoride supplement is based on the concentration of fluoride in the drinking water, age and weight of the child and other available fluorides.

The council on Dental Therapeutics of the American Dental Association recommends the dosage schedule for dietary fluoride supplements.

	Concentration of fluoride in drinking water		
Age (Years)	*< 0.3 ppm*	*0.3–0.7 ppm*	*> 0.7 ppm*
Birth to 2 years	0.25 mg	0	0
2 to 3 years	0.5 mg	0.25 mg	0
3 to 14 year+	1.0 mg	0.5 mg	0

Supplements are recommended for children and infants up to 16 years of age.

ANSWER 20

Salt Fluoridation

Salt is freely available and is used on large scale all over the globe. With the introduction of iodized salt, it was felt that salt can act as a vehicle for fluoride. Therefore fluoridation of salt was seen as a useful mode of systemic fluoridation. Fluoridation of salt was suggested more than 30 years ago. Dr Wespi (Gynecologist) was responsible for its introduction in Switzerland for the first time. Initially the fluoride supplement was 90 mg/kg of salt, however recently it has been raised to 250–350 mg/kg of salt.

Preparation

Sodium or calcium fluoride can be mixed with a slightly moist salt or mixed with a flow conditioner such as tricalcium phosphate and then mixed with dry salt.

Advantages

1. It does not require a centralized community water supply.
2. It permits individuals to accept or reject.

Disadvantages

1. Fluoridated salt consumption is lowest when the need for fluorides is greatest.
2. The current view that a high salt intake may contribute to hypertension.
3. Difficulty in controlling the fluoride intake (fluoride can be ingested through various sources)
4. The amount of fluoridated salt ingested may decrease with increasing consumption of processed foods.

Mode of Action

Fluoridated salt raises ambient oral fluoride concentration throughout life in a manner similar to water fluoridation. Marthaler et al, has observed substantial reductions in caries experience in teeth exposed only post-eruptively to fluoridated salt. It has a topical as well as systemic action.

ANSWER 21

Milk Fluoridation

Milk is an essential component of the human diet throughout life. Ziegler in 1956 was the first one to mention milk fluoridation as a possible method of systemic fluorides. Fluoridated milk can be produced in a number of different forms- liquid and powder. Flouride compounds which have been used include sodium fluoride, calcium fluoride, disodium monofluorophosphate and disodium silicofluoride. WHO experts committee (1994) has recommended upto 1 mg fluoride per day according to the age and fluoride concentration in the water supply. Studies have shown 40–50 % caries reduction. The bioavailability of fluoride is not reduced by milk and a low accumulation of fluoride is found in the enamel. It is found that fluoridated milk keeps a permanently low level of ionized fluoride within the oral cavity promoting remineralization. However the use fluoridated milk have confirmed fluorides dual mode of action, i.e. topical and systemic. The preventive effects of fluoridated milk was greater, the earlier in the child's life the consumption commenced. The concentration of fluoride in milk is 5–15 ppm.

Practical Aspects

Milk fluoridation was not very successful because of variable consumption patterns of milk which cannot be controlled and depends on the socio-economic status, religion and ethnic factors.

Children residing in rural areas cannot afford milk.

Controversy of fluoride binding and complexing to calcium and protein of the milk.

ANSWER 22

School Water Fluoridation

Where community water fluoridation is not feasible school water fluoridation is a suitable alternative because school age children during school days would consume it, thus making it one of the several effective alternatives for prevention of dental caries in children. The reduction is found to be 40%. The optimum fluoride concentration recommended for school water fluoridation is 4–5 times more then the optimal level.

Reasons for Increased Fluoride Concentration

To compensate for the reduced water intake in the school, this is only during the school days in a year.

Comparison Between Community and School Water Fluoridation

	Community water fluoridation	*School water fluoridation*
Benefit	Whole community	Particular community (Children)
ppm fluoride.	0.7 to 1.2 ppm	4–5 times more
Caries reduction	50–60 %	40%
Cost	Economical	Non economical

ANSWER 23

Water defluoridation is the downward adjustment of the fluoride ion concentration in a public drinking water supply so that the level of fluoride is maintained at the normal physiological limit of 1 ppm to prevent dental caries with minimum possibility of causing dental fluorosis.

The defluoridation techniques depend primarily on two principles:

1. Ion adsorption method
2. Ion exchange method.

The different techniques are:

1. lime softening
2. Alum
3. Alum + lime (Nalgonda technique)
4. Activated alumina
5. Activated bone
6. Bone char
7. Bone char and charcoal
8. Synthetic bone
9. Bauxite
10. Electro dialysis
11. Reverse osmosis.
12. Cation exchange resins (defluoron I, defluoron II, carbion)
13. Other treatment agents.

ANSWER 24

Defluoridation of water using Nalgonda technique- After extensively testing since 1961, NEERI (National Environmental Engineering Research Institute at Nagpur) has evolved an economical and simple method for removal of fluoride which is referred to as Nalgonda technique **(Fig. 8.4)**. It involves addition of aluminum salts, lime and bleaching powder followed by rapid mixing, flocculation, sedimentation, filtration and disinfection.

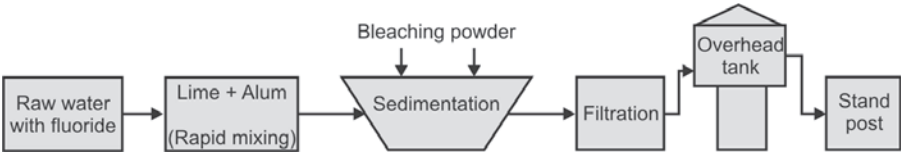


Fig. 8.4: Layout of Nalgonda technique

Mechanism

Rapid Mixing

Aluminum salts added to water may be in the form of aluminum sulphate, aluminum chloride or combination of these two. Aluminum salt is responsible for removal of fluoride from water. The dose of aluminum salt increases with increase in fluoride and alkalinity levels of raw water and also depends on chloride and sulphate concentration in water. The dose of lime is empirically 1/20th that of of aluminum salts. Lime facilitates forming dense floc for rapid

setting. Bleaching powder is added at the rate of 3 mg/litre for disinfection. All these chemicals are added just when the water enters the system. The rapid mixing provides mixing of all the added salts.

Flocculation

Flocculators provide subsequent gentle agitation before entry into the sedimentation tank. The flocculation period permits close contact between the fluoride in water and poly aluminic species formed in the system. The chemical reaction is complex. It is a combination of polyhydroxy aluminum species complexation with fluoride and their adsorption on polymeric aluminum hydroxides (floc). Besides fluorides, turbidity, colour, odour, pesticides and organics are also removed. The bacterial load is also removed. All these are adsorbed on the floc.

Sedimentation

It permits settling of the floc loaded with all the impurities which will be removed by the filters.

Filtration

Rapid, gravity sand filters are suggested to receive coagulated and settled water. In this filters, unsettled gelatinous floc is retained. Residual fluoride and bacteria are absorbed on the gelatinous floc retained on the filter bed.

Disinfection and Distribution

The filtered water collected in the storage water tank is re chlorinated with bleaching powder before distribution.

ANSWER 25

Toxicity of Fluoride

Fluoride is always referred as a double edged sword, in low concentration it helps reduce dental caries but in high concentration it produces harmful effects on the system. The toxic effects of fluoride can be divided into two types: Acute fluoride toxicity and chronic fluoride toxicity.

Acute Fluoride Toxicity

Acute fluoride toxicity results from rapid ingestion of excessive fluoride at one time.

Sign and symptoms of acute fluoride toxicity:

- Immediate reaction on gastrointestinal system—Nausea, vomiting, diarrhea, Abdominal pain and Cramps. Other immediate reactions are excessive Salivation, Tearing Mucous discharges from nose and mouth and cold wet skin
- Neurological—Convulsions, seizures, headache, parasthesia, tetany, CNS depression and coma
- Muscular—Carpopedal spasms, spasms of the extremities
- Blood—Hypocalcemia, hyperkalemia, hypomagnesemia and acidosis
- Respiratory—Respiratory acidosis leading to respiratory centre depression.
- CVS—Thready pulse, weak pulse, pallor, shock, hypotension, cardiac irregularities and ultimately failure.

Chronic Fluoride Toxicity

Chronic fluoride toxicity results from long term ingestion of small amount of fluoride. The toxic effects are seen on the teeth and skeletal system.

Effect	*Dosage*	*Duration*
Dental fluorosis	Greater than twice the optimal level of fluoride	Until 5 years of age
Skeletal fluorosis	10–25 mg/day of fluoride.	10–20 years

- Dental fluorosis ranges from mild to severe fluorosis and is characterized as loss of translucency and white flecks on the enamel, white chalky opaque areas covering 25% to more than 50% of the tooth surface, attrition of the enamel, brownish stains and pitting of the enamel in the severe fluorosis.
- Skeletal fluorosis is characterized by:
  1. Osteosclerosis become more dense and diffuse, progressing to marked thickening of cortical bone, numerous exostoses throughout the skeleton and calcification of ligaments and tendons .
  2. ***Knock-knee syndrome:*** outward bending of legs and hands.
  3. ***Crippling fluorosis:*** This is the severest form of fluorosis. The spine becomes rigid and the joints stiffen, virtually immobilizing the patients.

ANSWER 26

Intraoral Fluoride Slow Release Devices

The intraoral slow release device is being developed for caries control. The therapeutic fluoride agent is sealed within a plastic core that permits a

calculated amount to be continuously diffused to the surface and into the oral environment. The resulting cariostatic benefits are mainly from the continuous local availability of fluoride. The device is made in the form of a plastic capsule 8 mm long, 3 mm wide, 2 mm thick and is attached to the buccal surfaces of both the upper first molars by direct bonding with a sealant, e.g: Copolymer membrane device, fluoride glass device.

ANSWER 27

Dietary Fluoride Supplements

The fluoride supplements were first introduced in the late 1940 and were intended as a substitute for fluoridated water for children in non-fluoridated areas.

Different Dietary Fluoride Supplements

1. Fluoride drops without vitamins (0.125, 0.25 and 0.5 mg drops).
2. Fluoride tablets (0.25, 0.5 and 1 mg tablet)
3. Lozenges intended to the sucked slowly or permitted to dissolve slowly in the mouth. (0.25, 0.5 and 1 mg lozenges)
4. Oral rinse supplements (swished and swallowed)
5. Salt fluoridation
6. Milk fluoridation

Also refer Answer 19.

ANSWER 28

Systemic Fluorides

It provides a low concentration of fluoride to the teeth over a longer period. It circulates through the blood stream and is incorporated into the developing teeth. After teeth erupts, fluoride contacts teeth directly through salivary secretion.

Different Types Systemic Fluoride Supplementation

- Community water fluoridation.
- School water fluoridation.
- Dietary fluoride supplementation.
- Milk fluoridation.
- Salt fluoridation.

Method	*% of caries reduction*
Community water fluoridation	50–65%
School water fluoridation	40%
Dietary fluoride supplements	50–65%
Professionally applied topical fluoride	30–40%
Self applied topical fluoride	20–50%

Also refer Answers 5, 19, 20, 21, 22, 27.

ANSWER 30

Newbrun in 1989 demonstrated the Halo effect of fluoride. This occurs when the residents of non fluoridated communities are exposed to the benefits of fluoridation by the consumption of foods and beverages containing fluorides processed in the fluoridated communities.

ANSWER 31

Probably toxic dose (PTD) is defined as the threshold dose that could cause serious or life threatening systemic signs and symptoms and that should trigger immediate emergency treatment and hospitalization.
PTD for an individual = 5 mg fluoride/Kg body weight.

ANSWER 32

Certainly lethal dose (CLD) = 32–64 mg fluoride/kg body weight.

ANSWER 33

Safely tolerated dose (STD)= 1/4th CLD = 8–16 mg fluoride/kg body weight.

9 Pit and Fissure Sealants

QUESTIONS

1. Write a note on pit and fissure sealants.
2. Write a note on preventive resin restoration (PRR).

ANSWER 1

Pit and Fissure Sealant

Definition

A cement or a resin material that is introduced into unprepared occlusal pits and fissures of caries susceptible teeth forming a micro-mechanical retent and physical protective layer that acts to prevent the demineralization of the enamel by blocking the interaction of cariogenic bacteria and their nutrient substances, thus eliminating the harmful acidic byproducts.

Indications

1. Sound deep pits and fissures
2. Recently erupted teeth
3. Patients who are highly susceptible to caries.

Contraindications

1. Carious pits and fissures
2. Caries exists on other surfaces of the same tooth
3. When large occlusal restoration is already present.

Types of Pit and Fissure Sealants

Based on generation

1. *First generation:* Activated by UV Light.
2. *Second generation:* Chemical cure (auto polymerization), e.g. 3M (concise).

3. *Third generation:* Activated by visible lights, e.g: fissurit (Voco), Delton (Johnson and Johnson).
4. Fluoride containing sealants, e.g. GIC sealant.

Based on filler

1. *Free of fillers:* Have better flow.
2. *Semi-filled:* More resistant to wear.

Based on color

1. *Clear:* Difficult to identify during follow up.
2. *Tinted:* Easily identified.
3. *Opaque:* Easily identified.

Based on materials

1. BIS –GMA (Bisphenol- a glycidyl methyl acrylate).
2. Cyanoacrylates
3. Polyurethanes
4. GIC.

For maximum retention of sealants the following factors are to be viewed:

1. Tooth should have maximum surface area.
2. Presence of deep irregular pits and fissures.
3. Teeth should be clean and absolutely dry and not contaminated with saliva.
4. Type of sealants used.
5. Age of the patient.
6. Clinical skill of the operator.

Procedure

1. Polish the tooth surfaces.
2. Isolation and drying of surfaces.
3. Etching by using 37% of orthophosphoric acid for 15–30 seconds.
4. Rinsing the tooth surfaces for 15 seconds.
5. Isolation and drying of surfaces.
6. Apply bonding agent.
7. Material application: Care should be taken to prevent air trap.
8. Evaluate the sealants.
9. Check occlusion.
10. Recall and periodic maintenance.

ANSWER 2

Preventive resin restorations (PRR) are an extension of the sealant technique. Unlike the old philosophy of *"Extension for prevention"* wherein excess of tooth

reduction existed, this is a method of caries control with minimal loss of tooth structure. This is indicated when caries within a fissure has just reached dentin. The procedure involves removal of only those areas of the tooth affected by caries using dental hand piece followed by bonding resin restorative material into them, and finally covering all restorative material and any remaining fissured anatomy with sealant.

Advantage

- Minimal intracoronal preparation
- Minimal tooth structure loss.

10 Caries Activity Test

QUESTIONS

1. Caries activity tests.
2. Snyder's test (Refer **5** in Ans 1)
3. Alban's test. (Refer **6** in Ans 1)

ANSWER 1

A caries activity test facilitates the clinical management of patients for the following reasons:

1. To determine the need and the extent of personalized preventive measures.
2. To serve as an index of the success of the therapeutic measures
3. To motivate and monitor the effectiveness of educational programs relating to dietary and oral hygiene procedures.
4. To manage the progress of restorative procedures.
5. To identify high risk groups and individuals.

The different caries activity tests are:

1. Flow rate of Saliva → Stimulated saliva / Unstimulated saliva

For the collection of the stimulated saliva, the patient sits in an upright position with the head bent forward. Chewing on a paraffin block for a period of 5 min is recommended. The saliva produced is collected in a graduated tube. The flow rate is expressed as ml/min.

- The risk limit value is < 0.7 ml/min.
- Low flow rate limit value is 0.7–1.0 ml/min
- Medium flow rate limit value is 1.1–2.0 ml/min
- High flow rate limit value is 2.1– 3.0 ml/min.

2. ***Salivary buffering capacity:*** *Titration method:* 2 ml of stimulated saliva is added to 4 ml of distilled water under a paraffin seal. The delivery end of a micro burette and a micro glass electrode are introduced under the seal and the amount of 0.5 N HCl, required to bring the saliva to pH 5.0 is measured. Salivary samples requiring less than 0.45 ml of HCl in this test have low buffer capacity and those requiring 0.45 ml and more have high buffering capacity.
   a. *Colorimetric method:* The indicator pH paper is dipped in the collected stimulated saliva and the color change in the pH paper is compared with the manufacturers color guide to obtain the pH value.

pH value	*Buffering capacity*
< 4.5	Low
4.5- 5.5	Medium
> 5.5	High

3. ***Streptococcus mutans levels (Saliva or plaque)***
   a. *Laboratory procedure:* The salivary sample is obtained, required quantity is taken in the transport media. 10 mL is streaked on the Mitis Salivarious Bacitracin agar (MSB) plate and is incubated anaerobically for 2 days. After 48 hours the number of colony forming units are recorded (cfu/ml)

   Interpretation: $< 10^5$/ml of saliva is low risk.
   $> 10^5$/ml of saliva is high risk.

   Other methods: Wooden spatula method, toothpick method, tongue blade method and chair side method (dentocult SM strip mutan test)
4. ***Lactobacillus colony count test:*** It was introduced by Hadley in 1933 and popularized by Jay. Here, saliva is collected by chewing on a paraffin block, required quantity is mixed with transport media (thioglycolate) and 1 ml of the suspension is evenly spread on a rogosa's SL agar plate. The plate is incubated for 3–4 days at 37° C, the number of lactobacillus colonies that develop are counted.

   Interpretation: $< 10^4$/ml of saliva is low risk.
   $> 10^4$/ml of saliva is marked risk.
5. ***Snyder's test:*** It measures the ability of salivary organisms to form organic acids from a carbohydrate medium. The medium contains bactopeptone, dextrose, sodium chloride, agar and an indicator dye, bromocresol green. Salivary sample is collected. 0.2 cc of saliva is pipetted into the melted medium at 50° C and then is incubated for 72 hours at 37° C.

Interpretation:

	Color change	*Caries susceptibility*
24 hours	Yellow	Marked
48 hours	Yellow	Definite
72 hours	Yellow	Limited
After 72 hours	No color change	Caries inactive

6. ***Alban's test:*** It is a simplified substitute for the Snyder test:
Preparation of the media: 60 grams of Snyder agar is placed in 1 litre of water and the suspension is brought to boil over a low flame. When thoroughly melted, the agar is distributed using about 5 ml per tube .These tubes should be autoclaved for 15 mins, allowed to cool and then stored in a refrigerator. The patient is asked to expectorate a small amount of saliva directly into the tube. The tube is labeled and incubated at 37° C for 4 days. The tubes are observed daily for color change.
Color change observed is bluish green to yellow.
Interpretation:

	Color change	*Risk*
1	No color change	-
2	Beginning color change (from top of the medium)	+
3	One half color change	++
4	3/4th color change	+++
5	Total color change to yellow	++++

7. ***Salivary reductase test (Susceptibility test):*** This test measures the activity of the reductase enzyme present in the salivary bacteria. A kit is available under the trade name Treatex. Saliva is collected in a plastic container .The sample is then mixed with the dye diazoresorcinol, the color changes and the caries conduciveness reading is taken after 15 mins. No incubation procedures are required.
Interpretation:

Color	*Caries conduciveness*
Blue in 15 mins	Non-conducive
Orchid in 15 mins	Slightly conducive
Red in 15 mins	Moderately conducive
Red immediately on mixing	Highly conducive
Colorless in 15 mins	Extremely conducive

8. ***Enamel solubility test (Susceptibility test):*** It is based on the fact that when glucose is added to the saliva containing powdered enamel, organic acids are formed, this in turn decalcify the enamel, resulting in an increase in the amount of soluble calcium in the saliva-glucose-enamel mixture. The extent of increased calcium is supposedly a direct measure of the degree of caries susceptibility. However, this test is not generally suited for office procedures.

11 Dental Caries Vaccine

QUESTIONS

1. Write a note on dental caries vaccine.
2. Limitations of caries vaccine.
3. Discuss the public health aspects of dental caries vaccine.

ANSWER 1

Dental Caries Vaccine

Since dental caries fulfills the criteria for an infectious disease, the possibility of vaccination have been considered. Goady was probably the first to advocate caries control in 1910, by inoculation of the mouth with organisms which would provide alkaline reaction. Thereafter many studies have been done and many are still under progress. Most of the immunological studies in caries have been concerned with the streptococcus mutans (organism responsible for caries initiation) and to a lesser degree with lactobacilli (organism responsible for progression of the caries). The subcellular units that are currently been studied seriously as vaccine are:

- ***Glucosyltransferase (GTF):*** These are group of extracellular enzymes involved in the synthesis of polymer from sucrose.
- ***Wall associated proteins:*** Two purified proteins from the surface of streptococcus mutans are currently been suggested for use as caries vaccine antigen A and antigen B.

Mechanism of Action

The immune response is through the saliva and systemic immune response. In saliva, with the production of secretory IgA, which plays an important role in preventing the colonization of streptococcus mutans by agglutination

of the organism. The second mechanism involves the systemic immune system and the production of IgG antibodies that travel through the gingival epithelium into the gingival crevicular fluid (GCF) that bathes the tooth and the plaque.

Route of Administration

1. ***Systemic***
   a. Periglandular salivary immunization.
   b. Salivary gland immunization by combined periglandular injection and installation of streptococcus mutans into the parotid duct.
   c. Parental immunization.
   d. Oral submucous immunization
2. ***Topica****l* (painting the tooth with antibodies)

Type of Immunization

1. ***Active immunization:*** Causes host tissue reactivity.
2. ***Passive immunization***: Direct introduction of specific pre-targeted antibodies in the mouth, e.g. monoclonal/polyclonal antibodies topically applied.

ANSWER 2

Limitations of Caries Vaccine

The following factors will explain why successful vaccine has not been developed:

1. ***Partial protection:*** Only certain percentage of disease is due to streptococcus mutans and vaccine are developed against streptococcus mutans, which will provide only partial protection.
2. ***Tolerance development:*** Since the disease is life long, the constant exposure to an antigen may lead to development of tolerance or to immune exclusion.
3. ***Disease of hard tissue:*** which does not bring contact of the organism with the immune system. The organism does not come in contact with phagocytes and complement system.
4. ***Cross reactivity:*** Antigen B has been suggested to have shown cross reactivity with the heart cells.
5. Caries is a multi-factorial disease.

ANSWER 3

An important question always arises whether the search for a caries vaccine is justified from a public health point of view. Two reasons for this can be stated;

1. ***Firstly:*** Introduction of vaccine against disease which is not life threatening. The caries prevalence is declining in most developed countries and with the use of fluorides, 50–60% reduction can be achieved. So it may lead one to question whether a vaccine which carries some risks, is its use warranted to achieve a further reduction of 40–50%.
2. ***Secondly*** caries is under control using preventive measures and hence no novel preventive measure is needed.

However, in special groups, caries vaccine could be of great help, e.g. those undergoing head and neck radiation, patient with xerostomia, sick children with continuous medication or on long term steroid therapy and in the developing countries where dental caries prevalence is increased in children and adolescent.

12 Atraumatic Restorative Treatment (ART)

QUESTION

Write a note on ART.

ANSWER

Dental caries is a widespread problem all over the world. In many developing countries most of these cases are untreated leading to extraction. To meet this problem, ART technique was developed mainly for the developing countries. It was pioneered in the mid 1980s by Dr. Joe Frencken, in Tanzania as a part of the community based primary oral health care program for the refugees by the University of Dar es Salaam. In 1994, WHO introduced ART as a part of oral health for healthy life.

This procedure involves excavating and removing caries with hand instruments and restoring with adhesive filling like Glass Ionomer Cement (GIC).

Advantages of ART

1. Non-threatening.
2. Non-painful.
3. Does not need local anesthesia.
4. Expensive electrically driven equipments are not used, so it is cost effective.
5. Only hand instruments are used.
6. Requires minimal cavity preparation, so conservation of sound tooth tissues.
7. Easy sterilization of hand instruments.

Indications

1. It is indicated in teeth where caries is involving only dentin.
2. In those areas where hand instruments are accessible.

Contraindications

1. Not used in cavities reaching pulp and with periapical abscess.
2. In those areas where hand instruments are not accessible.

Even non-dental professionals or primary health care workers can be trained for this procedure. This technique can be carried out in schools, primary health centers, villages and remote areas.

Instruments and Materials Used

All we need for operator is a stool and a flat surface for the patient to lie. Instruments used are:

1. Mouth mirrors.
2. Explorers.
3. Tweezers.
4. Spoon excavators (large and small).
5. Hatchets.
6. Hoes.
7. Carvers.
8. Mixing pad.
9. Plastic spatula.
10. Plastic strips.
11. Petroleum jelly.
12. Cotton rolls and pellets.
13. Wedges.
14. Articulating papers.

Glass ionomer is used as a restorative material because it chemically binds to the teeth, releases fluoride after setting and is dentin and pulp compatible.

Procedure

1. Isolation of the tooth.
2. Removal of caries using excavators and prepare the cavity with other hand instruments.
3. Dry the cavity.
4. Apply dentin conditioner.
5. Mixing of GIC powder and liquid.
6. Cavity and adjacent pits and fissures are overfilled.
7. Press the restorative material with petroleum jelly coated gloved finger.
8. Remove excess material with carver and apply varnish.
9. Check occlusion.

Limitations

1. Long term survival rates for glass ionomer ART restorations and sealants are not yet available, the longest study reported so far is of three years duration.
2. The techniques acceptance by oral health care personnel is not yet assured.
3. The use is limited to small and medium sized, one surface lesions because of low wear resistance and strength of existing glass ionomer materials.

4. The use of hand instruments over long periods can lead to hand fatigue.
5. Unstandardized mix of the material because of hand mixing, variation among operators and different geographical/climatic situations.
6. The apparent lack of sophistication of the technique.
7. The misconceptions by the public that the new glass ionomer white fillings are only temporary dressings.

13 Epidemiology of Periodontal Diseases

QUESTIONS

1. Epidemiology of periodontal diseases.
2. Local factors in the etiology of periodontal diseases.

ANSWER 1

Epidemiology of periodontal disease is explained under host, agent and environment factors:

Host Factors

Age

Survey data generally says that severity of the disease increases as age advances. The prevalence of periodontal disease is approximately 45% at 10 years of age, 67% at 20 years, 70% at 35 years and 80% at 50 years. There is a nine-fold increase in the prevalence of destructive periodontal disease with pocket formation between 20–70 years of age.

Sex

In general, males consistently have a higher prevalence and severity of periodontal disease than females. The male enter the beginning phase of destructive periodontal disease at approximately 35 years of age, while female enter by 45 years of age. Day states that in India, females show significantly lower bone loss than do the males.

Race

As per the studies done by Russell in United States, blacks showed high prevalence and severity of periodontal disease than whites.

Intraoral Variations

The variations in the plaque, gingivitis, calculus and bone loss put together produce the intraoral variation pattern of the periodontal disease in the individual. The teeth most affected are upper molars, lower central incisors and laterals. The teeth moderately affected are the lower molars, upper central, lateral incisor premolar and lower canine. The teeth least affected are lower bicuspids and upper canines. Bone loss and gingivitis is more severe in maxilla compared to mandible/more severe in the interproximal area then buccal and lingual.

Less periodontal disease is observed on the left side of the mouth as right handed people brush left side better than right.

Endocrine Changes

Hormonal changes during puberty, pregnancy, menstruation and menopause increases susceptibility for gingival disturbances and periodontal lesions.

Local Factors for Periodontal Disease (also refer Ans 2)

a. Traumatic occlusion which produces destructive forces to alveolar bone which leads to alveolar resorption and tooth mobility.
b. Food impaction.
c. Disuse (unilateral mastication).
d. Unreplaced missing teeth.
e. Tooth brush trauma.
f. Malocclusion.
g. Habits: Thumb sucking, tongue thrusting, fingers and nail biting, pencil biting.

Occupational Habits and Neurosis

It can act as predisposing factors for periodontal disease. Occupational habits includes holding of nails in the mouth by carpenters, thread biting and needle holding by tailors, pressure of a reed or mouthpiece upon teeth by musical instrument players. Neurosis includes lip biting, cheek biting, bruxism.

Tobacco

There is a clear association between smoking and periodontal disease. There is increasing scientific evidence that smoking has a detrimental effect on the progression of periodontal disease and healing after periodontal therapy. Heat and the accumulated products of combustion are particularly undesirable local

irritants. A high prevalence of periodontitis is seen among smokers. Smoking is thought to suppress the vascular reaction, cause polymorphonuclear leukocyt's defect in peripheral blood which is responsible for plaque accumulation and osteoporosis.

Oral Hygiene

Poor oral hygiene is an important risk factor in highly susceptible individuals. Improper or inadequate use of oral hygiene aids leads to accumulation of plaque and calculus which increases the risk for the occurrence of gingival and periodontal disease.

Concomitant Disease (Systemic diseases)

Diabetes is the most common disease predisposing to periodontal disease in which there is alveolar bone destruction, periodontal abscess and loss of teeth.

Other most common predisposing factors are: hematological disorders like acute monocytic leukemia (leads to gingival enlargement, ulcerations and hemorrhage), pernicious anemia, aplastic anemia, iron deficiency anemia, sickle cell anemia and , thrombocytopenic purpura. Debilitating diseases like syphilis, chronic nephritis, tuberculosis, GI disorders, liver disease, cardiovascular diseases (like arteriosclerosis, coronary heart disease, congenital heart disease) may show signs of periodontal disease. Immune deficiency disorders like HIV render the patient susceptible to opportunistic infections, psychogenic factors like stress and tension tends to develop abnormal habits antagonist to the periodontal health. There is no epidemiologic evidence that systemic factors are a significant cause of chronic periodontal disease, but it can influence the disease progression.

Iatrogenic Factors

Few iatrogenic factors may cause irritation to gingiva, acts as foci for plaque formation, or leads to food impaction.

a. Margins of restoration which are over hanging.
b. Contours—Over contoured/under contoured crowns and restorations.
c. Inadequate proximal contacts.
d. Occlusion—Over occlusion/under occlusion leads to traumatic occlusion or food impaction.
e. Design of removable partial dentures—Favors accumulation of plaque if they cover gingival tissue or is impinging on the gingiva.
f. Improper use of rubber dam clamps, copper bands, matrix bands leads to laceration and gingival inflammation.

g. Orthodontic bands—Irritation from these when extended into gingival tissue.
h. Abnormal orthodontic forces.
i. Few dental materials have corrosive products and leads to chemical irritation.

Socioeconomic Status

Periodontal disease is inversely related to the increasing levels of income. Study by Mehta et al in Bombay showed that periodontal disease increases in low socioeconomic status and decreases in high socioeconomic status. In high socioeconomic status people there is better oral hygiene, good education and greater visits to dentist. Poor oral hygiene and gingivitis is related to lower socioeconomic status. Few cultural factors associated with low socioeconomic status people may also act as a predisposing factor for periodontal disease.

Educational Background

Russel finds that periodontal disease is inversely related to degree of education. This is because of more systematic home care, and dental maintenance care among well educated people. Occupation along with education shows relationship with periodontal disease e.g: The prevalence and severity of periodontal disease are lower in office personnel than in factory workers.

Agent Factors

Plaque and Calculus

The most important local factors causing periodontal disease is bacterial plaque and calculus. Various bacterial flora are responsible for gingivitis and various periodontal diseases. Most widely accepted specific plaque hypothesis states, specific micro organisms are responsible for specific periodontal diseases.

Supragingival plaque mainly constitutes gram positive cocci and rods like outer surface, mature plaque contains gram negative rods, filaments and Spirochaetes.

Sub gingival plaque has tooth attached and tissue attached plaque.

- Tooth attached plaque mainly contains gram +ve rods and cocci like streptococcus mitis, streptococcus sanguis, actinomyces viscosus.
- Tissue attached plaque constitutes gram negative rods and cocci, filaments, like porphyromonos gingivalis, prevotella intermedia, fusobacterium nucleatum, campylobacter species, spirochaetes, peptostreptococcus micro organisms.

In juvenile and prepubertal periodontitis, actinomyces actinomycetemcomitans, P. gingivalis, P. intermedia are most commonly involved.

Chemicals

Certain chemicals like mercury, lead, bismuth phosphorus, arsenic, phenols, silver nitrate, chromium, benzene, thallium are known to show harmful effects on periodontal tissues. Drug like aspirin cause aspirin burns.

Environmental Factors

Geographic Areas

Russel found in few countries like Thailand, Burma, Malaya, Ceylon, India and Jordon, a relatively high prevalence of periodontal disease. But there is a weak generalization to say that underdeveloped and dentist deprived areas show greater periodontal disease than developed countries.

Nutrition

There is no consistent association established between periodontal disease and nutrition. It is a secondary factor in the etiology of periodontal disease. There is a possibility that generalized malnutrition may influence its severity, vitamin C deficiency causes scurvy, vitamin A deficiency has more chance of developing deep periodontal pockets and vitamin D deficiency shows osteoporosis and poor bone density. Vitamin B complex deficiency shows gingival inflammation. Niacin deficiency shows necrotic gingivitis. In animal studies shows that protein starvation and magnesium deficiency has effect on periodontium.

Radiation

Radiation therapy develops erythema and desquamation of oral mucosa including gingiva, leading to ulceration, and infection. Irradiated bone shows acellularity and avascularity with loss of osteoclasts and osteoblasts which makes bone more susceptible to infections. Periodontal disease is considered as a portal of entry for infection and development of osteo radionecrosis after radiation therapy.

Degree of Urbanization

In general, the prevalence and severity of periodontal disease is slightly higher in rural areas than in the urban areas.

ANSWER 2

Classification of Etiological Factors

Local Factors

1. ***Deposits on teeth***
   a. Supragingival (salivary), calculus.
   b. Subgingival (serumal) calculus.
   c. Materia alba.
   d. Mucinous plaque.
   e. Protein pellicle.
2. ***Abnormal habits***
   a. Unilateral mastication.
   b. Abnormal biting habits.
   c. Clenching and bruxism.
3. ***Food impaction***
   a. Vertical.
   b. Horizontal.
4. ***Non detergent diet***
5. ***Other irritants***
   a. Mechanical irritants.
   b. Chemical irritants.
   c. Atmospheric irritants.
   d. Improper orthodontic procedures.
   e. Improper tooth brushing.
6. ***Abnormal anatomy***
   a. Hard tissue structures
      i. Tooth form
      ii. Tooth contour
      iii. Proximal contact
      iv. Tooth position
   b. Soft tissue structures
      i. Abnormal attachment of frenum
      ii. Eruption of teeth
7. ***Factors of occlusal function***
   a. Overfunction
      i. Excessive stress on teeth
      ii. Insufficient periodontal support
      iii. Too powerful masticatory musculature.
   b. Underfunction
      i. Premature wear

ii. Non occlusion
iii. Indolent mastication (swallowing food after very little mastication)

Systemic Factors

1. Faulty nutrition.
2. Debilitating diseases.
3. Blood dyscrasias.
4. Endocrine dysfunctions.
5. Allergies and drug idiosyncrasies.
6. Roentgen, radium and atomic radiation.
7. Psychogenic factors.
8. Iatrogenic factors.

14 Prevention and Control of Periodontal Diseases

QUESTIONS

1. Define plaque control and discuss plaque control methods.
2. a. Dental floss.
   b. Interdental brushes
   c. Wooden tips
3. Dentifrices.
4. Chlorhexidine mouthwash.
5. Tooth brushes.
6. Mechanical plaque control. (Refer Ans: 1, 2, 3, 5)
7. Chemical plaque control. (Refer Ans: 1, 4)
8. Level of prevention for periodontal disease.

ANSWER 1

Plaque control is the removal of microbial plaque and the prevention of its accumulation on the teeth and adjacent gingival surfaces.

Plaque control is divided into mechanical and chemical plaque control.

Mechanical

1. ***Tooth brushes:***
   a. Manual tooth brushes.
   b. Electrical tooth brushes.
2. ***Dentifrices***
3. ***Interdental cleansing aids:***
   a. Dental floss.
   b. Wooden tips.
   c. Interdental brushes like

i. Proxabrush.
ii. Unitufted brush.
iii. Miniature bottle brush.

d. Rubber tips.
e. Knitting yarn.
f. Pipe cleanser.
g. Gauze strip.

4. ***Oral irrigation devices***
5. ***Prophylaxis by professionals.***

Chemical

1. **Enzymes:**
   - Mucinase, dehydrated pancreas, mutanase, dextranase.
2. ***Antibiotics:***
   - Penicillins, vancomycin, erythromycin, Kanamycin.
3. ***Phenols:***
   - Thymol, triclosan.
4. ***Quaternary ammonium compounds:***
   - Benzalkonium chloride, cetylpyridium chloride, benzethonium chloride, domiphen bromide.
5. ***Bisbiguanides:***
   - Chlorhexidine, Alexidine.
6. ***Bispyridines:***
   - Octenidine.
7. ***Metallic salts:***
   - Zinc, tin, copper.
8. ***Herbal extracts:***
   - Sanguinarine.
9. ***Aminoalcohols:***
   - Octapinol, decapinol.
10. ***Other surfactants:***
    - Sodium lauryl sulphate.

ANSWER 2a

Dental Floss

This is made up of nylon thread used to remove plaque in the proximal surfaces of the teeth.

Uses

1. Used to remove plaque and food debris between the teeth or in interproximal embrasures.
2. Remove plaque under pontics of the fixed partial denture.
3. Stimulating and massaging interdental papillae.
4. As a vehicle to carry therapeutic agents like fluoride solutions.
5. To locate subgingival calculus, overhanging margins of restorations, and proximal carious lesions.

Types

1. Thick, medium, thin and exxtra-thin.
2. Twisted or untwisted.
3. Bonded or unbonded.
4. Waxed or unwaxed.

Method of Use

Stretch the floss between two forefingers or between thumb and forefinger.

- Gently pass the floss into contact area by back and forth motion. Do not snap the floss. Once it has entered into the contact area wrap it around the proximal surface of the tooth, like semi-circle and move the floss down to contact area. Repeat up and down strokes.
- A dental floss holder is one in which floss is tied between two prongs and it has a handle. It is designed to be used by patients like physically handicapped patients, patients with restricted mouth opening and anyone who would prefer to use it.

It is indicated for type-I embrasure when there is no gingival recession.

ANSWER 2b

Interdental Brushes

They are cone-shaped brushes made of bristles mounted on a handle, e.g. Single tufted brushes, miniature bottle brush, cone shaped bristle brush and cone shaped plastic brush. These are particularly suitable for cleansing large, irregular or concave tooth surfaces adjacent to wide interdental spaces. They are inserted interproximally and are activated with the short back and forth strokes in between the teeth. For best cleaning efficiency the diameter of the brush should be slightly larger than the gingival embrasure so that the bristles can exert pressure on the tooth surfaces, working their way into concavities on the roots. Interdental brushes are indicated in Type II embrasures (moderate papillary recession) and unitufted brush is recommended in Type III embrasure. These are useful in patients with open embrasures.

ANSWER 2c

Wooden Tips

These are available with or without handle. Stim-U-Dent is triangle wooden tip without handle. It is inserted into interdental space with base of the triangle resting on the gingiva and the sides of triangle touching proximal surfaces of the tooth. It is moved in and out of the embrasure. It removes plaque and also stimulates gingiva. Perio-aid is a wooden tip with handle and used on the facial or lingual surfaces throughout the mouth. This is efficient in cleaning gingival margin and periodontal pockets.

ANSWER 3

Dentifrices (Dens = tooth, fricore = to rub)

They are the aids used for cleaning and polishing tooth surfaces. They are usually available in the form of paste, also available in powder form and as gel. Dentifrices are of two types: Cosmetic and therapeutic.

The ingredients are as follows:

1. ***Abrasives*:** Abrasive action eliminates plaque and removes stained pellicle and polishes the teeth, e.g. Calcium carbonate, Dicalcium phosphate dihydrate, etc.
2. ***Surfactants/detergents/ foaming agents:*** The foam produced helps in the removal of debris and plaque, e.g. sodium laurylsulphate, sodium-N-laurylsarcosinate.
3. ***Humectants:*** They preserve moisture and maintain the consistency of the paste, e.g. Glycerine, Sorbitol, Polyethyl glycerol.
4. ***Binders:*** They bind the solid ingredients and form a homogenous paste, e.g. Sodium carboxylmethylcellulose, alginates.
5. ***Flavouring agents:*** To provide flavour, e.g. Spearmint oil, peppermint oil, oil of wintergreen.
6. ***Sweetening agents:*** e.g. Sorbitol, mannitol and saccharin.
7. ***Preservatives:*** To prevent microbial growth, e.g. benzoic acid.
8. ***Colouring agents.***

Therapeutic Dentifrices

These contain the basic constituents of a dentifrice and also therapeutic agents for specific purpose. They are as follows:

1. ***Anticaries dentifrices:*** Contains fluoride from 550 ppm to 3000 ppm. To prevent dental caries, agents used are sodium fluoride, sodium mono-fluorophosphate.

2. ***Antiplaque dentifrices:*** To reduce the incidence of plaque formation. Agents used are chlorhexidine 0.1to 0.2 % and sanguinarine 0.03%.
3. ***Anticalculus dentifrices:*** These prevent calculus formation. Agents used are tetrasodium pyrophosphate, zinc chloride, triclosan.
4. ***Desensitizing dentifrices:*** These prevent the sensitivity of the tooth due to exposure of dentin/cementum by abrasion or attrition or in cases of recession. Agents used are potassium nitrate, strontium chloride, stannous fluoride, etc.

ANSWER 4

Chlorhexidine Gluconate

It is used as one of the chemical plaque control agents which is classified under cationic chlorophenyl bisbiguanide group. It has both bacteriostatic and bactericidal action in low and high concentration respectively.

Instruction

1. ***Short term therapy:*** Rinsing with 10 ml of 0.2% aqueous solution, two times daily for 30–45 seconds.
2. ***Long term therapy:*** 1:1 dilution of chlorhexidine with water is used for rinsing, twice daily for 30–45 seconds.

Mechanism of Action

Chlorhexidine inhibits plaque formation by the following ways:

1. It effectively blocks acidic group of salivary glycoproteins which will reduce their adsorption to hydroxyapatite and prevents formation of acquired pellicle.
2. Chlorhexidine adsorbs to extracellular polysaccharides of bacterial capsules or glycocalyx and prevents their adherence to the tooth surface.
3. Chlorhexidine may compete with calcium ions for acidic agglutination factors in plaque.

Depending on the bacterial species and the amount of chlorhexidine attached to the tooth surface, these microorganisms are either killed or are simply prevented from multiplying.

Uses

1. After periodontal surgery.
2. As a prophylactic rinse before ultrasonic scaling, and extractions.
3. As a subgingival irrigation after scaling and polishing of periodontal pockets.

4. In medically compromised patients who suffer from recurrent oral infections.
5. For patients with poor oral hygiene.
6. Physically and mentally compromised patients, patients with fixed orthodontic appliances, intermaxillary fixations where mechanical plaque control is impaired.

Adverse Effects

1. Discolors the teeth to yellowish brown extrinsic stains.
2. Painful desquamative lesions of oral mucosa.
3. Transient impairment of taste sensation.

ANSWER 5

Toothbrushes

The bristle toothbrush appeared about the year 1600 in China, was first patented in America in 1857. Different types of toothbrushes available are as follows:

1. Manual
2. Powered by battery or electricity.
3. Sonic and ultrasonic toothbrushes.
4. Ionic toothbrushes.

According to the size: Toothbrush should be selected according to age and size of the jaws:

1. Large or adult size.
2. Medium size.
3. Small size.
4. Baby size.

According to the hardness: Stiffness and firmness of bristles:

1. Extra hard.
2. Hard.
3. Medium.
4. Soft.
5. Extra soft or super soft.

Pattern of the bristles: Multitufted regular or Crisscross pattern, with or without indicator.

According to the Bistle material

1. Natural bristles (from hogs).
2. Artificial filaments (nylon).

According to modification in the shank straight, contra-angled or angled.

According to the design of toothbrush head: rectangular, diamond or oval shaped, fixed or flexible.

Parts of Manual Toothbrush

1. Handle.
2. Head: It has two parts— Toe and heel.
3. Bristles.
4. Shank.

ADA specification of manual toothbrush:

- *Brushing surface:* 1 to 1.25 inches (25.4 to 31.8 mm) long.
- 5/16 to 3/8 inch (7.9 to 9.5 mm) wide.
- 2–4 rows of bristles.
- 5–12 tufts per row, 80–86 bristles per tuft.

Powered Toothbrushes

In 1939, electrically powered toothbrushes were invented. There are many types of toothbrushes, some with reciprocal or back and forth motions, some with combination of both, some with circular and some with elliptical motion. Regardless of type of device, best results are obtained if patient is instructed to use properly. Placement of the moving bristles should be placed correctly around the mouth. These are recommended for:

1. Individuals lacking fine motor skills.
2. Small children or handicapped or hospitalized patients who need to have their teeth cleaned by someone else.
3. Patients with orthodontic appliances and
4. Patients who prefer them.

Sonic and Ultrasonic Toothbrushes

They produce high frequency vibrations, which lead to the phenomenon of cavitation and acoustic micro streaming. This phenomenon aids in stain removal as well as disruption of the bacterial cell wall.

Ionic Toothbrushes

They change the surface charge of a tooth by an influx of the positively charged ions. The plaque with a similar charge is thus repelled from the tooth surface and is attracted by the negatively charged bristles of the toothbrush.

ANSWER 8

Level of Prevention for Periodontal Disease

Levels	*Primary*		*Secondary*	*Tertiary*	
Preventive services	Health promotion	Specific protection	Early diagnosis and prompt treatment	Disability limitation	Rehabilitation
Services provided by the individual	Periodic dental visit; 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 efforts; provision of oral hygiene aids; lobby efforts.	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 malalignment; prophylaxis	Complete examination; scaling and curettage; corrective, restorative and occlusal services	Deep curettage; root planning; splinting; periodontal surgery; selective extractions	Removable fixed prosthodontics; minor tooth movement

15 Epidemiology of Oral Cancer/Prevention and Control of Oral Cancer

QUESTIONS

1. Discuss the epidemiology of oral cancer.
2. Discuss the various contributing agent factor in the occurrence of oral cancer (Refer Ans 1)
3. Describe the prevention and control of oral cancer.
4. Describe the various levels of prevention for oral cancer.
5. Toluidine blue staining.
6. Exfoliative cytology.

ANSWER 1

Oral cancer is one of the 10 most common cancers in the world. In the industrialized countries it ranks second to cardiovascular diseases. In developing countries it ranks third.

Epidemiology of Oral Cancer

Host Factors

Age: It is predominantly seen in older age group (5th and 6th decade of life). Persons as young as 21 years have also being reported to have oral cancer.

Sex: It is more common in males as compared to females. In developing countries, the males are at 2.5 times and females are at 4 times more risk as compared to developed countries. In India, the incidence rate for oral cancers in females are much lower than males except in Bangalore (females higher than males).

Site: In India, cancer of tongue and buccal mucosa constitutes the bulk of oral cancers. The lateral border, under surface of tongue, labial commissure and buccal mucosa are sites particularly associated with betel tobacco chewers. It has been remarked that buccal mucosa (65%), lower alveolus (30%), retromolar

trigone (5%) grouped together as the gingivo- buccal complex can be called "Indian oral cancer" as they constitute more than 60% of all cancers. In females the most affected sight is buccal mucosa and palate.

Occupation: Textile workers show an increase risk of cancer in oral cavity. Male leather workers show an increase risk of cancer of buccal cavity, larynx and pharynx.

Ethnic variation: Ethnicity strongly influences prevalence as a result of social and cultural practices, e.g. among the Indians living in Malay Peninsula, the overall incidence of oral cancer has long been considerably higher than that among the Malay or Chinese subjects. In US the incidence and mortality rates for black Americans are substantially higher than those for white Americans.

Familial and genetic predisposition: There is little evidence of a strong effect of familial and genetic predisposition to oral cancer. Of some relevant studies, in Kerala a familial association was seen in 0.94% of total oral cancers that occurred from January to June 1995, consistent with an autosomal mode of inheritance.

Demographic shift: Urbanization, industrialization, changes in lifestyle, population growth and increase in the age expectancy have contributed for epidemiological transition in the country. Changes in the age expectancy alters the disease pattern associated with the age and increases the burden of problems such as cancer.

Agent (Etiology)

Tobacco: The role of tobacco in the etiology of oral cancer have been shown in numerous studies. Data for India, says that 90% of oral cancer is directly attributable to chewing and tobacco smoking. 70% smoke bidi, 10% smoke cigarette and 20% use smokeless tobacco.

The various smoking habits prevalent are—bidi, chillum, chutta, cigarettes, dhumti, gudakhu, hookah, hookli.

The various smokeless varieties are khaini, mainpuri tobacco, mawa, mishri, paan, snuff, jarda. Raw and processed tobacco has been shown to have more than 2500 different chemical compounds. The most potent carcinogen in tobacco are: tobacco specific nitrosamines, nicotine, phenol, benzopyrene, carbon monoxide and polycyclic aromatic hydro carbons, tar, etc.

Alcohol: A synergistic effect of tobacco and alcohol has been observed. They account for 75% of all oral and pharyngeal cancers. Alcohol may promote carcinogenesis by various mechanisms which may include dehydrating effects

of alcohol on the mucosa, increasing the mucosal permeability to the carcinogen in tobacco, and causing nutritional deficiency. Also liver damage may weaken the immunological status.

Nutrition: Several components of diet are seen as tumor promoters or anti promoters. They may enhance or impede the delivery of carcinogen or alter the susceptibility of the target tissue to the carcinogen, e.g. Plummer-Vinson syndrome, deficiency of copper, zinc and manganese is reported to deplete levels of antioxidant nutrients in tissues and increase production of tumor enhancing free radicals. Beta carotene (concentrated in deep green, yellow or orange vegetables like carrots, spinach, lettuce) vitamin C and vitamin E are found to impede the carcinogenic action. In a study by Tata Institute of Fundamental Research, it was observed that those who did not consume vegetables, fish, buttermilk and pulses had a higher risk for oral cancer. Red chilly also emerged as a risk factor.

Other Agents

- All these factors can contribute towards increasing the risk of oral cancer.

Biological:

- Viral—Human papilloma virus, herpes simplex virus (HSV-1), Epstein-Barr virus
- Immunological disorders
- Fungal infection: Candida infections

Mechanical:

- Irritation from jagged teeth or denture
- Poor oral hygiene

Chemical:

- Arsenic, dyes, nickel, aromatic amines, chromium.

Environmental Factors

Effects of solar radiation: Occupation like farming, fishing, forestry and postal delivery are at risk due to long term exposure to UV radiation, e.g. lip cancer, Solar keratosis leading to Squamous cell carcinoma.

Effects of atmospheric pollution: Air pollution caused by release of a number of gases from factories, automobiles can act as a risk factor in the initiation of the cancer.

ANSWER 3

Prevention and Control of Oral Cancer

It has been estimated that 65–80% of oral cancer is environmental, attributed to lifestyle factors and thus can be prevented.

There are three main public health approaches:

- Regulatory or legal approach
- Service approach
- Educational approach.

The prevention and control of oral cancer spans the spectrum from primary prevention, through early detection, to treatment and after care.

Regulatory Approach

This applies to the governmental control of overuse of tobacco. As early as 1590, first governmental edict against tobacco use was declared in Japan where users were penalized by having their property confiscated or were jailed. In 1604, King James in England, increased the tax on tobacco by 4000% and in 1605, organized at Oxford the first public debate concerning the effects of tobacco. Similar edicts have been reported from the 17th century in Turkey, Russia and China. In 1965, USA legislation was passed requiring cigarette packages to carry a health hazard warning.

In India, the Cigarette Act, 1975 had made it necessary to print warning "Cigarette smoking is injurious to health" on the cigarette packets. Banning of advertisement on tobacco products has been undertaken. In 1985, National Cancer Control program has been started, which gives high priority for primary prevention of tobacco related cancers. Smoking in public places is banned. Maharashtra has taken lead in formulating state policy to make existing tobacco control legislature operative and use of governmental media for educational program.

Legislation should be enacted to:

- To prohibit the sale or handling over to minors of tobacco products for chewing or smoking
- Placing health warning on the cigarette packets and at places where it is sold
- Prohibiting advertisements of tobacco products
- Restrict smoking of tobacco products in enclosed public places
- Increase taxes on tobacco products
- Regulate the content of tobacco products: to reduce tar, nicotine and other carcinogenic agents.

Service Approach

This embodies screening of people for diagnosing cancer in its early stage. The oral cavity is easily accessible and its examination poses relatively little discomfort to the patient. It provides opportunity to identify and counsel patients about habits that increase the risk of oral cancer. The techniques used in screening are:

- Toludine blue vital staining
- Exfoliative cytology
- Biopsy techniques.

Educational Approach

Education has a important role to play in discouraging people from starting its use and helping people to stop the habit. Encouraging results with health education to disuse from tobacco habits have been observed in a study of 12,000 adult rural population by Mehta et al.

Levels of prevention for oral cancer

Levels of prevention	*Primary prevention*		*Secondary prevention*	*Tertiary prevention*	
Preventive services.	Health promotion	Specific protection	Early diagnosis and prompt treatment	Disability limitation	Rehabilitation
Services provided by individual patient	Periodic visit 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 dental professional	Patient education	Removal of known irritants in the oral cavity	Complete examination; biopsy; oral cytology; complete excision	Chemotherapy; radiation therapy; surgery	Maxillo-facial and removable prosthodontics; plastic surgery; speech therapy; counseling
Services provide for community	Dental health education programs; promotion of research efforts; lobby efforts	——	Periodic screening and referral; provision of dental services	Provision of dental services	Provision of dental services

Primary Prevention of Oral Cancer

In case of oral cancer, primary prevention focuses upon modifying habits associated with the use of tobacco in three major ways:

- Encourage people never to adopt any tobacco related habit
- Encourage people who already use tobacco to stop
- Encourage people who already use tobacco and cannot stop to at least decrease their use or to modify behavior in other ways to decrease the risk of cancer.

National preventive program: Public information and health education program: Reminding the public of the early signs of cancer by using mass media like TV, radio, newspaper, magazine, posters, folk drama. Displaying the health warning messages on the product carton and the places where it is sold. The health education can be done person to person, person to a group or to the large masses. The doctors, dentist, allied health workers like primary health care worker, female health worker and male health worker can be used for health education.

The educational program should be targeted at various levels: General public, decision makers, leading public figures, medical and para-medical personnel, schoolchildren and high risk individuals.

WHO observes 31st May as "No Tobacco day" and this day is celebrated throughout the world. Information is passed on about the adverse effects of tobacco on health.

Primary prevention in the clinic: The dentist can be in an ideal situation to advise the patient. The dentist can set an example by not using tobacco products. Educational materials can be displayed in the clinic. Educative magazines can be kept in the waiting room, one to one patient education can be done in the clinic.

Chemoprevention: It is a method of cancer control in which the occurrence of this disease is prevented by the administration of one or several chemical compounds, e.g.

1. Compounds those are effective against a complete carcinogen.
2. Compounds those are effective against a tumor promoter.
3. Compounds that inhibit neoplasia when administered shortly before exposure to a carcinogenic compound.

Secondary Prevention

At present in the developing countries, more than 50% of cancers are detected only after they have reached an advanced stage. Treatment required will be

both extensive and expensive and the survival rate are low. Hence, early detection can be very helpful.

Early detection: The natural history and anatomical site of oral cancer, provide excellent opportunity for early detection. Efforts at early detection can take many forms:

- Educate and encourage individuals to examine their own mouths for early signs of cancer.
- Screening the patients, who visit for other reasons.
- Organization and government can sponsor large scale efforts to seek out and examine groups of the population at risk.

De-addiction program: The patient can be motivated to go in for a de-addiction program.

Tertiary Prevention

Treatment modalities: The main treatment modalities are surgery, radiotherapy and chemotherapy. Prognosis will depend on the stage of the cancer. Additionally, supportive measures have an important impact on the effectiveness of the therapy. Good nutrition, attention to oral hygiene and dental care is especially important to prevent the adverse effects of the treatment, like osteoradionecrosis.

Rehabilitation: The objective of rehabilitation is to restore the patient to as normal a state of health. Reconstructive procedures may include correction of cosmetic defects, speech, swallowing and respiration. The extent of rehabilitation that will be needed is directly proportional to the extent of surgical excision.

ANSWER 4

(Refer levels of prevention for oral cancer in answer 3)

ANSWER 5

Toluidine Blue Vital Staining

It is a technique which has been used as a diagnostic adjunct to biopsy which can guide biopsy procedure by localizing small foci of tumor cells within the larger area of inflammation. A 1% solution of toludine blue dye (A basophilic vital nuclear dye) is used as a mouthwash and retained over the area of the diffuse lesion for nearly one minute. The area is then irrigated with 1% acetic acid. This stains the malignant lesions but not the normal tissues. It is remarkably reliable. False negative and false positive rates are significantly low with toluidine blue staining.

ANSWER 6

Exfoliative Cytology

It has been advocated as an adjunct to biopsy. The surface from where the specimen has to be taken must be first cleared of all debris and necrotic tissues. The edge of a moistened tongue blade is used to scrape the suspected area. Atleast, two samples should be taken. An adequate number of representative cells are usually picked up. The sample is then transferred to a glass slide and placed in 95% alcohol for 30 minutes, after this it is kept for fixation. The slides can be removed and air dried before forwarding it for microscopic evaluation in the laboratory. It is quick, simple, painless and bloodless procedure. It is especially helpful in follow-up cases of recurrent carcinoma in previously treated cases. The smear obtained is reported by cytologist as falling in one of the five classes.

Class I: Normal

Class II: Indicates presence of minor atypia but no evidence of malignant changes.

Class III: The cells display minor atypia that may be suggestive of cancer.

Class IV: A few cells with malignant characteristics. Biopsy is mandatory.

Class V: Cells are malignant. Biopsy is mandatory.

16 Epidemiology of Malocclusion/ Preventive Orthodontics

QUESTIONS

1. Etiology of malocclusion .
2. Preventive orthodontics.
3. Space maintainers .
4. Interceptive orthodontics .

ANSWER 1

Role of each factor in the development of malocclusion:
By Graber's classification:

General Factors

1. ***Hereditary:*** This factor is indicated as chief cause of malocclusion. This is influenced by environmental nutritional disturbances and idiopathic phenomenon. A child may have features resembling one of the parents or a combination of both parents.
   Hereditary plays a role in the following conditions like:
   a. *Congenital deformities:* Cleft lip and plate.
   b. Facial asymmetries.
   c. Macrognathia and micrognathia.
   d. Oligodontia and anadontia.
   e. *Tooth shape variations:* Peg laterals, Carabelli's cusp, etc.
   f. Deep overbite
   g. Mandibular retrusion and mandibular prognathism.
2. ***Congenital:*** Congenital defects have a strong genetic relationship. Few congenital conditions associated with dental malocclusion are as follows.
   a. Cleft lip and palate.
   b. Cerebral palsy

c. Torticollis
d. Cleidocranial dysostosis
e. Congenital syphilis.

3. *Environmental:*

a. *Prenatal:* The role of prenatal influences on malocclusion is said to be small. But factors like posture of the foetus, fibroids, amniotic lesions, maternal diet and metabolism, drug induced deformities as with thalidomide, injury or trauma, German measles, etc. act as predisposing factors for malocclusion, Congenital deformities like cleft lip and cleft palate are mainly associated with German measles and medications during pregnancy.

b. *Postnatal and birth injuries:* Injuries to infant's cranium at birth with high forceps delivery is an example for birth injuries. This can lead to
   i. Hypoplasia of mandible.
   ii. Ankylosis of TMJ joint which can inhibit growth of mandible.
   iii. Cerebral palsy.

   Other postnatal causes are condylar fractures which can lead to facial asymmetries scar tissue of cleft palate surgery can affect normal palate growth, prolonged Milwaukee brace wear can lead to restricted mandibular growth.

4. *Predisposing factors:*

a. *Endocrine imbalance:* Endocrine glands have influence on formation, calcification and eruption of teeth, growth pattern of jaws, face and cranium. Any endocrinal imbalance can lead to malocclusion.

   Example: In hypothyroidism there is delayed tooth eruption, retardation of formation of bone, narrowing of dental arches and submerging of teeth.

   In hyperthyroidism we can see retardation of skeletal and bone growth and osteoporosis.

   During hypoparathyroidism there are irregular and accentuated zones of under and over calcification of enamel and dentin.

   Hyperparathyroidism shows dentin hypocalcification, osteitis fibrosa, resorption of alveolar bone leading to tooth mobility.

b. *Metabolic disturbances:* The exact effects of the acute febrile conditions on the development of occlusion is not known, but they can bring about disturbances during the time of eruption, resorption, exfoliation, etc.

c. *Infectious diseases:* Diseases like poliomyelitis, disease with muscle malfunction like muscular dystrophy and cerebral palsy can have deforming effects on dental arch.

5. ***Dietary problems (Nutritional deficiency):*** Nutritional deficiencies during growth may result in abnormal development, causing malocclusion. Nutritional deficiencies like rickets, scurvy and beriberi can produce severe malocclusion.
6. ***Abnormal pressure habits:*** Abnormal pressure habits like thumb sucking, tongue thrusting, mouth breathing, lip biting, etc. can lead to proclination of upper anterior teeth, retroclination of lower anterior teeth, anterior open bite, increased overjet, posterior open bite, posterior cross bite, spacing between upper anterior teeth, etc.
7. ***Posture:*** Poor posture may accentuate an existing condition.
8. ***Accidents and trauma*****:** During growth, injuries can result in fracture of teeth, loss of vitality of tooth, abnormal resorptive pattern and may deflect the permanent tooth germ.

Local Factors

1. ***Anomalies in number of teeth:*** Under this we have supernumerary teeth and missing teeth.

   Supernumerary teeth are usually present in the midline, behind last molars and in premolar region. They interfere with eruption of teeth or may deflect the normal path of eruption of teeth. Most common congenitally missing, teeth are upper laterals incisors, lower second premolars, lower central incisors, which can cause spacing between teeth and lead to migration of teeth.
2. ***Anomalies of tooth size:*** If the teeth size are large and arch size is small or teeth size are small and arch size is large then it leads to crowding or spacing respectively.
3. ***Anomalies of tooth shape:*** Abnormal tooth shapes are seen in case of peg laterals, abnormal cingulum, fusion or gemination of a tooth which causes localized malocclusion.
4. ***Abnormal labial fremum:*** High frenal attatchment leads to midline diastema in the upper arch.
5. ***Premature loss of deciduous teeth:*** Premature loss of deciduous teeth can result in loss of space for the succeeding permanent teeth because of migration of adjacent teeth.
6. ***Prolonged retention of deciduous teeth:*** Prolonged retention of deciduous teeth leads to altered path of eruption of permanent tooth.
7. ***Delayed eruption of permanent teeth:*** Delayed eruption of permanent tooth results in impaction of underlying permanent tooth due to migration of adjacent teeth into edentulous space.

8. ***Abnormal eruptive path:*** Presence of supernumerary tooth, retained deciduous tooth, trauma, space deficiency, bony or mucosal barrier or idiopathic origin can lead to abnormal eruptive path.This will inturn lead to cross-bites or crowding.
9. ***Ankylosis:*** This is due to trauma, infection, endocrine disorders and congenital diseases like cleidocranial dysostosis. This can lead to submerged teeth and abnormal eruptive path.
10. ***Dental caries:*** Proximal caries of series of adjacent teeth should be restored to their anatomical form to prevent the reduction (loss) or arch length due to migration of adjacent teeth.
11. ***Improper dental restoration:*** Improper contact points of restorations can lead to loss of arch length, improper occlusal restorations can lead to supra eruption of opposing teeth or over restored tooth leads to functional prematurities and may act as foci for mandibular shift.

ANSWER 2

Preventive Orthodontics

The following are some of the procedures undertaken in preventive orthodontics:

1. Parent education
2. Caries control
3. Care of deciduous dentition
4. Management of ankylosed tooth
5. Check-up for oral habits
6. Extraction of supernumerary teeth
7. Space maintenance
8. Management of deeply locked first molar
9. Management of abnormal frenum attachment.

ANSWER 3

Space Maintainers

These are the devices used to maintain space created by premature loss of deciduous teeth.

Classification

According to Hitchcock

1. Removable or fixed, or semi-fixed.
2. With bands or without bands.
3. Functional or nonfunctional.

4. Active or passive
5. Certain combinations of the above.

Requirements of Space Maintainers

1. They should maintain the entire mesio-distal space created by a lost tooth.
2. It must restore the function as far as possible and prevent over-eruption of opposing teeth.
3. It must be simple in construction.
4. It should be strong enough to withstand the functional forces.
5. It should not exert excessive stress on adjoining teeth.
6. It must permit maintenance of oral hygiene.
7. It must not restrict normal growth and development and natural adjustments which takes place during the transition from deciduous to permanent dentition.
8. The space maintainer should not come in the way of other functions.

Commonly used Removable Space Maintainers

1. ***Acrylic partial dentures:*** These are used successfully when there are multiple loss of teeth. These are readily adjusted to allow the eruption of teeth. Teeth are included to restore masticatory function. Clasps are used for retention.
2. ***Complete dentures:*** Used when all teeth are indicated for extraction due to rampant caries in pre-school child. These denture restores both masticatory function and esthetics. They also guide first permanent molars into their correct function as the posterior borders are placed over the area approximating the mesial surface of unerupted first permanent molar. A portion of denture is cut to allow the permanent incisors to erupt. When molars and incisors erupt a partial denture is given.
3. ***Removable distal shoe space maintainer:*** It is an immediate acrylic partial denture with an arylic distal shoe extention. It is used to guide the first permanent molar into the position when deciduous second molar is lost shortly before the eruption of the first molar.

Fixed Space Maintainers

Few commonly used fixed space maintainers are:

1. ***Band and loop:*** It is unilateral fixed space maintainer indicated to maintain space in posterior segment when a single tooth is lost. Tooth distal to the space is banded and a thick stainless-steel wire is soldered to it with its mesial end touching the tooth mesial to the space.

2. ***Crown and loop:*** It is similar to band and loop except instead of band, crown is given in cases where abutment tooth is highly carious, marked hypoplasia or pulpotomized.
3. ***Lingual arch:*** It is the most effective appliance for space maintenance in the lower arch. It is indicated when there are bilateral multiple loss of primary molars. It helps in maintaining the arch perimeter by preventing both mesial drifting of the molars and also lingual collapse of the anterior teeth. Bands are cemented on first permanent molars or on the second deciduous molars and joined by stainless steel wire contacting the lingual surface of the four mandibular incisors.
4. ***Palatal arches:*** Also called "Nance palatal arch". It is similar to the lingual arch but wire does not contact maxillary incisors. It incorporates an acrylic button in the anterior region that contacts the palatal tissue. It is designed to prevent mesial migration of the maxillary molars.
5. ***Transpalatal arch:*** It has been recommended for stabilizing the maxillary first permanent molars when the primary molars require extraction. (A best example is when one side of the arch is intact and multiple primary teeth on the other side are missing). It consists of a thick stainless steel wire that spans the palate connecting the first permanent molar of one side with the other.
6. ***Distal shoe space maintainers:*** It is also called intra-alveolar appliance. It is indicated when primary second molars are extracted prior to the eruption of first permanent molar. Band is placed on deciduous first molar or canine and the horizontal bar is soldered to the band. The vertical component of bar (intra-gingival extension) is placed in the bone mesial to the permanent first molar. Depth of bone is calculated by the radiograph. The vertical component guides the first permanent molar to erupt into its position.
7. ***Band and bar/Crown and bar:*** Similar to the band and loop and crown and loop instead of using loop, a bar is used to connect the abutment teeth on either side of the extraction space.

ANSWER 4

Interceptive Orthodontics

It has been defined as that phase of science and art of orthodontics employed to recognize and eliminate potential irregularities and malpositions of the developing dentofacial complex.

The following measures are undertaken:

1. Serial extractions

2. Correction of developing cross bite.
3. Control of abnormal habits.
4. Space regaining
5. Diastema closure
6. Muscle exercises
7. Interception of skeletal malrelation
8. Removal of soft tissue or bony barrier to eruption of teeth.

Serial Extractions

These are done in the early mixed dentition, to recognize and anticipate potential irregularities in dento-facial complex and corrected by planned extraction of certain deciduous teeth and later specific permanent teeth in an orderly sequence and predetermined pattern to guide the erupting permanent teeth into a more favorable position.

Three step serial extraction procedure proposed by Dewel is extraction of C D and 4. First deciduous canines are extracted to align incisors, then deciduous first molars are extracted to allow eruption of first premolars and lastly first premolars are extracted to allow permanent canines to erupt.

Correction of Cross Bites

Dento-alveolar cross bites can be effectively treated using tongue blades, Catalan's appliance, double cantilever springs and posterior bite plates.

Control of Abnormal Habits

- Abnormal habits like tongue thrusting, thumb sucking which are corrected by using.

  Removable or fixed habit breaking appliances, e.g. Haw ley's appliance with cribs/spikes extending down from the palatal surface of the appliances and fixed appliances like squad helix with cribs.
- ***Mouth breathing habit:*** It may be obstructive or habitual in nature. The interceptive procedures should involve identification and removal of the cause. Persistence of habitual oral breathing is an indication to use a vestibular screen to intercept the habit.

Bruxism can intercepted by using soft rubber splint.

Space Regainers

If a primary molar is lost early and space maintainer is not used, a reduction in arch length by mesial movement of the first molar occurs. This space can

be regained by the distal movement of the first molar. Space regaining is done preferably in early age prior to the eruption of second molar.

For example: Gerber space regainer, space regainer using jack screws, Adam's space regainer, space regainer using cantilever springs.

Muscle Exercises

It helps in improving aberrant muscle function

- Exercise to strengthen the massetter muscle involves clenching of teeth while counting upto ten and then repeated again for some more time.
- Exercise for the lips (short hypotonic lips): Stretching the upper lip down towards the chin, holding and pumping of water back and forth behind the lips, massaging of the lips, button pull exercise and stretching of the upper lip to maintain lip seal.
- Exercise for the tongue (for correction of the improper positioning of the tongue): One elastic swallow, two elastic swallow, tongue hold exercise and the, hold pull exercise.

Interception of Skeletal Malrelations

If the skeletal malocclusion are diagnosed at an early age, it can be intercepted so as to reduce the severity of the malocclusion, e.g. Class II malocclusion due to deficient mandibular growth is usually treated by myofunctional appliances. Class III malocclusion as a result of maxillary retrognathism , FR III or face mask therapy is indicated. If Class III malocclusion is as a result of mandibular prognathism chin cup with head gear helps in restriction of mandibular growth.

17 Epidemiology of AIDS

QUESTION

Disease the epidemiology of AIDS.

ANSWER

AIDS/HIV Impact on Nation's World Wide

Approximately 65 to 70 million people infected with HIV; more than 25 million have died. Six million people were infected with HIV globally in 2006. The condition is worst in the Sub-Saharan Africa region followed by Caribbean. There is a growing concern emerging in parts of eastern and central Asia. India is one of the worst affected countries next only to South Africa in terms of prevalence of HIV. In India, AIDS is into its second decade.

Based on sentinel surveillance, the HIV prevalence in adult population can be broadly classified into three groups of states/union territories in the country.

Group 1: High prevalence states
- HIV infection has crossed 5% mark in high risk group.
- 1% or more among antenatal women.
- Spreading from urban to rural areas.
- States included are Maharashtra, Tamilnadu, Karnataka, Andhra Pradesh, Manipur, Nagaland.

Group 2: Moderate prevalence states
- HIV infection has crossed 5% mark in high risk group.
- Less than 1% among antenatal women.
- States included are Gujarat, Goa, Pondicherry.

Group 3: Low prevalence states
- HIV infection in any of the high risk group is still less than 5%.
- Less than 1% among antenatal women.
- Includes remaining states.

Epidemiological Features

1. ***Host factors***
   a. *Age:* Most cases have occurred among sexually active persons aged between 20-49 years. Children below 15 years make upto less than 3% of cases.
   b. *Sex:* More commonly seen in homosexual and bisexual men, however it is found to differ in different parts of the world. In Africa, women outnumber the men. Certain sexual practices increase the risk of infection more than others like multiple sexual partners, male homosexuality but higher rate is found in prostitutes.
   c. *High risk groups:* Sex workers, intravenous drug abusers, transfusion recipients of blood and blood products, hemophilia's and clients of sexually transmitted disease (STD).
2. ***Agent factors***
   a. *Agent:* The causative factor involved is the virus by name human immunodeficiency virus. It is a retrovirus; its diameter is 1/10,000th of a millimeter, consists of a protein capsule containing two short strands of RNA and enzymes. It replicates in actively multiplying T4 lymphocytes and can remain in lymphoid cells in a latent state that can be activated. They destroy the human T-helper cells or T-4 cells also called CD4+T lymphocytes/CD4+ cell. These cells play an important role in immune response. HIV selectively infects T-helper cells. They can spread throughout the body, also can pass blood-brain barrier and destroy some brain cells.
   b. *Reservoir of infection:* These are cases and carriers. The virus remains in the body for life-long. HIV infection can take many years to manifest itself, incubation period is uncertain may vary from few months to 10 years or more. The symptomless carrier can infect other people for years.
   c. *Source of infection:* Greater concentration of the virus is found in blood, semen and cerebrospinal fluid (CSF), lower in tears, saliva, breast milk, urine, cervical and vaginal secretions. To date, only blood and semen have been conclusively shown to transmit the virus.

Mode of Transmission

1. Sexual transmission
2. Blood contact
3. Maternal-fetal transmission: Mother to child transmission.

Clinical Manifestations

These are classified into four broad categories:

1. Initial infection with the virus and development of antibodies.
2. Asymptomatic carrier state.
3. AIDS-related complex (ARC).
4. AIDS.

1. ***Initial infection:*** About 70% of people show mild illness like fever, sore throat and rash after initial infection but most of them show no symptoms for first five years or so. HIV antibodies usually appear between 2 to 12 weeks in the blood stream. The period before the antibodies appear is the "Window period".

2. ***Asymptomatic carrier state:*** Infected people have antibodies, but no overt signs of disease except persistent generalized lymphadenopathy.

3. ***AIDS-related complex (ARC):*** Person with ARC has illness due to damage to the immune system but does not show opportunistic infections and cancers associated with AIDS, but they exhibit one or more of the following clinical signs; unexplained diarrhoea lasting longer than one month, fatigue, malaise, loss of more than 10% body weight, fever, night sweats, or other milder opportunistic infections such as oral thrush, generalized lymphadenopathy or enlarged spleen. Some patients with ARC subsequently develop AIDS.

4. ***AIDS:*** This is the end-stage of HIV infection. A number of opportunistic infections and cancers are seen. Death is due to uncontrolled or untreatable infection.

Few opportunistic infections and cancers commonly associated with AIDS are:

Tuberculosis, persistent generalized lymphadenopathy, kaposis sarcoma, oropharyngeal candidiasis, cytomegalovirus retinitis, pneumocystis carinii pneumonia, toxoplasma encephalitis, hairy leukoplakia, herpes zoster or shingles, severe prurigo or pruritic dermatitis, severe or recurrent skin infections.

18 Indices

QUESTIONS

1. a. Define index.
   b. Define dental index.
2. Ideal requisites of an index.
3. Classify indices.
4. Uses of indices.
5. Name a few indices used for assessment of dental caries for permanent dentition.
6. Decayed missing filled teeth index (DMFT).
7. Limitations of DMFT index
8. DMFS index.
9. Differences between DMFT and DMFS indices.
10. Name a few indices used for primary dentition and discuss about "def" index. Modifications of "def" index.
11. Name a few indices used for assessment of periodontal diseases.
12. Russell's periodontal index.
13. Ramfjord's periodontal disease index.
14. Community periodontal index of treatment needs (CPITN).
15. Community periodontal index (CPI).
16. Name a few indices used for oral hygiene assessment.
17. Oral hygiene index–simplified (OHI-S).
18. Discuss the differences between OHI and OHI-S.
19. Plaque index by Silness.P. and Loe.H.
20. Name a few indices used for assessment of gingival diseases.
21. Explain about gingival index by Loe.H. and Silness.J.
22. Name a few indices to measure fluorosis.
23. Dean's fluorosis index.

24. Community fluorosis index.
25. Name a few indices to measure malocclusion.
26. Dental aesthetic index (DAI).
27. Scales used for indices.

ANSWER 1A

Index is defined as a numerical value describing the relative status of a population on a graduated scale with definite upper and lower limits designed to permit and facilitate comparison with other populations classified by the same criteria and methods (Russell AL).

ANSWER 1B

Dental index is an objective mathematical description of a disease or condition based on carefully determined criteria under specified circumstances.

ANSWER 2

Ideal Requisites / Properties of an Index

- ***Clarity, simplicity and objectivity:*** Should be clear, reasonably easy to apply
- ***Validity:*** Index should measure what it is intended to measure, should correspond with clinical stages of disease under study
- ***Reliability:*** Index should be able to measure consistently at different times and each time the score should be the same
- ***Quantifiability:*** Index must be amenable to statistical analysis, so that it can be expressed by mean, median or other statistical measure
- ***Sensitivity:*** Index must be able to detect clinically small shifts in condition in either direction
- ***Acceptability:*** Index must not be painful or offending to the subject.

ANSWER 3

Dental indices are classified as:

1. ***Depending on the condition measured***
   a. *Reversible index:* Measures conditions that can be changed, e.g. gingivitis-gingival index
   b. *Irreversible index:* Measures conditions that cannot be changed, e.g. dental caries-DMFT index
   c. *Reversible and irreversible index:* Measures both the conditions, e.g: gingival and periodontal disease - Russel's periodontal index.

2. ***Depending on the site of the examination***
   a. *Simplified index:* Measures only a representative sample of the dental apparatus, e.g.-OHI-S
   b. *Full mouth index:* Measures entire patient's periodontium or dentition, e.g. Russel's periodontal index, DMFT index.
   c. *Half mouth index:* Only half of the mouth is examined, e.g. extent and severity index ESI (contralateral sides of the mouth are examined).
3. ***Depending on the entity the index measures***
   a. *Disease index:* 'D' portion of DMFT index.
   b. *Symptom index:* Gingival/sulcular bleeding indices.
   c. *Treatment index:* 'F' portion of DMFT index.
   - 'TN' of CPITN.
4. ***Index based on the special category***
   a. *Simple index:* Measures the presence or absence of a condition, e.g. patient hygiene performance (PHP) index.
   b. *Cumulative index:* Measures all evidence of a condition present and past, e.g. DMFT index

ANSWER 4

The uses of indices are:

1. ***For individual patients:*** An index can:
   a. Provide individual assessment to help a patient recognize an oral problem.
   b. Reveal the degree of effectiveness of present oral hygiene practices.
   c. Motivate the person in preventive and professional care for the elimination and control of oral disease.
   d. Evaluate the success of individual and professional treatment over a period of time by comparing index scores.
   e. Provide a means for personal assessment by the dental hygienist to educate and motivate individual patients.
2. ***In research:*** An index is used to:
   a. Determine baseline data before experimental factors are introduced.
   b. Measure the effectiveness of specific agents for the prevention, control or treatment of oral conditions.
   c. Measure the effectiveness of mechanical devices for personal care, such as toothbrushes, interdental cleansing devices or water irrigators.
3. ***In community health:*** An Index can:
   a. Show the prevalence and trends of incidence of a particular condition occurring within a given population.

b. Provide baseline data to show existing dental health practices.
c. Assess the needs of a community.
d. Compare the effects of a community program and evaluate the results.

ANSWER 5

The following are few indices used for assessment of dental caries in permanent dentition.

- DMFT - Decayed, missing, filled teeth index
- DMFS - Decayed, missing, filled surfaces index
- Moller's index
- Stone's index
- Czechoslovakian caries index
- Caries severity index
- Caries susceptibility index
- DMF surface percentage index
- WHO dentition status and treatment needs
- Root caries index.

ANSWER 6

DMFT—Decayed, Missing, Filled Teeth Index

- Introduced by Henry T Klein, Carrole E Palmer and Knutson JW in 1938
- Universally employed index for dental caries
- It is a irreversible and cumulative index (it measures total life time caries experience)
- D- decayed teeth, M- missing teeth due to caries, F-filled teeth due to caries.
  a. ***Purpose:*** To determine total dental caries experience past and present.
  b. ***Selection of teeth***
     Select all the teeth except:
     – Third molars
     – Unerupted teeth
     – Congenitally missing and supernumerary teeth
     – Teeth removed for other reasons (orthodontic or prosthodontic)
     – Teeth restored for other reasons
     – When both primary tooth and its permanent successor are present, primary tooth is not included.

WHO Modification of DMFT Index (1986)

1. All third molars are included.
2. Temporary restorations are considered as "D"

3. Only carious cavities are considered as 'D' and not chalky spots or stained fissures etc.

Procedures

a. ***Instruments:*** Mouth mirror and explorer.

b. ***Criteria for identification of dental caries:***

- Lesion should be clinically visible and obvious.
- Explorer tip can penetrate deep into soft yielding material.
- Discoloration or loss of translucency, typical of undermined or demineralized enamel is apparent.
- Definite catch in a pit or fissure which resists removal of the probe after moderate to firm pressure and when there is softness at the base or wall of the area.

c. ***Criteria for recording or principles and rules governing DMFT index:***

- No tooth must be counted more than once
- D, M and F teeth should be recorded separately.
- Restorations with recurrent decay are considered as decayed.
- Teeth which are badly carious, root pieces, non restorable carious teeth that are indicated for extraction are considered as missing teeth.
- A tooth having several restorations must be counted as one tooth.
- Deciduous teeth are not included in DMF count.
- Defective filling but without evidence of caries is considered as 'F' tooth.
- Permanent fillings are considered as 'F' teeth.
- Tooth is considered as erupted when there is total exposure of occlusal surface or incisal edge or if the occlusal surface/incisal edge can be exposed by gently reflecting the overlying gingival tissue.

Scoring

1. ***Individual DMFT:*** Each component is given a score of 1.

- Add scores of each component separately
- Total DT + MT + FT = DMFT. (DMFT score can range from 0-28/person excluding the third molars and 0-32/person including the third molars).

2. ***Group average:***

a. Add the D,M,F, Teeth scores for each individual.

b. Divide the total DMFT score by number of individuals in the group, e.g. 30 individuals, a total of DMFT = 210.

$$\text{Average DMFT} = \frac{210}{30} = 7$$

Limitations of DMFT Index

1. Not related to the number of teeth at risk.
2. It is invalid in older adults.
3. It can be misleading in children (because of exfoliation and/or extraction for orthodontic reasons).
4. Can overestimate the caries experience in teeth with preventive restorations.
5. DMFT index cannot be used for measuring root caries.
6. DMFT index is not a sensitive index.
7. Tooth scores exactly the same under extremes of clinical conditions.

ANSWER 7

Refer Ans 6. (Limitation of DMFT Index).

ANSWER 8

DMFS–Index

DMF index when used to assess each individual surface of each tooth it is termed as DMFS index.

Surfaces Examined

- Posterior teeth—Mesial, distal, buccal, lingual/palatal, occlusal.
- Anterior teeth—Mesial, distal, labial, lingual/palatal.
  For 28 teeth—The number of surfaces examined is 128.
  For 32 teeth—The number of surfaces examined is 148.

(Procedure/Principles/guidelines same as DMFT index…refer Answer 6)

Scoring

Each surface is scored as 1. Total number of surfaces for anterior teeth are 4 and for posterior teeth are 5.

For Individual

DMFS = Sum of total D surfaces, M surfaces and F surfaces.
Average group DMFS = Total DMFS/Number of individuals.

Advantages

1. ***Sensitive index:*** A finer measurement is possible when compared with DMFT index.
2. Index of choice in a clinical trial of caries preventive agent.

Limitations

1. *Overestimation of score:*
   - Score to be allocated to extracted teeth, which may have been attacked on one surface only and its extraction results in loss of 4 or 5 surfaces.
   - Score to be given to 2 surface fillings on posterior teeth, e.g. (MO), where the attack may have been on only proximal surface and the occlusal surface was involved later to provide an adequate class II type of cavity for restoration.
2. Time consuming and more likely to produce inconsistencies in diagnosis.
3. May require the use of radiographs to be fully accurate.
4. It has wider range of values therefore a larger standard error.

ANSWER 9

Refer answers 6 and 8.

ANSWER 10

The following are a few indices used for assessment of dental caries for primary dentition:

- deft/defs
- dmft/dmfs
- dft/dfs
- Moller's Index
- WHO dentition status and treatment needs.

def Index

- This index was given by Gruebbel AO in 1944
- This is signified by lower case letters.
  d- decayed teeth
  e- carious teeth indicated for extraction
  f- filled teeth.

Selection of Teeth

"d"= primary teeth with dental caries but not restored.
This code indicates the number of teeth those are decayed.

"e"= teeth indicated for extraction because of dental caries.
This code includes those teeth which are grossly destructed due to caries and are indicated for extraction. Missing teeth are not recorded because of difficulty in distinguishing between teeth exfoliated and extracted teeth. But, include those teeth which give accurate history of missing due to caries.

"f"= filled primary teeth that do not have dental caries.
This code includes those teeth which are restored due to caries and are free of recurrent decay.

Principles

No tooth should be counted more than once. If the tooth has both filling and decay it should be considered only once and decay has the first priority.

Number of teeth examined = 20.

The score can range from 0–20.

- Modifications of this index are:

  dmft/s—For children before age of exfoliation.

  dmft/s—Index is performed only on the primary molars and canines (7 to 12 years).

  dft/s—Here the "missing" component is ignored (to avoid the confusion arising from the tooth been naturally exfoliated or extracted). This index is a choice of the WHO in the basic oral health survey. It can be applied to the whole dentition as dft or dfs.

Mixed Dentition

DMFT/DMFS index for the permanent teeth and deft/defs for deciduous teeth. The two scores should not be added and are represented separately.

ANSWER 11

The following are few indices used for assessment of periodontal disease:

1. Russell's periodontal index (PI).
2. Ramfjord's periodontal disease index (PDI).
3. Community periodontal index of treatment needs (CPITN).
4. Community periodontal index (CPI).
5. Gingival periodontal index (GPI).
6. Extent and severity index (ESI).

ANSWER 12

Periodontal Index by Russell AL (1956)

Selections of Teeth

All the teeth present in the mouth are examined.

Procedure

1. ***Instruments:*** Mouth mirror and periodontal probe.

2. ***Score and criteria***

Score	*Condition*	*Criteria*
0	Negative	Neither overt inflammation of investing tissues nor loss of function due to destruction of supporting tissue.
1	Mild gingivitis	An overt area of inflammation in the free gingiva that does not circumscribe the tooth.
2	Gingivitis	Inflammation completely circumscribes the tooth but no break in the epithelial attachment.
6	Gingivitis with pocket formation	Break in the epithelial attachment and pocket formation, no interference with normal masticatory function, tooth is firm and not drifted.
8	Advanced destruction with loss of masticatory function	Tooth may be mobile, may have drifted, may sound dull on percussion with metallic instrument, may be depressible in its socket.

Additional Radiographic Criteria Followed in the Index

Code 0, code 1, and code 2: Have radiographic appearance normal.

Addition of code 4: Radiographs showing early notch like resorption in the alveolar crest.

Code 6: Horizontal bone loss involving the entire alveolar crest upto half of the length of the tooth root.

Code 8: Advanced bone loss involving more than one half of tooth root or definite infrabony pocket with widening of periodontal ligament. May be root resorption or rarefaction at apex.

Scoring

1. ***Individual scoring:*** Add the scores for each tooth and divide by the number of teeth present and examined

Interpretation:

Clinical condition	*Scores*
i. Clinically normal supportive tissues	0–0.2
ii. Simple gingivitis	0.3–0.9
iii. Beginning destructive periodontal disease	0.7–1.9
iv. Established destructive periodontal disease	1.6–5.0
V. Terminal disease	3.8–8.0

Uses

1. Used in epidemiological surveys.
2. More data can be assembled using PI than any other index of periodontal disease.

ANSWER 13

Periodontal Disease Index (PDI) by Sigurd P Ramfjord (1959)

It consists of 3 components:

- Gingival and periodontal component.
- Plaque component.
- Calculus component.

Gingival and Periodontal Component of Ramfjord's Index

1. ***Purpose:*** To assess the prevalence and severity of gingivitis and periodontitis. To show periodontal status of an individual or a group.
2. ***Selection of teeth:*** 16, 21, 24, 36, 41, 44.
3. ***Procedure***
   a. *Determine gingival status*
      i. Consistent standard light, dry the gingiva with cotton to observe color and form.
      ii. Apply gentle pressure with probe to determine consistency and color change.
   b. *Determine crevice depth from CEJ*
      i. To measure crevice or sulcus depth from CEJ to bottom of the pocket.
      ii. Instrument used is michigan O probe (markings are at 3, 6, and 8 mm).
      iii. Two measurement are taken: One at the middle of the facial surface and another at the facial aspect of the mesial contact area, with the side of the probe held touching both teeth.

Scoring Criteria

Scores	*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.
4	When the crevices (pockets) of any two recorded areas extend apically to the CEJ not more than 3 mm (including 3 mm).

Contd...

Scores	*Criteria*
5	When the pockets of any two recorded areas extend apically to the CEJ from 3 mm to 6 mm.
6	When the pockets of any two recorded areas extend more than 6 mm.

Scoring

1. ***For individual:*** Add scores for individual teeth and divide by the number of teeth examined. PDI score ranges from 0–6.
2. ***Interpretation:***
   0–3.9 indicates gingival involvement only.
   4–6 indicate periodontal involvement.
3. ***PDI score for group:***

$$\text{Group PDI} = \frac{\text{Total individual PDI scores}}{\text{Number of individuals examined}}$$

Plaque component of PDI by Ramfjord

a. Purpose: To evaluate the extent of plaque on the basis of tooth surface coverage.
b. Selection of teeth and surfaces: 16, 21, 24, 36, 41, 44 and surfaces recorded are facial, lingual, mesial and distal.
c. Procedure:
   i. Apply disclosing agent using two saturated pellets, one for maxillary and one for mandibular teeth.
   ii. Request patient to spit and then rinse with water.
   iii. Use direct or indirect vision to observe specific surfaces with disclosed plaque.
   iv. Scoring criteria:

Scores	*Criteria*
0	No plaque.
1	Plaque present on some but not all interproximal, facial, lingual surfaces.
2	Plaque present on all interproximal, facial and lingual surfaces, but covering less than one half of these surfaces.
3	Plaque extending over all interproximal, facial and lingual surfaces and covering more than one half of these surfaces.

d. Scoring: Add the plaque scores for each tooth and divide by the number of teeth examined.

Calculus Component of PDI by Ramfjord

1. ***Purpose:*** To evaluate the presence and extent of calculus.
2. ***Surface and teeth:*** 16, 21, 24, 36, 41, 44 and facial, lingual, mesial and distal.
3. ***Procedure***
   a. *Instrument used:* subgingival explorer (e.g. T.U. –17).
   b. *Scores and criteria:*

Score	*Criteria*
0	No calculus
1	Supragingival calculus extending slightly below the free gingival margin (not more than 1 mm).
2	Moderate amount of supra and subgingival calculus or subgingival calculus only.
3	Abundance of supra and subgingival calculus.

4. ***Scoring:*** Add individual teeth score and divide by number of teeth examined.

ANSWER 14

CPITN: Community Periodontal Index of Treatment Needs (TRS 621 Method)

Developed by the joint working committee of WHO and FDI in 1982 by Jukka Ainamo, David Barnes, George Beagrie, Terry Cutress, Jean Martin and Jennifer Sardo-Infirri.

1. ***Purpose:*** To screen and monitor individual or group periodontal status and treatment needs.
2. ***Selection of teeth:***
   - Mouth is divided into 6 segments (sextants).

17–14	13–23	24–27
47–44	43–33	34–37

   - There should be minimum of two functional teeth to consider the sextant.
   - If no teeth are present then exclude the sextant.
   - If only one index tooth is present include that tooth in adjacent sextant.

   Index teeth

   - *Above 20 years:*

17, 16	11	26, 27
47, 46	31	36, 37

- *Below 20 years:*

16	11	26
46	31	36

- Molars are examined in pairs and only one score (highest) is recorded
- Below 15 years, pockets are not recorded, only bleeding and calculus are recorded
- *In epidemiological survey:* For individuals of 20 years and above consider 10 index teeth; for individuals below 20 years consider only 6 index teeth.

Procedure

1. ***Instrument used:*** CPITN probe
   - It has a ball tip of 0.5 mm diameter
   - Light weight probe weighing 5 grams.

Types of CPITN Probe (Fig. 18.1) (TRS 621 probe)

1. ***CPITN-E:*** Epidemiological probe. Marking on the probe: color coded band between 3.5 mm and 5.5 mm.
2. ***CPITN-C:*** Clinical probe. Marking on the probe: color coded band between 3.5 mm and 5.5 mm and additional markings at 8.5 mm, and 11.5 mm.

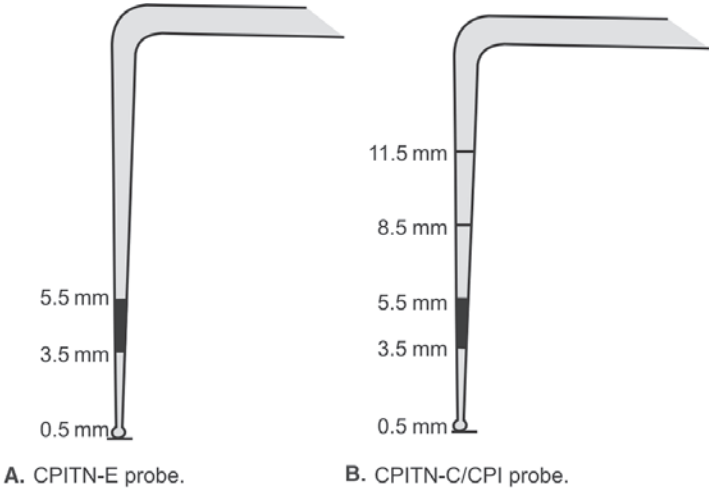


Fig. 18.1: Types of CPITN probes

How to Use the Probe

The probe tip is inserted gently into the gingival sulcus or pocket and total extent of sulcus or pocket is explored and should follow the anatomical configuration of the surface of the tooth root. Probe should be parallel to the long axis of the tooth. Both buccal and lingual surfaces are examined.

For checking bleeding on probing: The sensing force is 20 grams. (A practical test to estimate this force is done ; 20 grams force is equal to the force applied by probe under the thumb nail to produce blanching in the nail).

Codes and Criteria

Code	*Criteria*
0	Healthy
1	Bleeding on probing (30 sec)
2	Calculus detected during probing or presence of plaque retentive areas (the entire black band is visible).
3	4 to 5 mm of pocket (gingival margin within the black band on the probe).
4	Pocket 6 mm or more (black band on the probe not visible).
X	Excluded sextant
9	Not recorded.

Periodontal Treatment Need Scale

Scale	***Interpretation***
TN–0	No need for treatment (code 0)
TN–1	Need for improving the personal oral hygiene (code 1)
TN–2	Improving personal oral hygiene + scaling and root planing and removal of plaque retentive factor (code 2 + code 3)
TN–3	TN-1+TN-2 + Complex periodontal therapy, deep scaling, root planning and complex surgical procedure (code 4)

ANSWER 15

CPI: Community Periodontal Index

This is the modification of the earlier used ''Community Periodontal Index of Treatment Needs''. Modification is done by the elimination of "Treatment Needs" category and inclusion of "Loss of Attachment."

Selection of Teeth

- Mouth is divided into six segments (sextants).

18–14	13–23	24–28
48–44	43–33	34–38

- There should be minimum of 2 functional teeth to consider the sextant.
- If no teeth are present then exclude the sextant.

Index Teeth

- *Above 20 years:*

17, 16	11	26, 27
47, 46	31	36, 37

- *Below 20 years:*

16	11	26
46	31	36

- Molars are recorded in pairs and only one score (highest) is recorded.
- Below 15 years, pockets are not recorded, only bleeding and calculus are recorded.
- ***In epidemiological survey:*** For individuals of 20 years and above consider 10 index teeth; for individuals below 20 years consider only 6 index teeth.

Procedure

1. ***Instrument used:*** CPI probe (CPITN-C probe)
   - It has a ball tip of 0.5 mm diameter
   - Light weight probe weighing 5 gms.
   - *Marking on the probe:* Color coded band between 3.5 mm and 5.5 mm, markings at 8.5 mm, and 11.5 mm. (CPITN-C- Probe)
2. ***How to use the probe:*** The probe tip is inserted gently into the gingival sulcus or pocket and total extent of sulcus or pocket is explored and should follow the anatomical configuration of the surface of the tooth root. Probe should be parallel to the long axis of the tooth. Both buccal and lingual surfaces are examined.

   For checking bleeding on probing/pockets: The sensing force is 20 grams. (A practical test to estimate this force is done; 20 grams force is equal to the force applied by probe under the thumb nail to produce blanching in the nail).

3. *Codes and criteria*

Code	*Criteria*
0	Healthy
1	Bleeding on probing
2	Calculus detected during probing (the entire black band is visible).
3	4 to 5 mm. of pocket (gingival margin within the black band on the probe)
4	Pocket 6 mm. or more (black band on the probe not visible).
X	Excluded sextant (less than two teeth present).
9	Not recorded.

Loss of Attachment

Code	*Criteria*
0	Loss of attachment 03 mm. (CEJ not visible and CPI score 0–3).
1	Loss of attachment 4-5 mm. (CEJ within the black band).
2	Loss of attachment 6-8 mm. (CEJ between the upper limit of the black band and the 8.5 mm. ring).
3	Loss of attachment 9-12 mm. (CEJ between the 8.5 mm and 11.5 mm rings).
4	Loss of attachment 12 mm. or more (CEJ beyond the 11.5 mm rings).
X	Excluded sextant. (Less than two teeth present)
9	9—Not recorded (CEJ neither visible nor detectable).

ANSWER 16

1. ***Indices used to measure oral hygiene and debris:***
   a. Oral hygiene index (OHI).
   b. Oral hygiene index (OHI-S).
   c. Patient hygiene performance index.
2. ***Indices used to measure plaque:***
   a. Plaque index by Silness.P. and Loe.H.
   b. Turesky—Gilmore—Glickman modification of the quigley hein plaque index.
   c. Navy plaque index.
   d. Shick and Ash modification of plaque criteria.
   e. Glass index.
3. ***Indices used to measure calculus:***
   a. Calculus surface index.

b. Calculus surface severity index.
c. Marginal line calculus index.
d. Volpe Manhold index.

ANSWER 17

Oral Hygiene Index-Simplified

- Given by John C Greene and Jack R Vermillion in 1964.
- OHI-S is a simplified index of the original index OHI given by the same authors in 1960.

Purpose

To assess oral hygiene by estimating the tooth surface covered by debris and/or calculus.

OHI-S has two Components

- Simplified debris index (DI-S)
- Simplified calculus index (CI-S)
- Both the components are recorded separately and then added to obtain OHI-S

$$\text{OHI-S} = \text{DI-S} + \text{CI-S}$$

Procedure

The examination is done on the 6 surfaces of following six index teeth.

Index teeth	*Surface examined*	*Substitute index teeth*
16	Buccal	17/18
11	Labial	21
26	Buccal	27/28
31	Labial	41
36	Buccal	37/38
46	Buccal	47/48

- Only fully erupted index teeth are examined
- If the index tooth is missing, has a crown restoration or if the height of the tooth is reduced because of caries or trauma then the substitute index tooth is examined.

Method and Scoring System for DI-S

The DI-S should be performed before the CI-S assessment. Area covered by the debris is assessed by moving the side of the explorer along the tooth surface from incisal to cervical. Instrument used are: explorer No. 5- Shepard's crook and mouth mirror.

Score and Criteria

0—No debris or no extrinsic stains present.
1—Soft debris covering not more than one third of tooth surface being examined or presence of extrinsic stains without debris regardless of surface area covered.
2—Soft debris covering more than one thirds but not more than two thirds of the exposed tooth surface.
3—Soft debris covering more than two third of the exposed tooth surface.

Method and Scoring System for CI-S

No. 5 explorer (Shepard's crook) is used to estimate the area covered by the supragingival and subgingival calculus.

Score and 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 presence of individual flecks of subgingival calculus around the cervical portion of tooth.
3—Supragingival calculus covering more than two thirds of the exposed tooth surface or continuous heavy band of subgingival calculus around the cervical portion of the tooth.

Scoring

OHS-S for an individual:

$$\text{DI-S} = \frac{\text{Total debris scores}}{\text{No. of teeth examined}}$$

$$\text{CI-S} = \frac{\text{Total calculus scores}}{\text{No. of teeth examined}}$$

$$\text{OHI-S} = \text{DI-S} + \text{CI-S}$$

Interpretation

DI-S and CI-S values will range from 0–3

Rating	*Scores*
Good	0.0–0.6
Fair	0.7–1.8
Poor	1.9–3.0

OHI-S values will range from 0–6

Rating	*Scores*
Good	0.0 –1.2
Fair	1.3–3.0
Poor	3.1–6.0

ANSWER 18

Difference Between OHI and OHI-S

	OHI	*OHI-S*
Teeth examined	All the teeth. (mouth is divided into sextants and all the teeth in the sextant are examined).	Only index teeth
Surfaces scored	12 (2 scores per sextant, buccal and lingual surface).	6 (one surface per index tooth)
DI and CI score range	0– 6	0–3
Total DI+CI	0–12	0–6

ANSWER 19

Plaque Index (PI)

- Given by Silness P and Loe H in 1964.
- ***Selection of teeth:*** Entire dentition or selected teeth (index teeth=16, 12, 24, 36, 32, 44).

Surfaces Examined

Examine for plaque only in the cervical third areas of Distal, Disto-facial, facial margin, mesial facial and lingual surface of the tooth.

Procedure

Dry the teeth and examine visually using adequate light, mouth mirror and probe or explorer. Pass the probe or explorer across the tooth surface in the cervical third and near the entrance to the sulcus.

- Include plaque on the surface of the calculus and on the dental restorations in the cervical third.
- Use disclosing agent, if necessary to assist evaluation for the score 0 and 1.

Scoring Criteria

Score	*Criteria*
0	No plaque
1	A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may be recognized only after application of disclosing agent or by running the explorer across the tooth surface.
2	Moderate accumulation of soft deposit 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 on the tooth and gingival margin.

Scoring

1. ***PI for tooth:*** Add score of each area: Distal, facial, mesial and lingual and divide by 4.
2. ***Total PI score:*** Add scores of each tooth and divide by the number of examined teeth.

Interpretation

Rating	*Score*
Excellent	0
Good	0.1–0.9
Fair	1.0–1.9
Poor	2.0–3.0

ANSWER 20

The following are few indices used for assessment of gingival diseases:

For assessing gingival inflammation:

1. PMA (papillary marginal attached gingival) index by Maury Massler and Schour I in 1944.
2. Gingival index by Loe H and Silness J in 1963.
3. PMI (papillary marginal index) by Muhlemann H.R. and Mazor Z.S.
4. Modified gingival index by Lobene R et al.

For assessing gingival bleeding

1. Sulcus bleeding index by Muhlemann HR and Mazor ZS.
2. Papillary bleeding index by Muhlemann HR (modification of sulcus bleeding index in 1977).
3. Gingival bleeding index by Carter and Barness.
4. Modified sulcular bleeding index.
5. Eastman interdental bleeding index.
6. Gingival bleeding Index (GBI) of Ainamo J and Bay I

ANSWER 21

Gingival index given by Loe H and Silness J in 1963

1. ***Purpose:*** To assess the severity of gingivitis based on color, consistency and bleeding on probing.
2. ***Selection of teeth:***
   - All teeth or selected teeth (index teeth = 16, 12, 24, 36, 32, 44).
   - Four gingival areas examined - Disto-facial papilla, facial margin, mesio-facial papilla and entire lingual margin.
3. ***Procedure:***
   a. Teeth and gingiva are dried; using a mouth mirror and probe examine the teeth, under adequate illumination.
   b. Probe is used to press on the gingiva to determine the degree of firmness.
   c. To evaluate bleeding, pass the probe along the soft tissue wall of the gingival sulcus.
4. ***Score and criteria:***

Score	*Criteria*
0	Normal gingiva.
1	Mild Inflammation—Slight change in color, slight edema, no bleeding on probing.
2	Moderate inflammation—redness, edema and glazing, bleeding on probing
3	Severe inflammation—marked redness, edema, ulceration, tendency to spontaneous bleeding.

Scoring

1. Each surface is given a score.
2. ***For each tooth:*** Add the scores of each surface and divide by four.
3. ***For individual:*** Add the scores of each tooth and divide by number of teeth examined.

Interpretation

Rating	*Scores*
Excellent (Healthy tissues)	0
Good	0.1–0.9
Fair	1.0–1.9
Poor	2.0–3.0

ANSWER 22

The following are few indices to measure fluorosis:
1. Dean's fluorosis index.
2. Community fluorosis index.
3. Tooth surface index of fluorosis (TSIF).
4. The Thylstrup-Fejerskov classification of enamel bluorosis.
5. Fluorosis risk index.
6. Young's classification of enamel fluorosis.
7. Murray and Shaw's classification of enamel fluorosis.
8. Simplified fluoride mottling index.

ANSWER 23

Dean's Fluorosis Index

- Given by Trendly H Dean in 1934.
- Dean's fluorosis index set criteria for categorizing dental fluorosis on a 7 point ordinal scale (normal, questionable, very mild, mild, moderate, moderately severe and severe).
- In 1942, he revised the index into 6 point scale as normal, questionable very mild, mild, moderate and severe.

Selection of Teeth

Examine all the teeth. The score is based on the two most severely affected teeth, but if the two teeth are not equally affected, then the score for the less affected of the two is recorded.

Criteria

Code	*Criteria*
Normal	The enamel surface is smooth, glossy, and usually a pale creamy-white color.
Questionable	The enamel shows slight aberration from the translucency of normal enamel which may range from a few white flecks to occasional spots.
Very mild	Small, opaque, paper white areas scattered irregularly over the teeth but involving less than 25% of the labial tooth surface.
Mild	The white opacity of the enamel of the teeth is more extensive than for code 2, but covers less than 50% of the tooth surface.
Moderate	The enamel surface of the teeth show marked wear and brown stain is frequently a disfiguring feature.
Severe	The enamel surface are badly affected and hypoplasia is so marked that the general from of the tooth may be affected. There are pitted areas or worn areas and brown stains are widespread and teeth have a corroded appearance.

ANSWER 24

Community Fluorosis Index (CFI)

To determine severity of dental fluorosis as a public health problem Trendly H Dean in 1935 devised a method of calculating the prevalence and severity of fluorosis in a group or community which he termed as community fluorosis index.

Criteria	*Statistical weights*
Normal	0
Questionable	0.5
Very mild	1
Mild	2
Moderate	3
Severe	4

In 1946, he related the numerical scale of CFI to what he defined as the public health significance of community fluorosis index score.

It is calculated as: $\frac{\text{Frequency} \times \text{Statistical weight}}{\text{Number of individuals examined}}$

Scores for CFI	*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

Example

Criteria	*Statistical weights*	*Frequency*	$f \times w$
Normal	0	10	0
Questionable	0.5	2	1
Very mild	1	5	5
Mild	2	3	6
Moderate	3	4	12
Severe	4	1	4
		25(n)	28

$$\text{CFI} = \frac{f \times w}{n} = \frac{28}{25} = 1.12$$

Interpretation

Public health significance (community fluorosis) is medium.

ANSWER 25

The following are few indices to measure malocclusion:

- Angle's classification.
- Dental Aesthetic index.
- Handicapping labio-lingual deviation index.
- Malocclusion severity estimate by Grainger.
- Malalignment index by Vankirk.
- Occlusal index by Summers.
- Treatment priority index by Grainger.
- Handicapping malocclusion assessment record by Salzmann Master and Frankel.
- Index of orthodontic treatment needs.

ANSWER 26

Dental Aesthetic Index

It was developed by N C Cons, J Jenny and FJ Kohaut in 1986. This index has been adopted by the WHO in the basic oral health survey, 1997.This index is performed only for the permanent teeth; 10 occlusal traits are recorded using CPI probe and the DAI score is calculated using the occlusal traits in a regression equation:

(missing visible teeth × 6) + (crowding) + (spacing) + (diastema × 3) + (largest anterior maxillary irregularity) + (largest anterior mandibular irregularity) + (anterior maxillary overjet × 2) + (anterior mandibular overjet × 4) + (vertical anterior openbite × 4) + (antero-posterior molar relation × 3) + 13.

The severity of malocclusion within a population is classified on the basis of the DAI scores as shown in the table below:

Severity of malocclusion	*Treatment indication*	*DAI score*
No abnormality or minor	No or slight need	< 25
Definite malocclusion	Elective	26–30
Severe malocclusion	Highly desirable	31–35
Very severe or handicapping malocclusion	Mandatory	> 36

ANSWER 27

Several kinds of scales for measuring intensity of a condition:

1. ***An ordinal scale:*** Lists the condition in order of severity without attempting to define any mathematical relation between the categories, e.g. Interpretation score of OHI-S index, good, fair or poor.
2. ***Nominal scale:*** It simply gives names to different condition and is strictly not a scale, e.g. Kennedy's classification of edentulousness, Angle's classification for malocclusion.
3. ***Interval scale:*** The numbers used in measuring scale purport to have mathematical relation to each other. This scale does not have an true zero point and hence is not used for dental indices, e.g. Temperature measured in Celsius or Fahrenheit (here 0 degree does not mean absence of temperature).
4. ***Ratio scale:*** The numbers used in measuring scale purport to have mathematical relation to each other. This scale has a true zero point and hence can be used in the dental indices, e.g. Gingival index:

Score	*Criteria*
0	Normal gingiva (absence of disease).
1	Mild inflammation.
2	Moderate inflammation.
3	Severe inflammation.

19 Planning and Evaluation

QUESTIONS

1. Define the term planning/plan.
2. Discuss the planning cycle in detail.
3. Define evaluation and discuss the different types of evaluation.
4. Criteria's for evaluation of dental services.
5. Evaluation. (Refer Ans 3 and 4)
6. Discuss the steps in evaluating a program.
7. How will you evaluate a dental health education program in school having strength of 300 children?
8. Give your plan to evaluate the clinical trial of fluoride mouthwash with a sample of 35 in the study group and 30 in the control group (with placebo).
9. Write briefly how you will evaluate the water fluoridation program in the school?

ANSWER 1

E.C Banfield defined plan as a decision about a course of action.

ANSWER 2

When planning, one needs to have a deep understanding and analyze the system for which planning has been done. The planners who do the planning are of two types:

1. External planners
2. Internal planners.

The planners may have training on the job in the organization or would have undergone professional training.

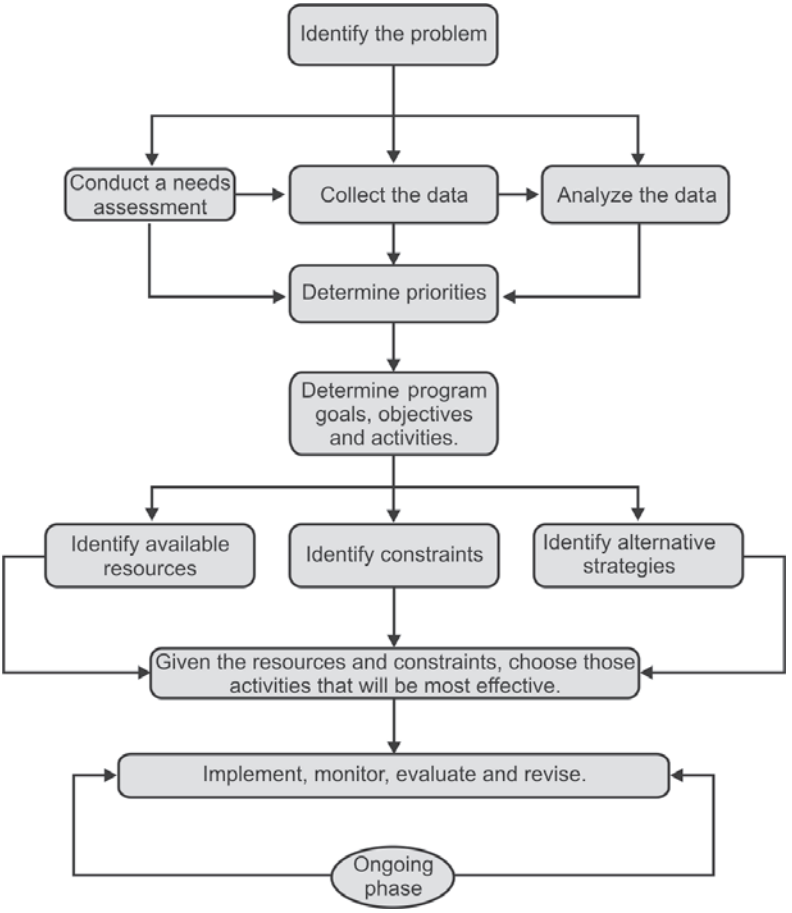
External Planners

The planner brought in from outside is usually an individual who contracts to work for the company or agency on a consulting basis. The advantage of this type of planner is that he or she potentially brings to the organization a fresher look less bias and a greater sense of objectivity. However, the external planner requires more time to reach a level of understanding of the system sufficient to plan a appropriate course of action.

Internal Planner

A planner hired from within the system. He already has a true understanding of the issues and operation of the system. The knowledge helps the planners to begin making decisions more quickly regarding appropriate actions. However the planner may already have acquired certain biases about the system that could influence his or her objectivity.

Flow chart 19.1: Planning and implementation strategy



Planning Cycle (Flow chart 19.1)

1. ***Conducts needs assessment:*** The planner should conduct needs assessment:
   a. To define the problem and to identify its extent and severity.
   b. To obtain the profile of the community to ascertain the causes of the problem. This information helps in developing the appropriate goals and objectives in the problem solution.
   c. To evaluate the effectiveness of the program.

   The data can be primary or secondary. It can be obtained through survey, questionnaire, clinical examination, personal communication and interviews.
2. ***Determining priorities:*** It is method of imposing people's values and judgments of what is important onto the raw data. If the priorities are not determined, the program may not serve those individuals or groups who need the care most. A problem that affects large number of people generally takes priority over a problem that affects a small number of people or a problem that is more severe or serious takes the priority in comparison to less serious disease. The various target or priority groups are: preschool and school aged children, mentally and physically disabled, chronically ill, medically compromised, elderly persons, expectant mothers and low income minority groups.
3. ***Development of program goals and objectives:*** Program goals are broad statements on the overall purpose of a program to meet a defined problem. For example, if the problem is caries among school children then the program goal is "To improve the oral health of the school aged children in the community."

   Program objectives are more specific and describe in a measurable way, desired end result of program activities or they are the specific avenues by which goals are met. For example, by the end of 2010 more than 80% of the children aged 12 years from the Belgram community will not have any tooth loss as a result of caries.
4. ***Resource identification:*** Selection of resources for an activity must be determined by considering what would be the most effective, efficient, adequate and appropriate task for accomplishment.
5. ***Resources like:*** Personnel, sponsors or supporters (Governmental, public, dental organization, health consumer groups, business foundation, philanthropic groups, etc).

   Equipment and supplies (Dental supply companies, public health clinics, hospitals, government, industries).

   Facilities (Hospitals, dental clinics, schools, HMO's, nursing homes, health centers, transport).

   Financial resources (Governmental or voluntary health organization).

5. ***Identifying constrains: (Road blocks or obstacles):*** By identifying constraints early in the planning stages, one can modify the design of the program and thereby create a more practical and realistic plan. It is always better to include community leader while planning because he can not only identify the constraints but can also suggest alternative strategies. Constraints may result from resources limitation, people's negative attitude, socioeconomic status, sociocultural and educational barriers etc.
6. ***Alternative strategies:*** It is important to generate a sufficient number of courses of action that might be needed incase any constraints arise. These strategies must be effective in attaining the objectives.
7. ***Implementation, supervision, evaluation, revision:*** The process of putting the plan into action is referred to as the implementation phase. This process like the planning process involves individuals, organization and community. It is an 'ecological approach' which is attained through teamwork between the individual and the environment.
8. ***Monitoring, evaluating and revising the program:*** Once the plan has been implemented the program requires continuous surveillance of all activities. The program success is determined by monitoring how well the program is meeting its stated objectives, how well individuals are doing their job, how well equipments function and how appropriate and adequate facilities are. Before problems arise in any areas, adjustments must be made to fine tune the program.

ANSWER 3

Program Evaluation

The fundamental purpose of program evaluation is to provide information for decision making. Evaluation is a judgment of merit or worth about a particular person, place or thing.

Evaluation is Conducted to Study

- The structure (program setting, logistics, facilities, equipments, finances and human resources)
- The process (The actual ways or methods employed in the provision of program services like delivering health care, educating children, etc)
- The outcome (The actual impacts, effects and changes brought about as a result of the program being evaluated).

"Scriven" defines evaluation to be of two types:

1. Formative evaluation
2. Summative evaluation.

Formative Evaluation

It refers to the internal evaluation of a program. It is an examination of the processes or activities of a program as they are taking place. It is usually carried out to aid in the development of a program in its early phases. It is used primarily by program developers and program staff members concerned with, whether various components of a program are workable or whether changes should be made to improve program activities. If any sequence is found to be incorrect, formative evaluation allows the program to make remedial changes at that point and thereby improve the performance. Such strategy is much better than waiting till the program is completed and then announcing that there were procedural errors.

Four types of recommendations can be derived from formative evaluation.

a. Terminate the project
b. Reorganize
c. Fine tune
d. Continue with the project as it was implemented.

Summative Evaluation

It judges the merit or worth of a program after it has been in operation. It is an attempt to determine whether a fully operational program is meeting the goals for which it was developed. It is aimed at program decision makers who will decide whether to continue or terminate a program and also at decision makers from other programs who might be considering adoption of the program.

Other Types of Evaluation

1. Formal and informal evaluation.
2. Relevance evaluation.
3. Effectiveness evaluation.
4. Impact evaluation.
5. Efficiency evaluation.
6. Progress evaluation.

Formal Evaluation

An evaluation which is carried out in a structured manner in which there is an exclusively designed program, with clear objectives and specific criteria to measure the success of the program.

Informal Evaluation

An evaluation which is carried out in an unstructured manner, without any exclusively designed program, unclear objectives and no specific criteria to measure the success of the program.

Relevance Evaluation

It is designed to determine whether the program is needed or whether the program is targeting its efforts at the individuals in need.

Effectiveness Evaluation

It refers to whether program results meet predetermined objectives. Here the emphasis is on immediate outcomes of the program activities and whether these outcomes meet the objectives specified by the program planners.

Impact Evaluation

It refers to the evaluation of the long term outcomes of the program.

Efficiency Evaluation

It attempts to relate the results obtained from a specific program to the resources used to maintain the program.

Progress Evaluation

It is also called as formative evaluation. A process of evaluation which is carried out while the planning is taking place.

ANSWER 4

Criteria of Evaluation

1. ***Appropriateness:*** Is the program acceptable to both consumer and provider and do the priorities reflect a proper interpretation of the needs of the population?
2. ***Adequacy:*** Has the intended coverage of the target population being achieved / and are the services readily available?
3. ***Effectiveness:*** Have the tested objectives been achieved.
4. ***Efficiency:*** What has been the cost in manpower or finance in relation to the output of the program?

ANSWER 6

Steps in evaluating a dental program are:

1. Determine the objectives.
2. Defining the instruments for evaluation.
3. Collection of data.
4. Presentation of results and recommendation.

20 Survey Procedures

QUESTIONS

1. Define survey.
2. Types of surveys.
3. Define basic oral health survey.
4. Pathfinder survey.
5. a. Describe the procedural steps in conducting the survey.
   b. Discuss scientific method in dental epidemiology.
6. WHO index age and age groups.
7. Types of ADA examination.
8. Calibration. (Refer Ans 5)
9. Duplication. (Refer Ans 5)
10. Discuss how you will conduct a survey to find out the incidence of periodontal disease in the community. (Refer Ans 5)
11. Describe the steps involved in conducting a survey to find out the prevalence of dental caries among school children. (Refer Ans 5)
12. How would you plan to conduct a survey in rural area for assessing the gingival disease? Describe the index you use for this purpose? (Refer Ans 5 and for gingival index refer chapter on indices)

ANSWER 1

A survey is an investigation in which information is systematically collected, but in which experimental method is not used. There is no active intervention by the investigators. It may be simply called as non-experimental investigation.

ANSWER 2

Different types of surveys are:

1. ***Descriptive survey***
   a. Cross-sectional
   b. Longitudinal

2. *Analytical survey*
   a Cross-sectional
   b Longitudinal
3. *Basic oral health survey*
   a Pathfinder survey
      i. Pilot survey
      ii. National pathfinder survey

1. A descriptive survey sets out to describe a situation, e.g. distribution of disease in a population with respect to time, place and person.
2. An Analytic survey or exploratory survey tries to explain the situation or prove a hypothesis.

Surveys descriptive or analytic can be cross-sectional or longitudinal depending on the time period covered by the study.

ANSWER 3

Basic oral health surveys are defined as surveys to collect the basic information about oral disease status and treatment needs that are needed for planning or monitoring oral health care programs. They are not designed to collect information about the etiological factors affecting disease distribution or severity, or about the clinical effectiveness of different preventive or care procedures or about etiological factors affecting disease distribution or severity. However, the information obtained using basic oral health surveys can be used to monitor aspects of the effectiveness of oral care services.

ANSWER 4

The most practical, economic survey sampling methodology to be used in oral epidemiological survey is defined by the pathfinder method. The pathfinder survey can be of two types depending on the number and type of sampling sites and the age groups included.

1. Pilot survey
2. National pathfinder survey

The method used in selecting a sample is a stratified cluster sampling technique, which aims to include the most important population subgroups likely to have differing disease levels.

A pilot survey is the one which includes only the most important subgroups in the population and only one or two index ages, usually 12 years and one other age group. Such a survey provides the minimum amount of data needed to commence planning.

A National Pathfinder survey incorporates sufficient examination sites to cover all important subgroups of the population that may have differing

disease levels or treatment needs, and at least three of the age groups or index ages. This type of survey design is suitable for the collection of data for the planning and monitoring of services in all countries what ever the level of disease, availability of resources, or complexity of services.

ANSWER 5A

Steps of Survey

1. ***Pre-survey***
   a. Prepare survey protocol
      - Establish the objectives
      - Type of study
      - Sampling method

   b. Organizing the survey
      - Obtaining permission from higher authority
      - Budgeting, schedules, emergency care and referral
      - Courtesy report

   c. Reliability of the data
      - Examination method
      - Diagnostic criteria and aids
      - Selection of examiner
      - Calibration
      - Duplicating examination

   d. Pilot survey.
2. ***Implementation of the survey***
   a. Contact person in authority
   b. Continuous supply of schedules and instruments
   c. Personnel (organizing clerk, recording clerk)
   d. Traffic arrangement
3. ***Post-survey action***
   a. Analyzing the data.
   b. Preparing the report.
      - Introduction
      - Aims and objectives
      - Material and methods
      - Results and findings
      - Discussion and conclusion
      - Summary.

Pre-survey

1. ***Preparing the survey protocol:*** It is important to prepare written protocol for the survey which will include the objectives of the study, the description of the population to be studied, sampling methodology (e.g. Simple random, stratified random, cluster or multistage sampling) , type of study (e.g. Descriptive, Analytical, longitudinal or prevalence study), type of data that will be collected, the personnel involved, about the budget, the statistical methods used and the time table of the activities.
2. ***Organizing the survey:*** The permission from the authorities should be obtained, like the official permission from the government if the survey is for general population, from school principals and parents if it is for the school children. The local community leaders have to be contacted and also the health authorities. The dental organizations, local dental practitioners and the organizers also need to be contacted. A budget has to be prepared for the survey which will include all the resources required including the personnel and all the activities of the survey. The time schedule for the survey also needs to be decided. The planner must estimate the time required for examination, e.g. 5–10 minutes for the child and 15-20 minutes for the adults. The schedule should allow for some flexibility so that unexpected delays do not cause major upsets in the survey time table. In one half session, 25–30 children can be examined by a single examiner. Provision should be made for some medical facility at the survey site or referral services to attend to any medical emergency or life-threatening situation during the survey. Courtesy reporting should be done wherein a report of the survey findings to the local authorities on day to day basis should be done.
3. ***Reliability of the data:*** The examination method for data collection should be decided. Usually ADA type 3 examination method is used. The data collection can be done on the WHO health assessment form 1997 or can be modified as per the requirement or a new proforma can be formulated. *Diagnostic criteria and aids* used in assessment should be circulated among all the examiners. The right decision about the type of index for recording the disease should be made, e.g. dentition status and treatment needs/ DMFT/DMFS index for recording dental caries, gingival index by Loe and Sillness/ Ramfjord index when assessing the gingival status, CPI/ Ramfjord index/extent and severity index for assessing the periodontal condition.
   a. *Selection of examiner / training / calibration:* In the epidemiological survey it is essential that the participating examiners be trained to make

consistent clinical judgments. There can be variation among the examiners while reporting the results of the examination and hence to reduce intra-examiner and inter-examiner variability training and calibration of examiner is needed.

The objectives of standardization and calibration are:

- To ensure uniform interpretation, understanding and application by all examiners of the codes and criteria for the various diseases and conditions to be observed and recorded
- To ensure that each examiner can examine consistently.

The trainer who is experienced with the methodology is appointed to train the examiners in the survey. Training usually takes 2 days or more which will depend on the number of indices used in the survey.

b. *Calibration:* In-order to achieve intra-examiner and inter-examiner consistency a method known as calibration is followed. Intra-examiner consistency is the ability of one examiner to reproduce the same results when examining a subject over a number of times. Inter-examiner consistency is the ability of the group of examiner to produce same results after examining the same subjects.

When there is a single examiner, he should practice examination on 10 subjects who are pre-selected and having all the disease condition. Then the examiner should examine about 20 subjects twice ideally on the successive days or after an interval of 30 minutes. The results of both the examination should be compared and checked for consistency. 85–95% consistency level should be obtained, but if the results show major discrepancies then it indicates wide variability which should be rectified by studying the examination criteria again and conducting additional examination.

When the survey is conducted by group of examiners it is important to assess the intra-examiner and inter-examiner consistency. The examiner should first practice the method individually on 10 patients, then all the examiners should perform examination on the same 10 or more subjects and compare his/her findings. When findings contain major discrepancies, subjects should be recalled in order that the differences in the diagnosis can be reviewed by the examiners and resolved by group discussion. It is essential that the group of examiners should be able to examine consistently using a common standard.

c. *Duplication:* Examiners may change the way they apply diagnostic criteria during the course of a series of examination. To allow detection and correction of this tendency, it is advisable for each examiner to

perform duplicate examination on 5–10% of the sample(not less than 25) in the main survey. During re-examination as far as possible the examiner should not be able to identify the subjects, since this information can affect the quality and thoroughness of the duplicate examination. Duplication is conducted about half way through the survey and at the end of the survey. When a survey is to be conducted by a group of examiners an experienced epidemiologist may be appointed to act as validator for the survey team. The validator should examine atleast 25 subjects who have already been examined by each member of the survey team. To calculate the reproducibility of the duplication results Kappa statistics is employed.

4. ***Pilot survey:*** A survey is conducted before the main survey on a small group of subjects to assess the feasibility and to evaluate the survey planning.

Implementation of the Survey

The persons in authority at the institution or the organization where survey is to be conducted should be contacted. The basic information should be obtained like the water supply, electricity, socio-economic level and accessibility of the resources. Arrangements of the instruments used in the survey (generally 30 mouth mirrors and probes per examiner are needed), the sterilization procedure, supply of the survey forms, selection of the examination site, examination position, arrangement of tables and chairs for the survey, the selection of the people to be the recording clerk, light arrangements, avoidance of crowding and control of the patient traffic should be arranged. Appoint persons as the organizing clerk who would manage the arrangement of all the necessary things for the survey.

Post-survey Action

The collected data is first arranged, edited and is analyzed manually or using computer. The results are computed and statistical test are performed as is required. The last step is preparation of the report which will contain the following information:

- Introduction
- Purpose of the survey
- Material and methods(will include the area and population surveyed, the nature of information collected, sampling method, personnel and physical arrangements, statistical analysis and computational procedures, cost analysis, reliability and reproducibility of the results)
- Results and findings

- Discussion and conclusion
- Summary.

ANSWER 5B

Scientific method in dental epidemiology.
An investigation should follow a logical scientific pattern:
1. Establishing the objectives*
2. Designing the investigation*
3. Selecting the sample*
4. Conducting the examination*
5. Analysing the data*
6. Drawing the conclusion*
7. Publishing the results*

For writing the answer in detail refer*.
1. (refer pre-survey in answer 5)
2. (refer answer 2)
3. (explain different sampling methods)
4. (refer pre-survey in answers 5 , 6 and 7)
5. (refer post-survey action answer 5)
6. (refer post-survey action answer 5)
7. (refer post-survey action answer 5)

ANSWER 6

WHO Index Ages and Age Groups

The following ages and age groups are recommended: 5 years for primary teeth and 12, 15, 35–44 and 65–74 years for permanent teeth.

5 Years

The children can be examined between their 5th and 6th birthday. This age is of interest because a complete complement of deciduous teeth is present. This age reveals the levels of caries of the primary teeth. It is also the age at which the child starts the schooling.

12 Years

This age is especially important as it is generally the age at which children leave primary school, and therefore in many countries, is the last age at which reliable sample is obtained easily through the school system. Also, it is likely at this age that all permanent teeth, except third molars will have erupted.

For this reason 12 years has been chosen as the global monitoring age for caries for international comparisons and monitoring of disease trends.

15 Years

At this age permanent teeth have been exposed to the oral environment for 3–9 years. The assessment of caries prevalence is therefore often more meaningful than at 12 years of age. This age is also important for the assessment of periodontal disease indicators in adolescents.

35–44 Years (Mean = 40 Years)

This age is standard monitoring group for health conditions of adults. The full effects of dental caries, level of severe periodontal involvement and the general effects of care provided can be monitored using data for this age group. The sample in the age group can be drawn from organized groups such as office or factory workers, etc.

65–74 Years (Mean = 70 Years)

This age group has become more important with the changes in the age distribution and increases in life span that are now occurring in all countries. Data for this group are needed both for planning appropriate care for the elderly and for monitoring the overall effects of oral care services in a population. The sample here can be drawn from the day care center, institutions and in and, near the houses.

ANSWER 7

There are four types of examination methods given by ADA.

1. ***Type 1 (used in intensive clinical study):*** This involves a very complete examination using mouth mirror and explorer, good illumination, full mouth radiographs and such additional diagnostic methods like study models, pulp testing, transillumination and laboratory investigations.
2. ***Type 2 (used in clinical trials):*** This is more limited examination, using mirror and explorer, good illumination and bite wing radiographs. Periapical radiographs are included where ever appropriate.
3. ***Type 3 (used in epidemiological surveys):*** Inspection using a mirror and explorer. Examination is done under good illumination.
4. ***Type 4 (used in inspection and screening):*** This is a screening procedure only using tongue depressor and available illumination.

21 Health Education and Communication

QUESTIONS

1. Define health education.
2. Aims of health education.
3. Methods of approaches to public health.
4. Contents of health education.
5. Principles of health education.
6. Barriers in health education.
7. Educational aids in health education.
8. Methods in health education for individual.
9. Methods in health education for group.
10. Methods in health education for public at large scale.
11. Methods in health education.
12. Panel discussion. (Refer Ans 9).
13. Group discussion. (Refer Ans 9).
14. Symposium. (Refer Ans 9).
15. Colloquy. (Refer Ans. 9).
16. Types of communication.
17. Socratic method of communication.(Refer Ans 16)
18. Didactic method of communication. (Refer Ans 16)

ANSWER 1

Health education is defined as "Health education is a process that informs, motivates and helps people to adopt and maintain healthy practices and lifestyles, advocates environmental changes as needed to facilitate this goal and conducts professional training and research to the same end".—Adopted by the National Conference on Preventive Medicine in USA.

ANSWER 2

Aims and Objectives of Health Education

1. To encourage people, to adopt and sustain health promoting lifestyle and practices.
2. To promote the proper use of health services available to them.
3. To arouse interest, provide new knowledge, improve skills and change attitudes in making rational decisions to solve their own problems; and
4. To stimulate individual and community self-reliance and participation to achieve health development through individual and community involvement at every step from identifying problems to solving them.

ANSWER 3

Different methods of approaches in public health are:

1. ***Regulatory approach /legal approach***

- This approach seeks change in health behavior and improvement in health through a variety of external control or laws placed on people
- Any governmental intervention direct or indirect, designed to alter human behavior, e.g. child marriage restraint Act, pollution Act
- This seems to be the simplest and quickest way to improve people's health but has some limitations like
  i. The cause of the disease can not be eradicated.
  ii. Involving personal choice like diet, exercise, smoking, etc. This approach cannot pass legislation to force people to eat balanced diet or not to smoke.
  iii. People must be ready to accept a law.

2. ***Service approach/administrative approach***

- This approach was aimed to provide all the basic health services needed by the people at their doorsteps on the assumption that people would use them to improve their health
- This approach may go failure if the services are not based on the felt needs of the needs.

3. ***Health education approach***

- This approach is found to be most effective means for achievement of changes in health practices and life-styles of the community
- If the necessary behavior changes have to takes place, people must be educated through planned learning, experiences, informed, educated and encouraged to make their own choice for a healthy life. This does not "order" the individual. The results are slow but are permanent and enduring

- Mass media and social organizations must be helpful in introducing new attitudes and new habits.

4. ***Primary health care approach***
   - This is a new approach starting from the people with their full participation and active involvement in the planning and delivery of health services based on principles of primary health care namely community participation and intersectoral co-ordination
   - This approach is a fundamental shift from the earlier approaches.

ANSWER 4

Contents of Health Education

1. Human biology.
2. Nutrition.
3. Hygiene
   a. Personal.
   b. Environmental.
4. Family health.
5. Disease prevention and control.
6. Mental health.
7. Prevention of accidents.
8. Use of health services.

ANSWER 5

Principles of Health Education

1. ***Interest:*** A health education program will be successful when the message is based on felt needs of the people. People will participate with interest when education is based on the needs of the people.
2. ***Participation:*** If interest is created in people, participation of people goes simultaneously. Health education should aim at encouraging people to work actively with health workers and others in identifying their own health problems and developing solutions to solve them. Good participation will provide maximum feedback.
3. ***Motivation:*** Every individual has a fundamental desire to learn, awakening this desire is called motivation. Motivation is an important factor, in health education we can make use of motivation to change the behavior through incentives. There are two types of motives, primary and secondary motives. Primary motives are inborn desires and secondary motives are created by outside forces through incentives.

4. ***Comprehension:*** This is related to the level of knowledge, level of understanding, education and literacy of people. Health education or teaching should be in simple language which people can understand. Use of layman terms are preferred to scientific terms.
5. ***Reinforcement:*** Few people can learn in a short period but some need repetition or reinforcement at intervals. If repetition is not there it is likely that people may not remember. This principle is called booster dose in health education.
6. ***Learning by doing:*** This principle goes with the proverb "If I hear, I forget; if I see, I remember; if I do, I know". So learning is an action process. Just by hearing or seeing new things it is difficult to follow them. It is better to instill in people's mind by doing.
7. ***Known to unknown:*** Teaching should start from the things which people know and proceed to unknown things, start with easy information to difficult ones. We start where the people are and with what they understand and then proceed to new knowledge.
8. ***Soil seed and sower:*** These three forms are the important content of health education and should be selected carefully. The people to whom the message is delivered can be compared to the soil, the health facts to be given can be compared to the seeds and the media used to transfer the message can be compared to the sower**.**
9. ***Good human relations:*** The educator should have good personal qualities maintain good relationship with the people. He should have kind and sympathetic attitude towards people and should always be helpful to them in clarifying their doubts. Maintaining good relationship will develop communication skills.
10. ***Community leaders:*** The leaders from the community can be used to reach the people of the community. The leaders can be educated, who will educate the people, as they will have a better rapport and friendliness with the people of their community. The leader should have good qualities like guiding the people, advising and understanding them, selfless, honest, impartial, considerate sincere, and be accessible to the people.
11. ***Feedback:*** Feedback is one of the key concepts of the system approach and is of paramount importance. Health educator can modify the things in the health education process like message, channels etc. depending upon the feedback from the audience.
12. ***Credibility:*** It is the degree to which the message to be communicated and perceived as trustworthy by the receiver. The message should be consistent and compatible with scientific knowledge, local culture, educational system and social goals.

ANSWER 6

Barriers in Health Education

To have a better effect of health education it is necessary to identify and overcome the barriers of communication, which can result in failure. These are:

1. ***Psychological barrier:*** They are emotional disturbances, depression, neurosis, different levels of intelligence and any other psychosomatic disorder causing barrier in communication. Special methods and utmost care should be adopted while interacting with individuals with any psychological problems.
2. ***Physiological barrier:*** These includes difficulties in hearing, seeing and difficulties in expression and understanding.
3. *Environmental barrier:* These are due to excessive noise, improper vision/invisibility, crowding, congested areas, etc.
4. *Cultural barrier:* They include illiteracy, levels of knowledge and understanding, customs, beliefs, religion, attitudes, patterns of behavior, habits, economic and social class differences, language variations, and difference between urban and rural education.

ANSWER 7

Educational Aids used in Health Education

1. Audio aids
2. Visual aids
3. Audio visual aids

Audio Aids

Most commonly used are:

1. Megaphones
2. Microphones
3. Amplifier
4. Radio
5. Tape-recorder
6. Gramophones records and discs.

These are useful in reproducing any kinds of words spoken and also helps in repeating the same, can be used for entertainment and mass communication.

Visual Aids

Visual aids helps people to understand better. These can be classified as:

1. ***Projected aids:*** These needs projection from a source onto a screen, e.g. films or cinemas, film strips, slides, overhead projectors, epidiascopes,

transparencies, bioscopes, silent films, video cassettes. Advantages of these are real life situations can be projected, self explanatory, creates special interest, situational effects can be shown and can leave a lasting impression in viewer's minds.

2. ***Non projected aids:*** Do not require any projection, e.g. black board, pictures, leaflets, posters, charts, exhibits, models, specimens, photographs cartoons, graphs, brochures, booklets, pamphlets, flannel graphs, flash cards.
3. ***Other aids:*** Puppet shows, dramas, folkdance, folksongs, etc.

Combined Audio-visual Aids

The advantage of this is both vision and sound can be combined together to have better presentation, e.g. television, films (cinemas), slide—tape combination, video cassette player and recorders, multimedia computers.

ANSWER 8

Health Education for the Individuals

Individual health education can be possible through personal interviews in the consulting room of the doctor, health centre or home. Topics of health counseling may be selected according to the relevance of the situation. The nursing staff also has opportunities to give health education. Public health nurses, health visitors and health inspectors are visiting hundreds of homes, they have plenty of opportunities for educating the people. The advantage of this approach is that , the educator can have discussion, and persuade the individual to change his/her behavior. It provides a two way communication. Disadvantage is that number of people we reach is small and is possible only among those who come in contact.

ANSWER 9

Health Education for the Group

Group of many kinds like school children, industrial workers, mothers, patients etc. can be educated through this approach. The subject must relate directly to the interest of the group. A suitable method of health education including audio-visual aids should be selected for successful health education.

Few Methods of Group Teaching are as Follows

1. ***Chalk and talk (Lecture):*** A lecture is defined as a carefully prepared oral presentation of facts, organized thoughts and ideas by a qualified person. Its effectiveness depends to a large extent on speakers communication skills, ability to write legibly and to draw on the blackboard.

Group should not be more than 30 and lecture should not extend 15 to 20 minutes. The audio-visual aids can be combined along with lecture like over head projector (OHP), powerpoint presentations, flip carts, flannel graphs, models, charts, films, etc.

Disadvantages

- Involvement of group to a minimum extent
- Learning is passive
- Does not stimulate thinking or problem solving capacity
- Comprehension of a lecture varies with the individuals in the group.

2. ***Dialogue:*** Dialogue is another form of lecture where two people instead of one present a discussion between themselves in front of the audience. Since there are two people instead of one the audience reacts with much greater interest than the lecture.
3. ***Group discussion:*** It is a group of people interacting in a face to face situation. It is considered as effective method since there is free exchange of knowledge, ideas and opinions.

   Group should comprise of not less than 6 people and not more than 12 members. They should sit in a circle and there is a group leader who initiates discussion and continues it without side conversations, encourages every one to participate and summaries at the end.

   Limitations of this may be unequal participation of members, one may dominate the discussion and one may be shy and not participating.

   The members have to follow few rules:

   a. Ideas are clearly and concisely expressed
   b. Listen to what others say
   c. Not to interrupt when others are speaking
   d. Make only relevant remarks.
4. ***Buzz session or small group discussion:*** It is the most informal way of group discussion and allows for free expression of the ideas. Usually it is followed in high school teaching where it is monitored by the class teacher or the student monitor who will keep the discussion on track and control the group.
5. ***Symposium:*** It is a series of speeches on a selected subject by speakers. Each person will present an aspect of the subject briefly. There is no discussion among speakers and at the end, the audience are invited to ask questions and chairman gives summary at the end of the entire session.
6. ***Workshop:*** It consists of a series of meetings, usually four or more, with emphasis on individual work, within a group with the guidance of consultants and resource personnel. The total workshop is divided into small groups with chairman and recorder for each group. Each person in that group solve a part of the problem contribute for group work and group

discussion and leave the workshop with a plan of action on the problem. Workshops are mainly advantageous for people with previous experience on particular topics, for institutions and departments. It can be called as a problem solving method.

7. ***Panel discussion:*** In panel discussion, there are 4 to 8 qualified people who sit and discuss a given problem or topic before audience. The Chairman opens the meeting and he has to keep the discussion going on. After the discussion is over by panel speakers the audience are invited to take part, but the participation is limited. It is an effective method of education, provided it is properly planned and guided.
8. ***Conferences and seminars:*** These are good teaching methods that can be employed by educational institutions. Education can be given to a large number of people among the presence of persons qualified in topics of interest or in allied disciplines. They provide opportunity to large number of people to come together and exchange their ideas and views on the topics of interest.
9. ***Colloquy:*** In this method of group health education, the audience gets the opportunity for direct participation. Discussion/problems/questions are put forward by few selected members of the audience. A group of experts on the particular topic of discussion are selected and they listen to the problems/questions raised by the members and give answers and comments on them.
10. ***Programmed Instructions:*** In this method, teaching progresses step by step called as "instructional frames". It is based on Socratic method of advancing in learning through easy stages or steps.

    Advantage is that individual gets the opportunity to participate in the program through practical experiences at different stages.
11. ***Simulation exercise:*** In this method individuals within the group are given opportunities to participate in exercises that resembles real life situations, e.g. demonstration of artificial resuscitation as a first aid measure on dummies helps them to learn each step thoroughly.

    Advantage is better understanding and visual impression is installed in the minds of the participants.
12. ***Demonstrations:*** It is a carefully prepared presentation to show how to perform a skill or procedure. The demonstrator involves audience in discussion so they understand how to perform it. This is based on principle of learning by doing, e.g. clinical teaching in hospitals, demonstration of brushing technique to class of students.
13. ***Role playing:*** Role playing or socio-dramas are a form of dramatic expression in health education. It is also called as psycho-dramas. It is a form of demonstration where real life situations are acted out without any

artificial ingredients, e.g. variety of socio-dramas are staged to educate people about the AIDS, oral cancer, any other communicable and non-communicable diseases and other social causes in the society. The main advantage of this is that people can understand better when they visualize the situations and it produces a lasting impression in their minds.

14. ***Puppet shows:*** Puppet shows are among the earliest forms of theatre and are still appealing especially to children because of the humor of the puppet. Puppets are little folks of imagination with whom the child can identify. Puppetry is a form of lecture with words and actions to convey facts and ideas of health; it has a long lasting effect on the minds of the children.
15. ***Institute:*** It is a popular method of group health education in the western countries. The institute comprise of a number of meetings which are scheduled over a few days or weeks. The purpose of institute is to convey specific information and instructions in a selected area of work. The other methods of health education like symposia, group discussion, and panel discussions can be made use of in institute.

ANSWER 10

Health Education for Larges Masses/General Public

Mass media is useful in transmitting messages to people in large number (millions) even from the remotest places. It is an effective method of health education for the whole community. It is a one-way communication. Mass-media alone is inadequate, in changing the human behavior but will be more effective with other methods.

1. ***Television:*** It is most popular of all media. It is not only effective in creating awareness but also has influence on people and introducing new ways to life. It is one-way communication. It can only be an aid to teaching cannot cover all aspects of learning. It covers large number of people and cater to all groups of people.
   Disadvantage: High cost of TV sets and not accessible by all people and is one way communication.
2. ***Radio:*** In developing countries radio is more popular than TV. They can reach illiterate population and also accessible to all socio-economic groups. Health information can be conveyed in the form of talks, plays, question and answer session, quiz programs, etc.
3. ***Internet:*** This is a fast growing communication media and has a large potential to become a major health education tool. This is a computer based communication system. There is vast communication through direct and instant communication by means of e-mail discussion forums and other online facilities.

4. ***Newspapers:*** Newspapers play an important role in mass communication. They represent all forms of literature and in most common languages. They are quite economical and easily accessible. Unfortunately, health problems have little of value to newspapers. Disadvantage of this is health information will not reach to illiterate people.
5. ***Printed material:*** Magazines, pamphlets, booklets , and handouts have long been in use for health communication. These should be presented in simple language. These can be produced in bulk for very little cost. Maximum matter about a particular health problem is explained in detail.
6. ***Direct mailing:*** It is the new innovation in health education in India. Main aim of this is to reach remote areas of the country with printed material on family planning, immunization and nutrition. These are mailed to the village leaders, literate persons, panchayats and bodies to be distributed to their community (people).
7. ***Posters, billboards and signs:*** These are generally used for mass education by displaying it in public places like railway stations, bus stations, multiplexes (commercial complexes), streets, hospitals and health centers. Message should be simple artistic and should catch the eye and create awareness. Right matter should be displaced on right, time i.e. during epidemics of viral hepatitis, material should be on viral jaundice and not on some other diseases. The materials should be changed frequently or it will loose their effect.
8. ***Health museums and exhibitions:*** These should be properly arranged to attract large number of people. Advantage is, there is a personal communication through workers who have exhibited the materials. Doubts can be clasified directly. By presenting a variety of ideas, they do increase knowledge and awareness.
9. ***Folk media:*** Health education is not only by electronic media and other media but also by indigenous media like keerthan, katha, folk songs, dances, dramas and puppet shows. The muslim community have their own traditional folk fourm like ghazals, kawali, etc.

ANSWER 11

Method in Health Education /Communication

These are grouped as:

1. Individual approach
2. Group approach
3. Mass approach.

(Refer Ans 8, 9 and 10).

ANSWER 16

Types of Communication

1. ***One way communication:*** It is also called didactic method. Communication is from the communicator to the audience. The example is lecture method in the class room.
   Drawbacks of this method are:
   a. Knowledge is imposed.
   b. Learning is authoritative.
   c. Little audience participation.
   d. No feedback.
   e. Does not influence human behavior.
2. ***Two way communication:*** It is also called Socratic method. In this method both educator and audience take part. The process of learning is active. There will be exchange of ideas, views and opinions.
3. ***Verbal communication:*** This is the way of communication by word of mouth.
4. ***Non-verbal communication:*** This is the method in which communication is not through words but by actions, bodily movements, posters, gestures, facial expressions, e.g. smile, raised eye brows, frawn, staring, gazing, etc.
5. ***Formal and informal communication***
   Formal communication is through normal channels.
   Informal communication exists every where, e.g. gossip circle/grapevine communication.
6. ***Visual communication:*** It is by seeing things like charts, models, posters, graphs, etc.
7. ***Telecommunication:*** This is through electronic magnetic instrument like TV radio, internet, telephone, telefax, telegram, etc.

22 School Dental Health Programs

QUESTIONS

1. Discuss the elements of school dental health program.
2. What are the objectives of the school dental program?
3. Name some school dental health programs.
4. Mention the aspects of school health program.
5. 'Learning about your oral health'.
6. Askov dental program.
7. Tattle tooth program.
8. SHARP dental program.
9. North Carolina Statewide Preventive Dental Health Program.
10. Comprehensive dental care.
11. Incremental dental care.
12. Write in detail the steps in planning dental health education program for controlling the dental disease in a school having 1500 children.
13. You are assigned the job of improving the dental knowledge of 500 school children of your town by the department of community dentistry. Give your detailed plan. (Refer Ans 12).
14. Prepare a dental health talk to be delivered on the radio.
15. Plan a comprehensive dental program for an orphanage school consisting of 350 girls and 200 boys (Refer Ans 10 and 12).

ANSWER 1

The important elements of school dental health program are:

- Improving school community relations
- Conducting dental inspections
- Conducting health education
- Performing specific programs

- Referral for dental care
- Follow up of dental inspection.

One of the first steps in organizing the school dental program is to form an organizing committee, with representation from the parents, teachers, school administrators, community leaders, health personnel and dentist. Annual or a semi-annual dental inspection should be conducted to obtain information on the disease status, which will help in program planning. This kind of dental exposure to the child will help to create awareness and motivation towards dental care and positive attitude towards the dentist. Conducting health education program in the school will help to spread the dental messages and help the child to develop healthy practices. This can also include formal training of the school teachers so that they can train the children. The various other programs that can be conducted in the school include: Tooth brushing program, fluoride mouth rinse program, fluoride tablet program, school water fluoridation program, diet counseling, sealant program and dental science fair. "Blanket referral" is also an important program wherein a referral card is provided to each student stating the dental condition, which is to be taken home and subsequently to the dentist. The dentist has to sign the card, upon completion of the examination and the necessary treatment. In this way the child can be motivated to take dental treatment and care of the teeth. The follow up program is of great use where in the children are monitored to see if the instruction have been followed and it's also a best way for reinforcement.

ANSWER 2

The ADA has given certain objectives of the school dental program:

- To help every school child appreciate the importance of a healthy mouth
- To help every school child appreciate the relationship of dental health to general health
- To encourage the observances of dental health practices, including personal care, professional care, proper diet and oral habits
- To enlist the aid of all groups and agencies interested in the promotion of school health
- To correlate dental health activities with the total school health program
- To stimulate the development of resources to make dental care available to all children and youth
- To stimulate dentists to perform adequate health services for children.

ANSWER 3

School Dental Health Programs

- "Learning about your oral health" developed by ADA
- "Tattle Tooth Program" Texas statewide preventive dentistry program
- "Askov Dental Health Program" for the Danish population
- "North Carolina Statewide Preventive Dental Health Program"
- "Preschool Dental Health Program" initiated in US
- "New Zealand School Dental Service Plan"
- "School Health Additional Referral Program"(SHARP) institute in Philadelphia
- "Love Teeth Day" (LTD) campaign started in China
- Bright Smile Bright Future Program-sponsored by Colgate Palmolive Ltd.
- "National Oral Health Care Program" (NOHCP) initiated in India by Directorate General of Health Services, Ministry of Health and Family Welfare, Govt of India.

ANSWER 4

There are three main aspects of school health program:

1. ***School health services:*** These are procedures established to:
   - Appraise the health status of pupils and school personnel
   - To counsel pupils, parents and others concerning appraisal findings
   - To encourage correction of remedial defects
   - To assist in identification and education of handicapped children
   - To help prevent and control disease
   - To provide emergency service for injury or sudden sickness.
2. ***School health education:*** It is the process of providing learning experiences for the purpose of influencing knowledge, attitudes or conduct relating to individual or community health.
3. ***Healthful school living:*** It designates the provision of a safe and healthful environment, the organization of a healthful school day and the establishment of interpersonal relationships favorable to emotional, social and physical health.

ANSWER 5

"Learning About Your Oral Health"

This program was developed by American Dental Association. The primary goal of this program is to develop the knowledge, skills and attitude needed

for prevention of dental diseases. The main aim of the program is to develop adequate plaque control skills and knowledge among the school children. Consideration is also given to increasing knowledge about diet and dental caries. The other topics included in this program are the significance of fluoride, oral safety, consumer health concepts, role of dental profession, relationship of oral health with general health.

Implementation of the Program

Program is implemented at five different levels:
Level I: Kindergarten to Grade 1.
Level II: Grade 2–4
Level III: Grade 5–6
Level IV: Grade 7–9
Level V: Grade 10–12.

The core material for each of the level is self contained in a teaching packet that allows the classroom teacher to adapt to the presentation for the needs of the students.

Program Evaluation

It was found that the program influenced favorably the oral health behavior and affected favorable changes in the attitudes towards oral health practices.

ANSWER 6

Askov Dental Program

Askov is a small farming community with a population mostly of Danish extraction. It showed very high dental caries in the initial surveys made in 1943 and 1946. During the period from 1949–1957 the section on dental health of the Minnesota Department of Health supervised a demonstration school dental health program in Askov, including caries prevention and control, dental health education and dental care. There was no communal water fluoridation; all other recognized methods for preventing dental caries were used. Dental care was rendered by a group of 5 dentists.

10 year evaluation of the program reveal a 28% reduction in dental caries in deciduous teeth of children aged 3 to 5 years. A 34% reduction in caries in the permanent teeth of children 6–12 years and a 14% reduction in children 13 to 17 years old. Beyond these improvements in good health, dietary habits for the children and improved filled teeth ratios were noticed. However, the cost of the program was greater and caries reduction was smaller than are now occurring with water fluoridation in the same community.

ANSWER 7

Tattle Tooth Program

It was developed in 1974–1976 as a co-operative effort between Texas Department of Health and the Texas Education Agency. The program was pilot tested in 1975, field tested in 1976 to schools within the state of Texas. In 1985, the legislation stimulated a need for the Tattle tooth program statewide.

In May 1987 an advisory committee recommended that a new program be developed to replace the existing Tattle Tooth Program. In 1989, the new program **Tattle Tooth II, A new generation "Superbrush" preschool curriculum** was intended for teachers and care givers who work with children aged 3 and 4 years. The oral health curriculum consists of 7 units and the primary purpose is to teach basic toothbrushing skills and to establish toothbrushing as a daily routine in schools or day homes. The curriculum includes children directed activities, which the children can do on their own and teacher directed activities which the teacher does with the children. The curriculum includes songs, games, stories, art work, a resource list and videotapes to show the parents. Separate lesson plans were developed, 3 videotapes were produced as part of the teachers training package.

Program Philosophy and Goals

It is based on an educational model that uses the philosophy of Maslow's hierarchy of needs. The basic goal is to reduce dental disease and develop positive dental habits to last a lifetime. The major thrust of tattle tooth is to convince students that preventing dental disease is important and that everyone can do it.

Program Implementation

The Texas Department of health employs 16 hygienists in the eight public health regions to implement Tattle Tooth Program. They instruct the teachers to conduct the program in the school. In 1987 it was decided to prepare the college students in teacher preparation classes to implement the oral health program. Topics covered in the curriculum were correct brushing and flossing technique, awareness of the importance of safety and factual information relating to dental disease, its causes and preventive techniques.

Program Evaluation

The results were positive. 94% of the teachers felt that teaching oral health can have a positive effect on children's dental health habits. Dental health knowledge was significantly increased at all grade levels.

ANSWER 8

SHARP (School Health Additional Referral Program)

A program called SHARP instituted in Philedelphia where the lowest rate for correction of physical defects prevailed. The purpose of the program was to motivate parents into initiating action for correction of defects in their children through effective utilization for community resources. The project was carried out by the district nurses with the co-operation of all school personnel. The nurse made day time visits to the families in which the mothers were at home. Working parents were contacted by phone.

ANSWER 9

North Carolina Statewide Preventive Dental Health Program

In 1973 Dr. Frank E Law initiated a 10-year program to reduce dental disease problem in North Carolina It was the first statewide program. This project included producing 19 videotapes for classroom teachers in teaching dental health and conducting a statewide oral health survey of a representative sample of children from Kindergarten to grade 12, during 1986–87.

Program Philosophy and Goals

The program activities include education components to modify the behavior patterns of individuals to improve their health habits through dietary changes, tooth brushing and flossing. Young children are the primary focus. Fluoride was recognized as the most effective public health measure for dental caries.

Implementation

It reaches several segments of population young children, parents, teachers, dental professionals and community leaders. Services delivered through the program included fluoridation of water, weekly fluoride rinses, screening, referral, dental health education and sealant program. Teachers were believed to be the key in the educational programs. Classroom and teacher's videos, teacher's guides for helping teachers to be effective while teaching are available. Additional teaching aids like leaflets, worksheets and hand outs on nutrition, fluoride, plaque control, routine dental visits, injury prevention and smokeless tobacco is available.

Program Evaluation

Oral health surveys were conducted to evaluate the effectiveness of the education program in changing knowledge, attitudes, values and practices of students.

ANSWER 10

Comprehensive Dental Care

It is the meeting of the accumulated dental needs at the time a population group is taken into the program. Comprehensive dental care includes preventive, therapeutic and maintenance care to the individual. Preventive care in terms of educational motivation and other measures aimed at minimizing the disease. Therapeutic care in terms of elimination of pain, restoration of the carious lesion and replacement of the missing teeth. Maintenance care includes recall visits and treatment of new increments of disease.

ANSWER 11

Incremental Dental Care

" It may be defined as periodic care so spaced that increments of dental disease are treated at the earliest time consistent with proper diagnosis and operating efficiency, in such a way that there is no accumulation of dental needs beyond the minimum". This concept is common at the school level. Here the youngest available group (first year) is taken and is carried forward in the subsequent years and every year adding a new class of children at their earliest age and carrying them forward to as high as age available resources permit.

Advantages

- Reduce economic burden, by treating small early increments of dental disease
- Inculcate a habit and awareness of dental care at an earliest age.

Disadvantages

- Funds are sometimes exhausted before the child reaches the secondary level of schooling
- Parents and few dentists feel permanent teeth should be given more importance then the deciduous teeth and also the child may not continue the habits taught to them in the childhood and hence such program should be targeted to the teenagers
- Break in the continuity of the program if the child drops out of the school.

ANSWER 12

Planning a School Dental Health Program

Steps

1. Collecting information essential for planning.
2. Establishing dental health education objectives.

3. Assessing the barriers to dental health education and methods of overcoming them.
4. Appraising apparent and potential resources.
5. Develop detailed plan of operation including evaluation.

Collecting Information Essential for Planning

- Vital and social statistics of the dental disease
- The present and the potential dental health services and facilities
- Information about the people to be reached, their understanding about the dental health, their level of doing something for their problems
- Their customs, beliefs, habits and taboos
- Channels of communication among the people
- How they get dental information.

All this information can be collected by interview or by using a questionnaire. *"A Knowledge Attitude Behavior Survey"* will provide the necessary information.

Establishing Dental Health Education Objectives

Taking into account the background information, specific objectives need to be formulated before the program begins. The target areas to be concentrated are:

- Specific beliefs affecting dental health that needs to be changed
- Determining the groups to be targeted
- Specific information the public will need in order to take the desired actions.

Assessing the Barriers to Dental Health Education and Methods of Overcoming them

Take into account the various barriers which need to be detected and then overcome.

- Physiological barrier: Communication barrier, language, literacy level
- Psychological barrier: Emotional disturbances, neurosis, depression, etc
- Geographical isolation: People living far from sources of dental care
- Cultural barrier: Community attitude towards the program and towards the provider
- Economic status: Ability to buy the prescribed preventive services and/or dental treatment.

Appraising Apparent and Potential Resources

1. ***Organization***
   - Health department/governmental agencies
   - Voluntary health agencies
   - Professional dental organization international, national, local
   - Other related organization- Educational society, public health association, civic groups, occupational groups and trade unions.
2. ***Manpower***
   - General people who should be involved in planning and implementing program.
   - People whose views influence the community attitudes, e.g. teachers, community leader, and community worker
   - Health personnel who will provide the dental services.
3. ***Materials/equipment for the educational components of the program***
   - Mass informational resources: Newspaper, radio, TV
   - Educational aids: Pamphlets, Posters, Films, Slides
   - Supplies and Equipment: Transport/Projection equipments.
4. ***Funds***
   - Amount available from governmental agencies
   - Amount available from professional, voluntary organizations and philanthropic groups
   - Amount available from industries with a basic interest in dental health.

Develop Detailed Plan of Operation Including Evaluation

A detailed plan should be chalked out encompassing the

- Priorities
- Age groups
- Type of educational aids
- Type of health education
- Dental health educator selection
- Schedules.

Evaluation of the Program

Evaluation of the program should be undertaken at periodic intervals to reveal the places where the progress has or has not been made and indicate the reasons for success or failure. Continuous monitoring is required to find out if the program needs fine tuning, alterations, major modification or termination. Only through such continuous revision can the goals of dental health education of the public be most effectively realized.

Evaluation can be done by interview, knowledge, attitude and behavior survey and dental examination.

23 Dental Auxiliaries/ Ancillaries

QUESTIONS

1. Define dental auxiliary/ancillaries.
2. Classify dental auxiliaries.
3. Dental surgery assistant.
4. Four handed dentistry.
5. Dental laboratory technician.
6. Denturist.
7. a. New Zealand school dental nurse.
   b. Saskatchewan nurse.
8. Dental therapist.
9. Dental hygienist.
10. Expanded Function Dental Auxiliary (EFDA)/techno therapist.
11. Newer type of dental auxiliaries.
12. Degree of supervision of dental auxiliaries.
13. TEAM (training in expanded auxiliary management).
14. Dental auxiliary in India.

ANSWER 1

A dental auxiliary is defined as 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.

ANSWER 2

WHO classification (1967)

1a. Non-operating auxiliary

1b: ***Clinical:*** This is a person who assists the professional (Dentist) in his clinical work but does not carry out independent procedure in the oral cavity.

1c: ***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 been a professional is permitted to carry out certain treatment procedures in the mouth under the direction and supervision of a professional.

According to revised classification by WHO dental auxiliaries are classified into:

1. *Non-operating ancillaries*
- Dental surgery assistant
- Dental secretary/receptionist
- Dental laboratory technician
- Dental health educator.

2. *Operating ancillaries*
- School dental nurse
- Dental therapist
- Dental hygienist
- Expanded function dental ancillaries.

ANSWER 3

Dental Surgery Assistant

Is a non-operating auxiliary who assists the dentist or dental hygienist in treating patients but is not legally permitted to treat the patient independently.

Expert committee on auxiliary dental personnel of WHO gave the following duties:

1. Reception of the patient.
2. Preparation of the patient for any treatment he/she may need
3. Preparation and provision of all necessary facilities such as mouthwashes and napkins.
4. Sterilization, care and preparation of instruments.
5. Preparation and mixing of restorative materials including both filling and impression materials.
6. Care of the patient after treatment until he/she leaves, including clearing away of instruments and preparation of instruments for reuse.
7. Preparation of the surgery for the next patient.
8. Preparation of documents to the surgeon.
9. Assistance with radiography work and the processing and mounting of radiographs.
10. Instruction of the patient, where necessary, in the correct use of the tooth brush.
11. After-care of persons who have had general anesthetics.

Dental surgery assistant take on the job training or the training courses are available which extend over a period of one year but may extend for two

years. Voluntary certification programs for dental assistants exist in many countries but dental assistant is not required to be legally certified, registered or licensed to have completed any particular duration of education. The dental assistants have specialty certificates like certified oral and maxillofacial surgery assistant. Klein in 1994 found that addition of dental assistant to a clinic with one dental chair increases the number of patients by 33 and 62% by using two dental chairs.

ANSWER 4

Four Handed Dentistry

It is an art of seating both the dentist and dental assistant in such a way that both are within easy reach of the patient's mouth. The patient is in fully supine position. The assistant will hand the dentist, the particular instrument he needs. Assistant will also perform additional tasks such as retraction or aspiration. Thus the dentist keeps his hands and eyes in the field of operation and work with less fatigue and greater efficiency.

ANSWER 5

Dental Laboratory Technician

This type of personnel are also called as dental mechanics. He/she is a non-operating auxiliary who fulfills the prescriptions provided by dentists regarding the extra oral construction and repair of oral appliances and bridgework. They receive training through apprenticeship or formal training at a dental school or technical college, which lasts from 3 to 5 years. Their functions are casting of models from impression made by dentists, fabrication of dentures, splints, orthodontic appliances, inlays, crowns and special trays. They can be self employed or employed by the dentist or public health practice or by commercial laboratories.

(also refer answer 6)

ANSWER 6

Denturist

They are dental laboratory technicians who fabricate dentures directly for patients without dentist's prescription. They may be licensed or registered; they are permitted in few states of United States and elsewhere like Tasmania and Denmark. This practice is called as denturism. WHO defines this as illegal practice. In the state of Maine, denturist is permitted to take impressions and fit dentures but only under the direction of the dentist.

ANSWER 7A

The New Zealand 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 school children. Training is over a period of two years. A school dental nurse is assigned to each school having its own dental clinic and with more than 100 children. The dental nurse scheme was established in Wellington, New Zealand in 1921. The man who influenced its formation was T.A. Hunter. In New Zealand, the dental nurses are predominantly in the school-based salaried service, they provide care for children at six months intervals. The duties for school dental nurse are listed by New Zealand Department of Health Division of Dental Health as follows:

1. Oral examination
2. Prophylaxis
3. Topical fluoride application
4. Advice on dietary fluoride supplements
5. Administration of local anesthesia.
6. Cavity preparation and placement of amalgam filling in primary and permanent teeth
7. Pulp capping
8. Extraction of primary teeth
9. Individual patient instruction in tooth brushing and oral hygiene
10. Classroom and parent-teacher dental health education
11. Referral of patient to private practitioners for more complex services, such as extraction of permanent teeth, restoration of fractured permanent incisors and orthodontic treatment.

Other countries which have dental nurse services are Malaysia, Singapore, Thailand, South Vietnam, Myanmar, Indonesia, Hong Kong, Australia, part of Africa and South America.

ANSWER 7B

Saskatchewan Dental Nurse

In Saskatchewan, a Canadian province in North America is the only place where the dental nurse is allowed to legally drill and fill the teeth. They are trained under the direct supervision of the dentist for two months and then work with a more experienced dental nurse for the third month. They are presumed to provide care more cheaply than dentist.

ANSWER 8

Dental Therapist (Dental dresser, New cross auxiliary)

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. Their function is similar to New Zealand school dental nurse but they are not permitted to diagnose and plan dental care. They have to work to written treatment plans advised by the supervising dentist.

The training of these auxiliaries is about a period of 2 years including both reversible and irreversible procedures. Their functions are:

1. Clinical caries diagnosis
2. Technique of cavity preparation in deciduous and permanent teeth
3. Material handling and restorative skills
4. Vital pulpotomies under rubber dam in deciduous teeth, but are not trained to provide endodontic care
5. Extraction of deciduous teeth under local anesthesia.
6. They take radiographs under the supervision of dentist but have little training in interpretation of radiographs.

UK and Australia were using the services of dental therapist, later other countries like Hong Kong, Singapore, Vietnam and Tanzania started up with this service.

ANSWER 9

Dental Hygienist

A dental hygienist is an operating auxiliary licensed and registered to practice dental hygiene under the laws of the appropriate state, province, territory or nation.

In 1905, Dr. Alfred Fones trained Mrs. Irene Newman for dental prophylaxis. She worked with Dr. Fones and became the first dental hygienist. Dr. Fones is called "**Father of Dental Hygiene".** As per Indian Dentist Act of 1948, a dental hygienist means a person not being a dentist or medical practitioner, who scales, cleans or polishes teeth or gives instructions in dental hygiene. They have a training for 2 years.

Function of Dental Hygienist are:

1. Cleaning of mouth and teeth with particular attention to calculus and stains
2. Topical fluoride applications

3. Screening of patients or in groups such as school children or industrial employees so that they are referred to the dentist for treatment
4. Instructions in oral hygiene
5. Research work in the field of dental health.

The hygienists can work in the public or private setting and in some countries independently. Countries where hygienists work include USA, UK, Canada, India, Nigeria, China, Japan, Korea and Poland.

ANSWER 10

Expanded Function Dental Auxiliary (EFDA)

They are also referred to as expanded function dental assistant, expanded function dental hygienist, expanded function auxiliary, expanded duty dental auxiliary and techno-therapist.

An expanded function dental auxiliary is a dental assistant or dental hygienist in some cases, who have received further training in duties related to the direct treatment of the patients, though still working under direct supervision of a dentist.

They undertake reversible procedures like:

1. Placing and removing rubber dams.
2. Placing and removing temporary restorations.
3. Placing and removing matrix bands.
4. Condensing and carving amalgam restoration in previously prepared teeth.
5. Placing of acrylic restorations in previously prepared teeth.
6. Final finishing and polishing of the restorations.

Four levels of training and qualification were recognized in 1974's:

1. Certified dental assistant.
2. Preventive dental assistant.
3. Dental hygienist.
4. Dental hygienist with expanded duties.

ANSWER 11

New Auxiliary Types

The Expert Committee on Auxiliary Dental Personnel of the WHO has suggested two new types:

The Dental Licentiate

He/she is a semi-independent operator trained for 2 years to preform:

- Dental prophylaxis
- Cavity preparation and fillings of primary and permanent teeth

- Extraction under local anesthesia
- Drainage of dental abscesses
- Treatment of the most prevalent diseases of supporting tissues of the teeth
- Early recognition of more serious dental conditions.

Dental-aide

Their duties include elementary first-aid procedures for the relief of pain and

- Extraction of teeth under local anesthesia
- Control of hemorrhage
- Recognition of dental disease important enough to justify transportation of the patient to a center where proper dental care is available.

ANSWER 12

Degrees of Supervision of Auxiliaries

These levels are given by American Dental Association in 1998

1. ***Personal supervision:*** The dentist is personally operating on a patient and authorizes the auxiliary to aid treatment by concurrently performing supportive procedures.
2. ***Direct supervision:*** The dentist is in the dental office, personally diagnoses the condition to be treated, personally authorizes the procedure and remains in the dental office while procedures are being performed by the auxiliary and before dismissal of the patient, evaluates the performance of the dental auxiliary.
3. ***Indirect supervision:*** The dentist is in the dental office, has personally diagnosed the condition to be treated, authorizes the procedures and remains in the dental office while procedures are being performed by the auxiliary.
4. ***General supervision:*** The dentist has authorized the procedure and they are been carried out in accordance with the diagnosis and treatment plan and the dentist is not required to be in the dental office while procedures are provided.

ANSWER 13

Training in Expanded Auxiliary Management (TEAM)

As dentists become more accustomed to employing hygienists, they realized the advantages of doing so. The TEAM program includes training dental students and the dental supervisory staff in the utilization of expanded

functions dental auxiliaries (DAU- Dental auxiliary utilization.) and also, to manage and supervise dental health teams comprising both operating and non-operating auxiliaries.

ANSWER 14

Dental Auxiliaries in India

Non-operating Auxiliaries

- Dental surgery assistant
- Dental secretary/Receptionist
- Dental laboratory technician.

Operating Auxiliaries

- Dental hygienist.

24 Provision of Dental Care/ Structure of Dental Practice/Delivery of Dental Care

QUESTIONS

1. Different methods in delivery of dental care/provision of dental care/structure of dental practice.
2. Private practice/solo practice
3. Group practice.
4. Closed and open panel.
5. Health Maintenance Organizations (HMO's).
6. Mobile dental clinics/mobile dental van.
7. Portable equipments.
8. Hospital dentistry.
9. Franchised practices.
10. Neighborhood health centers.
11. Different methods of dental care delivery in India.

ANSWER 1

The following are the different methods by which dental care is provided:

1. Private practice
2. Solo practice.
3. Group Practice: Close panel and open panel
4. Health Maintenance Organization (HMO)
5. Preferred Provider Organization (PPO)
6. Contract Provider Organization (CPO)
7. Provision made by the government.
8. Neighborhood health centers.
9. Mobile dental clinics.
10. Hospital dentistry.
11. Franchised practice- Department store clinics
12. Part time practice.

ANSWER 2

Private Practice

Traditionally, dental care has been delivered by independent private practitioner. Solo practice is the most common form with two-third of the dentist's in private practice.

Advantages

- Flexibility to both provider and patient
- Earning capacity is increased
- Dentist has a freedom to treat or not to treat anyone
- Working hours can be decided by both
- Choice of equipment, materials is decided by dentist.

Disadvantages

- Maldistribution of the dentists
- Some groups are not readily treated like uncooperative preschool child, chronically ill, mentally retarded, physically handicapped, etc.
- Many elderly and poor people can not afford
- Dentists may have to meet with expenses like utilities, rent, equipment, supplies, staff payroll, etc. regardless of whether patient visits the clinic or not
- Inconvenience to the patients when dentist is on vacation.(No associate to cover when on vacation as in Group practice).

ANSWER 3

Group Practice

It is called non-solo practice.

Definition by ADA states that "a non-solo dentist works ''in a practice with at least one other dentist. Some of these dentists may be employed by the owner dentist in the practice".

Dentists are involved in many large group practices (including general dentists/specialists/semi-specialists) covering all the major phases of comprehensive dental care.

Advantages to the Patient

- ***Quality of care:*** As several operators with different skills are available
- ***Continuity of care:*** If regular dentists go on leave or unavailable, patients records are available to other members of the group

- ***Convenience:*** As all the types of treatment are available under one roof
- ***Economy:*** May reduce overhead costs
- ***Security:*** The patient feels more secure as good specialized care and good continuity of care are available.

Advantages to Dentist

- Can improve his own performance
- Can go for vacations
- Financial outlook is better as more patients are treated per year
- Can serve more patients in a year
- Gains security
- Reduction of overhead cost compared to solo practice.

Disadvantages

- Personal conflicts
- Location and business procedures may not please all members
- Patient is feared being shuffled from one operator to another.

ANSWER 4

Open Panel

- Any licensed (registered) dentist may participate
- The beneficiary may receive treatment from among all licensed (registered) dentists, with the corresponding benefits being payable to either the beneficiary or dentist
- The dentist may accept or refuse any beneficiary.

Closed Panel

It is a practice that is set up by an employer or union for the treatment of the employees and staffed by salaried dentists who treat only the employees and their dependents.

ANSWER 5

Health Maintenance Organizations (HMO's)

HMO is defined in 1973 act 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". HMO is a large group practice with a number of services available under one roof. The advantage of HMO's is, it reduces the cost of care for those enrolled. HMO uses a prepaid

capitation system of financing medical services. Dental care was limited to only preventive services (prophylaxis, topical fluoride and prescription of systemic fluoride for children upto 11 years), which was later removed and made a supplemental service. However, only a few HMO's provided dental services.

There are 5 elements which describe HMO's as

1. Managing organization
2. A delivery system
3. An enrolled population
4. A benefit package
5. A system of financing and prepayment.

In this the care provider is paid a fixed sum on a regular basis, usually monthly for each enrolled person irrespective of that enrollee uses any care in that month. When dental services are present, they are financed through—

a. Primary capitation premium
b. A separate premium
c. Fee for service basis.

Dental Personnel in HMO's

a. ***Staff model:*** Dentists, dental hygienist and dental assistant are salaried employees of HMO's. This is the only model where there is direct contact with dental personnel.
b. ***Group model:*** HMO contracts directly with the group practice for partnership or corporation for the provision of dental services. This group receives a regular capitation premium from HMO.
c. ***Independent practice association (IPA):*** It is an association of independent dentist that develops its own management and fiscal structure for the treatment of patient enrolled in the HMO. The IPA receives its capitation premium from the HMO. The dentist will continue to practice in their own practices.
d. ***Capitated network or direct contract model:*** The HMO contracts directly with the individual provider for provision of services.

ANSWER 6

Mobile Dental Clinics

They are also referred to as the clinics on wheels. They provide dental services to the people at their doorstep. Mobile dental clinics can be used in frontier and rural areas, in cities by saving in-patients transportation time. A mobile dental van can be parked in a schoolyard and provide screening, preventive

care and even comprehensive dental care. Mobile dental clinic are of two types:

1. Large mobile dental clinic
2. Small mobile dental clinic.

Large Mobile Dental Clinic

They provide almost all the general dental treatment. They can only go on the good roads because of their heavy body and large size. Here the internal structure of the body of the large bus is modified in such a way to accommodate the following:

- 1 or 2 dental chairs with complete units including air-rotors, cavitron, micromotor, etc.
- One complete dental X-ray unit
- One sterilizer and a generator
- One almirah to store the dental materials
- Overhead water tank
- Drainage tank.

Small Mobile Dental Clinic

They can go on the earthen roads and in small narrow lanes because of their light weight body and small dimension. They provide extractions, fillings, oral prophylaxis and all dental work requiring urgent attention. Small Mobile dental clinic are fitted with each of the following:

- One dental chair
- One dental motor
- One sterilizer
- One heavy duty battery and/or generator
- Overhead water tank
- Drainage tank.

Dental personnel in the mobile van

- Dental surgeons and interns
- Dental auxiliaries: Dental hygienist, dental assistant, clerk
- Mobile van driver.

ANSWER 7

Portable Equipments

Portable equipments are designed for variety of community uses:

- For home bound patients, for extraction, denture and fabrication work

- Hospital bound patients
- Where mobile dental van cannot reach the interior areas.

For extended comprehensive dental care to be rendered different combination of portable modules are available. One such assembly includes portable chair (folding chair), portable air compressor, stool, light unit, unit with an air hand piece, air and water syringe, saliva ejector, evacuator and waste system. This is contained in 4 containers; total weight of this is 300 pounds. A smaller assembly designed for missionary use in underdeveloped areas includes upholstered folding chair and a self contained dental unit operating on compressed air and a portable air compressor. An intermediate kit to attend patients in nursing home contains instrument case and high torque electric dental engine along with one commercially available unit with an amalgamator, an operating light, a pulp tester, and electrically heated wax spatula. The unit can be powered either by house current or by batteries.

ANSWER 8

Hospital Dentistry

Dental care is provided in the hospitals. Many dentists affiliated with these and other educational programs have full time or part time commitments to hospital based care. Dental care provided in hospital is often in those situations in which general anesthesia and other resources of hospital are required like treatment of rampant caries in young children, surgery of carcinomas, cleft palate repair, maxillofacial prosthetic treatment for victims of burns or trauma of head and neck, routine dental care for patients suffering from severe systemic diseases.

ANSWER 9

Franchised Practices

The concept of franchises is common in the United States. The dental clinics are opened in the departmental stores, which are operated during usual store hours and perceived by the store's management as further step in one stop shopping. They are viewed as an extra service for their customers. These dental clinics can also be practiced in restaurants, automobile servicing, retail stores, child care services, etc. The franchisor, for some combination of initial fees provides name and advertising, training, coordinated purchasing and management services. The franchisee runs the individual practice and except for the agreed payments to the franchisor, retains the profit from the business.

Individual private practices that are located in large departmental stores or malls but are not a part of the franchise chain are referred as retail or department store clinics.

ANSWER 10

Neighborhood health centers are a modern attempt to provide health services to group of disadvantaged people, where private medical and dental practitioners are not found. These centers are established where the low income people live in a place that will seem homelike to them. Certain services are provided in the homes and good primary medical and dental care is provided in the center; the center acts as a referring agency to sources of specialized care or hospitalization. It has a real function in vocational rehabilitation. It also trains and employs local people; by doing these the centre becomes more personalized. Supportive services offered at these centers are usually by the public health nurses, social workers and home counselors.

ANSWER 11

The following are the different methods by which dental care is provided in India:

1. Private practice/solo practice.
2. Part time practice.
3. Group practice: Close panel and open panel.
4. Provision made by the government
5. Mobile dental clinics.
6. Hospital dentistry.
7. Private/governmental dental institutions.

25 Finance/Payment in Dental Care

QUESTIONS

1. Classify methods/mechanism of payments of dental care.
2. Fee-for-service.
3. Post-payment plans.
4. Pre-payment plans/Third party payment plans.
5. Reimbursement in third party payment plans. (Refer Ans 4)
6. UCR fee. (Refer Ans 4)
7. Delta dental plans/dental service corporation.
8. 90th percentile.
9. Blue cross and blue shield.
10. Prepaid group practice.
11. Medicare.
12. Medicaid.
13. Mode of financing in India.

ANSWER 1

Different methods of payment for dental care are:

1. Private fee-for-service
2. Post payment plans
3. Private third party prepayment plans
   a. Commercial insurance companies
   b. Non-profit health service corporations, e.g. delta dental plans blue cross/ blue shield
   c. Prepaid group practice
   d. Capitation plans
4. Salary
5. Direct reimbursement
6. Public programs.

ANSWER 2

Private Fee-for-Service

- Two party arrangement
- In this, patient decides to visit any dentist and dentist suggests appropriate treatment and informs the fee for that service. If patient accepts the service, service is provided by the dentist and fee for that service is paid by the patient to dentist
- It is a traditional form of reimbursement and culturally acceptable
- This system is flexible and simple to administrate.

ANSWER 3

Post-payment Plans or Budget Payment Plans

Under this plan the patient borrows money from a bank or finance company to pay the dentist fee. The amount is repaid to the bank or finance company in budgeted amount. This plan was primarily used by the people in the middle income group rather than the lower income group.

ANSWER 4

Third Party Payment

a. In this system payment for dental services, i.e. the payment to the dentist is done by an agency rather than directly by the patient and the patient pays to the agency (Third party).
b. The patient and the dentist are the first and second parties and the administrator of the finance is the third party. The third party is also called as the carrier, insurer or administrative agent.

(Refer Ans 1 for types of third party payment).

Patient's Share of Payment

The portion of the cost of the service that a patient pays is either a **deductible or co-insurance.**

A deductible is a set amount of money that a patient must pay towards the cost of the treatment before benefits of the program goes into effect.

Co-insurance means that the patient pays a percentage of the total cost of treatment to the dentist.

Reimbursement of Dentists in Third Party Plans

- Usual, customary and reasonable (UCR) fee
- Table of allowances
- Fee schedules
- Capitation.

UCR Fee

1. ***Usual fee:*** This is that type of fee that an individual dentist most frequently charges for a given dental service.
2. ***Customary fee:*** This is the fee that is decided by the administrator of a dental benefit plan from actual submitted fee for a procedure to establish maximum benefit payable under a given plan for that procedure.
3. ***Reasonable fee:*** This fee is charged by a dentist for a specific procedure that is modified by nature and severity of condition being treated and by medical or dental complications or unusual circumstances.

Table of Allowances

It is defined as list of covered services with an assigned amount that represents the total obligation of the plan with respect to payment for such service, but that does not necessarily represents the dentist's full fee for that service.

Example: If dentist's usual fee for extraction is Rs 100 and plan lists a fee of Rs 90 as payable for that service, to make up the difference dentist will collect Rs 90 from the carrier and charges Rs 10 to the patient.

In this, a dentist should explain the patient the limited nature of the insurance payment because some patients are unaware that their plan may not cover them full.

Fee Schedule

It is a list of charges established or agreed by a dentist for specific dental services and is usually taken to mean payment in full.

Capitation

A capitation fee is usually a fixed monthly payment paid by a carrier to a dentist based on the number of patients assigned to the dentist for treatment. This requires patients to be assigned to specific dentist or practice so that payment can be paid to appropriate dentist or practice. Dentist receive fixed sum of money per head per month regardless of whether participant in the plan receive care in that particular month.

ANSWER 6

Delta Dental Plans

A dental corporation is a legally constituted not for profit organization, incorporated on state by state basis, that negotiates and administers contracts for dental care. In June 1954, the Seattle district Dental society in Washington

was approached by Union pacific maritime association with request of a proposal for a comprehensive dental care for children upto 14 years of age. The seattle district dental society developed a plan wherein the children could be treated in private clinics. Then later formed first dental service corporation. The original dental service corporation is now called as delta dental plan which is sponsored by constituent dental societies in each state.

Reimbursement of Dentist in Delta Dental Plans

The reimbursement at first used was the UCR fee for service and it still dominates. Reimbursement of dentist depends on whether they are participating or non participating dentist. Participating dentist generally agree the following conditions:

1. Filing of UCR fees
2. Acceptance of payment for their services at an agreed percentile
3. Fee audits
4. Post treatment inspection
5. With-holding of small amount of each payment by delta usually to build up delta capitation reserve fund.

Non-participating dentists can also treat patient covered under delta plans and are reimbursed by delta, but do not need to pre-file their fees, not subject to fee audits or with-holding. They are paid at 50th percentile rather than 90th percentile which are paid to participating dentist.

ANSWER 8

90th Percentile (Fig. 25.1)

It is one of the methods employed for reimbursing the dentist fees.(e.g. in delta dental plan, Blue cross and Blue shield). It is calculated as follows: First, obtain the usual fees of all the participating dentist, divide the total frequency into hundredths, so that the 90th percentile is that value below which 90% of the observations lie.

For example, if 100 dentists are there in a given area, and the filed fee for a particular service range from Rs 30 to Rs 100, spread out these filed fees on a cumulative frequency distribution table. The results may show 10% of dentists charge Rs 30, 50% charge Rs 55 or less, 80% charge Rs 68 or less and 90% charge Rs 85 and less. The 90th percentile fee is Rs 85.

In this method of reimbursement 90% of the dentist will get their usual fee but the remaining 10% dentist who charged above Rs 85 will be paid at 90th percentile (Rs 85) which will be less than their usual fee.

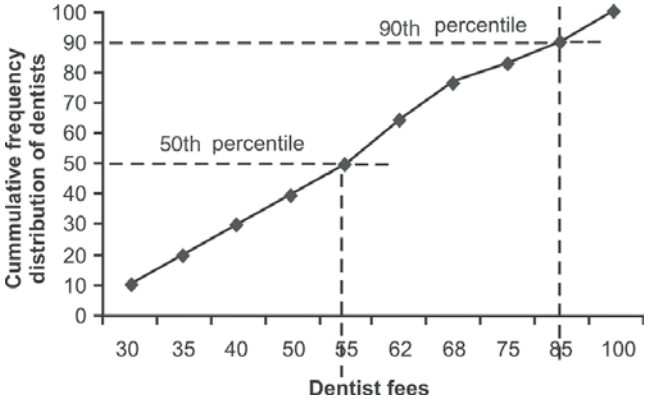


Fig. 25.1: 90th percentile

ANSWER 9

Blue cross and Blue shield is a non-profitable health service corporation which offered limited coverage for dental services under their main part of hospital-surgical-medical policies. In this the dentists are reimbursed like in the Delta dental plan or dentist prefiled UCR fee is used to create "fee screens" as a basis for reimbursement.

ANSWER 10

Pre-paid Group Practice

Here a group of dentists practice under one roof. The net income in this is provided equally or according to patient load, years of service, speciality and in some group practices dentists are salaried. Majority of the patients receive services on the usual private fee-for-service basis, larger group practices have resources and personnel that make it feasible for them to offer contracts to consumer groups on a pre-paid, capitation basis. The group practice may be OPEN PANEL (where any licensed dentist may participate, dentist may accept or refuse any beneficiary and the beneficiary has the choice to select among the dentist) or CLOSED PANEL (where the patients can receive dental service only at specified facilities from a limited number of dentists).

ANSWER 11

Medicare

Title XVIII of the social security amendment of 1965 is the program known as Medicare. It is funded wholly by federal government, US. This program removes all the financial barriers for hospital and physician services for all

26 Social Sciences

QUESTIONS

1. Culture and dental practices.
2. Social stratification.
3. Social class and dental health.
4. Write a note on social sciences.
5. Society. (Refer Ans 4)
6. Norms. (Refer Ans 4)
7. Folkways. (Refer Ans 4)
8. Taboos. (Refer Ans 4)
9. Anthropology. (Refer Ans 4)
10. Indigenous oral hygiene practices. (Refer Ans 1)

ANSWER 1

The word culture is derived from a latin word "colere" means to cultivate or to instruct. Culture is a learned behavior which has been socially acquired. It plays an important role in human societies. It is transmitted from generation to another generation through learning process both formal and informal. It is a dynamic force of the society. It is the cumulative experience of mankind's history from origin to the present. Culture influences the beliefs, behavior, perception, emotions, language, religion, family, diet, dressing, personality and also health.

Different Types of Cultural Practices

1. ***Type 1:*** consists of practices which are of benefit to health promotion and prevention of disease, e.g. washing hands before eating food, cleaning the teeth, taking bath, etc.

2. ***Type 2:*** consists of practices which have no bearing on health, neither harmful nor useful.
3. ***Type 3:*** consists of practices that demonstrate varying degree of harm to the oral health.

Cultural Practices Involving Teeth and Soft Tissues

1. ***Tooth mutilations:*** Deliberate tooth mutilations are known to have existed since the prehistoric times. Most of these are observed among people living in the tropical areas of the world. It comprises of large range of practices like:
   a. *Tooth chipping and filling:* Permanent anterior teeth are chipped out usually in late childhood and teenage years. Reason being esthetics, tribal identity, ritual and ritual motives
   b. *Lacquering and dyeing of teeth:* Deliberate application of stains and dyes mainly by chewing leaves or bark of specific plant species
   c. Gold crowns, inlays, glass, pearl or precious stone encrustation for beautification of teeth
   d. *Tooth evulsions:* Deliberate removal of teeth for ritual and traditional purposes.
2. ***Mutilation of soft tissues:***
   a. *Tattooing of gingival:* for the therapeutic benefit, seen mainly in North America, middle east mainly in Muslim women
   b. *Lip plugs:* Objects usually ring shaped inserted in the lips to alter the shape.
   c. *Piercing:* in the lip and peri-oral tissues
   d. Insertions of materials, e.g. wood, ivory, metal
   e. *Facial scarring:* Spikes and rod pierced through the cheeks (seen among Thai devotees)
   f. *Uvulectomy:* mainly among the Muslim population in east and north east of Africa.
3. ***Cultural effects on oral hygiene methods:*** Since, ancient times oral hygiene has been practiced in the country. It is a culturally ingrained process. Since 6th BC Shushruta has explained the importance of oral hygiene.
   a. *Indigeneous oral hygiene methods:* Traditional methods like the use of twigs: e.g. fruit parts, leaves of different plants like mango, twigs of neem, cashew, Acacia Arabica, etc.
   b. Twig brush or datun is used in Uttar Pradesh and Bihar and is believed to be very efficacious
   c. Neem bark is useful in bleeding gums

d. Burnt charcoal, tobacco, paddy husk, coconut hush ash, salt have been used for teeth cleaning.

4. ***Taboos (Medical superstitious):*** Regarding tooth and toothache there have been various superstitions. The ancestors related miracle cure of toothache to the workship of sun. In some parts of India, Brahmin priest clean their teeth with cherrywood invoking heavenly blessings to keep toothache away from them. In Switzerland, space between the teeth was considered to indicate that the child will be a good singer. In some tribes in Africa, a baby born with prenatal teeth was believed to be a threat to the tribe.
5. ***Beliefs (Misconception) that the diseases are caused due to the:***
   a. Supernatural causes
   b. Wrath of god or goddess
   c. Breach of Taboo
   d. Past sins
   e. Evil eye
   f. Spirit of ghost.

For example:

1. Diarrhea is associated with teething, but there are different beliefs:
   a. Some feel that it is a natural process and treatment is not required
   b. Some believe that it is dangerous to control it and the heat would get trapped in the body
   c. While some believe that it is due to the evil eye.
2. Superstitions regarding fluorosis:
   a. It is caused by biting on the banana leaf
   b. It is caused by biting on the palm leaf
   c. It is caused by eating brinjal.
3. Scalling leads to tooth loosening.
4. Extraction of tooth causes loss of eye-sight.

ANSWER 2

Social stratification is the classification of a group based on the socioeconomic status. Socioeconomic status (SES) is an important determinant of health. The different scales for measuring social status are:

1. Superior/Inferior.

2. a. *Ascribed:* Determined at birth, e.g. age, caste.
   b. *Achieved:* Is gained during the lifetime of the person.

3. a. *Open:* Form of stratification in which there is a change of rank and is related to the age.
   b. *Closed:* It is a permanent rank and determines ones whole lifestyle. There is no movement in any direction.

4. ***SES scale for rural Indian family:*** Developed by Pareek based on 9 items: Caste, occupation, education, level of social participation, land holding, housing, farm, material possession and family. The combined score for the 9 items is graded to indicate 5 SES categories.
5. SES for urban family developed by Kuppuswamy. It is based on 3 variables: Education, occupation and income.
6. SES based on Per capita income suggested by Prasad.
7. ***Social class:*** by British Registrar-General.

S.no.	*Social class*	*Occupation*
1.	Upper and middle	Higher professional: Medicine, engineering, architecture, authors, scientist. Large employers. Directors of business.
2.	Intermediate	Lower professional: Teachers, pharmacist, social workers. Owners of small businesses and managers. Farmers.
3N.	Non-manual skilled workers	Artisans, clerks, foreman and supervisor.
3M.	Manual skilled workers	
4.	Partly skilled workers	Semiskilled workers: Factory workers, agricultural laborers.
5.	Unskilled workers	Laborers, domestic servants, casual workers.

ANSWER 3

Social Factors and Dental Health

1. ***Upper middle class:*** The professional and business executive group, well educated, living in a preferred areas in well maintained, usually spacious homes. The members of this class seek out expert advice and follow the advice, with considerable religiosity. They value their teeth and are interested in preventive dentistry and actively pursue various types of dental care. The dentist is visualized as a professional who not only repairs teeth and stops pain but also prevents decay and loss of teeth and makes persons teeth more attractive and useful. The members of this class are much impressed with the desirability of having their own teeth for as long as possible.
2. ***Lower middle class:*** These include the small business, minor executives, teachers, salesman and white collar workers. They are highly moralistic group. They are the most compulsive in their dental care attitudes and

practices than any of the social classes. The dentist is regarded as an authority who fixes the teeth and is viewed as one who gives directions as to how teeth should be cared for.

3. ***Upper lower class:*** These are generally skilled and semi-skilled blue collar workers. They are people of limited education. In rather sharp contrast to the higher social groups they feel that tooth loss is inevitable and there is very little one can do. These people typically do not have personal relation with the physician and dentist. As a group these people are happier taking care from a clinic rather than an individual practitioner.
4. ***Lower class:*** Also called as the underprivileged or disadvantaged consists of unskilled laborer, people who shift from job to job, have a limited education, live in slum area and exhibit no stable pattern of life. They are the ones who reveal the most consistent neglected teeth and they require careful understanding if they are to receive adequate care in public health facilities.

Dental caries is found to be higher in the upper social class, but in the mid 19th century when sugar became cheap and was available to all, the lower class was also found to have caries. The decayed and the extraction component was higher as compared to the filling component which was more in the upper class. Preventive services were also more common among the upper class.

ANSWER 4

The five branches of social sciences include:

1. Sociology
2. Social or cultural anthropology.
3. Social psychology.
4. Economics.
5. Political sciences.

Sociology

It is the science concerned with the organization or structure of social groups. It is the science of behavior of man in a society or group of human beings.

Society may be defined as an organization of member agents having social relations amongst themselves.

Structural Aspects of Society

1. ***Social institution:*** It is a social structure and machinery through which human society organizes, directs and executes the multifarious activities required to satisfy human needs, e.g. school, college, hospital, etc.

2. ***Community:*** It is defined as the group, small or large, living together in such a way that the members share not one or more specific interests but rather the basic conditions of a common life.
3. ***Associations:*** They are groups of people united for a specific purpose or a limited number of purposes and are based on utilitarian interest.

Functional Aspects of Society

1. ***Norms:*** The specified rules of conduct to be followed by the members of a society are technically known as social norms. They are:
   a. *Folkways:* They refer to the customary ways of behavior. People conform to these ways not out of fear of being penalized, but because it is obligatory in the proper situation, e.g. ways of eating, dressing etc.
   b. *Mores:* They are socially accepted ways of behavior that involve moral standards. Each more is believed to be essential for social welfare. There is a greater unwillingness to see them violated. Taboos are a specific type of mores expressed in negative, e.g. Abstinence from beef and Pork in Hindus.
   c. *Laws:* Some important mores are converted into laws in order to ensure implementation.
2. ***Customs and habits***
   a. *Custom:* refers to practices that have been repeated by a number of generations, practices that tend to be followed simply because they have been followed in the past.
   b. *Habit:* is purely a personal affair, not entailing any obligation, e.g. toothbrushing twice daily, rinsing the mouth with water after every meal, smoking cigarette etc.
3. ***Etiquettes and conventions:*** Etiquettes are concerned with choice of proper form for doing something in relation to other people. Convention is merely an agreed upon procedure.
4. ***Social values:*** They constitute an important part of the selective behavior of man. Values refer to those standards of judgment by which things and actions are evaluated as good or bad. Norms are said to be enhancement of social values.

Cultural Anthropology

Anthropology is the study of man and his work. It has two main divisions:

1. Physical anthropology
2. Cultural anthropology

Physical Anthropology

It is the study of man as a biological organism.

Cultural Anthropology

It is the branch dealing with man's behavior and products. Its main theme is culture. The branches of cultural anthropology are:

1. ***Ethnology:*** It is the comparative study of culture
2. ***Archeology:*** It is study of past cultures and civilizations and uses their remains as the principal source of information
3. ***Linguistics:*** It is study of speech patterns of man, i.e. study of languages and dialects
4. ***Social anthropology:*** It is a specialized branch of cultural anthropology dealing with comparative study of kinship and non kinship organization patterns in different societies.

Social Psychology

It deals with human nature and attitudes in general. It explains how and why perceptions, thoughts, opinions, attitudes and behavior vary in different groups and societies.

Economics

It studies the economic aspects of man, i.e. production, distribution and consumption of the three basic essentials for his living namely food, shelter and clothing. Scarcity or excess of these are found to affect human behavior.

Political Science

It deals with the constitution, government and the laws of the state which impose some sort of discipline on man's movements or behavior.

27 Dental Ethics

QUESTIONS

1. Define ethics.
2. Define dental ethics.
3. Principles of ethics.
4. Unethical practices.
5. Ethical practices.
6. Informed consent.
7. Nuremberg code. (Refer Ans 6)

ANSWER 1

Ethics is defined as the science of the ideal human character and behavior in situations where distinction must be made between right and wrong, duty must be followed and good interpersonal relations maintained.

ANSWER 2

It is the moral obligation (duties) of the dentist towards the patient, his professional colleagues and to the society at large.

ANSWER 3

Principles of Ethics

1. ***Non-maleficence (To do no harm):*** Practitioners should not harm his patients.
2. ***Beneficence (To do good):*** Attempts must be made to maximize the benefits and minimize the harm.
3. ***Veracity or truthfulness:*** The doctor-patient relationship is based on trust; failure of this can result in disrespect to the patient and threatens relationship.

4. ***Respect for person***
   a. *Autonomy:* This principle says that health care professionals respect the patients right to make decision concerning the treatment plan.
   b. *Informed consent:* Informed consent should be obtained from all patients, which includes these four attributes: "voluntary, legally competent, informed and comprehending".
5. ***Justice:*** The primary duty of the health professional is to serve the patient irrespective of class, creed, race, nationality, social class differences etc (No discrimination among patients).
6. ***Confidentiality:*** All records of patient regarding illness, investigations, communications, treatment and history are kept confidential and are not disclosed to others without authorization from the patient.

ANSWER 4

Unethical Practices

1. Dental Practice by unregistered practitioner.
2. Styling dental clinics as dental hospitals.
3. Issuing bogus/false certificates.
4. Practicing or aiding in any illegal practice.
5. Promise of radical cure by the employment of secret methods of treatment.
6. Employing any agent for the purpose of obtaining patients.
7. Using sign boards larger than 0.9 m by 0.6 m and writing things like painless extraction or any attractive words to attract patient.
8. Placing sign boards on a chemist shop or any other place where the dentist does not reside or work.
9. Advertising in press about practice for the purpose of increase in flow of patients.
10. Using abbreviations after dentist's name except indicating dental qualifications like RDP, MIDA, MRSH, FICD, MICD, FACD.

ANSWER 5

Ethical Practices

1. ***Duties of doctors in general***
   a. A doctor must always maintain the highest standards of professional conduct
   b. A doctor must not allow himself to be influenced merely by motives of profit.

2. *Duties of doctors or dentists to the sick or patient*
   a. Should keep in mind the importance of preserving human life from time of conception until death.
   b. Should be completely loyal to the patient. When treatment is beyond his capacity he should call/contact another doctor who is competent
   c. Should give necessary treatment in emergency unless he is sure that he can do or call/contact another doctor who is competent
   d. Maintain confidentiality.
3. *Duties of doctors to each other*
   a. Should not entice patients from his colleagues
   b. Should observe the principles of "The Declaration of Geneva approved by World Medical Association"
   c. When another doctor comes and treats in emergency he shall be entitled to charge the patient for his services
   d. Should pass least/no comments when patient comes from other dentist about the treatment done by the other doctor
   e. Regard it as a pleasure and privilege to render services to another dentist or his family members.
4. *Duties of doctors towards patients and public*
   a. Behavior towards the patient and public shall be polite and dignified and be courteous, sympathetic, friendly, helpful to respond to the call of his patients
   b. Be punctual in fulfilling patient's appointments
   c. Deem it a point of honor to adhere with as much uniformity as the varying circumstances may admit to the remuneration for professional services
   d. Not permit consideration of religion, nationality, race, caste and politics or social standing to intervene his/her duties towards his/her patients.
   e. Maintain confidentiality
   f. Should remember that care of the patient and treatment of the disease depends on his skill and prompt attention shown by him and always remember that his personal reputation, professional ability and fidelity remain his best recommendation.

ANSWER 6

Consent: Patient's right to self-determination.

Nature of consent: A patient may indicate consent in many ways. It may be written, oral, partly written and partly oral or apparently implied by law and implied by actions of the patient.

Types of Consent

1. ***Implied consent:*** If a patient enters the dental clinic and sits on the dental chair and opens his/her mouth for examination then it is implied consent. Other forms of implied consent are in cases of emergency and accidents.
2. ***Informed consent/express consent:*** It is first stated and by far the largest principle of **Nuremberg Code** which identifies four attributes of consent that must be "Voluntary", "legally competent", "informed" and "comprehending". This consent is a statement documented and recorded in writing and assigned by the signature of the person. Informed consent plays a vital role in the ethical justification of research involving human subjects.

   Other forms of informed consent

   a. *Proxy consent:* In case individuals form a part of collective group then informed consent can be obtained from one of the members of the group who is the leader.

      For example: obtaining informed consent from the principal of the school on behalf of school children.

   b. *Consent of minors*

      i. Emancipated minor: is the one who is not subject to parental control or regulation and can give consent himself/herself independently

      ii. The mature minor rule: Here, the minor (in the absence of parental consent) who is capable of appreciating the nature and consequences of the surgery to be done on the body, usually in the age group of 14–18 years gives the consent

      iii. Child of divorced parent: In this case, the parent of the child with legal custody have the right to give the consent of the child

      iv. When a minor or mentally incompetent patient is been treated than the consent must be obtained by parent or guardian.
3. ***Telephone consent:*** If the consent is taken on the telephone the patient should be informed that a third party is listening on the extension. After the consent is obtained appropriate notes should be made on the patient chart and signed by the one who obtained the consent and countersigned by the third party.

Model Consent Form

CONSENT FORM

I,_____aged _____ have been informed by the investigators about my involvement in the study. Thereby,

1. I agree to give my personal details like name, age, sex, phone no., address, occupation and other details required for the study to the best of my knowledge.
2. I will co-operate with the investigators for my oral examination.
3. I will follow the instructions given by the investigators during the study.
4. I will visit the investigators as and when required for the study, at the given appointments (date and time).
5. I permit the investigators to utilize the information given by me and results obtained from this study for presentation and publication.
6. The investigators have assured me, that the information given by me will be kept confidential.
7. I will not claim any returns for my co-operation in the study, even if it is being sponsored by agency.
8. I am participating at my own wish and will.

I have read, gone through and understood the above information given by the doctor about my study. I have entered and signed this application.

Investigator's Name: Subject's Name:

Investigator's Signature: Subject's Signature:

28 Dental Jurisprudence

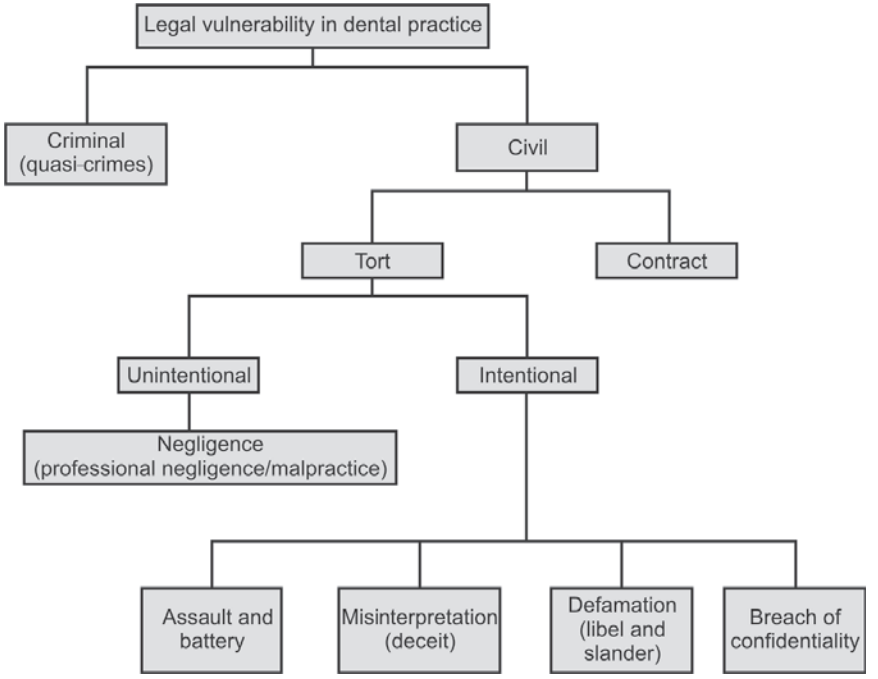
QUESTION

Define dental jurisprudence.

ANSWER

Dental jurisprudence **(Flow chart 28.1)** is the science of law as applied to the practice of dentistry.

Flow chart 28.1: Process of dental jurisprudence



1. Violations of statutory law are termed crimes
2. Violation of administrative law are termed as quasi-crimes
3. Tort is a civil wrong or injury independent of a contract, that results from a breach of a duty
4. ***Negligence/Malpractice:*** It is an unintentional tort in which harm was not intended.
   a. Failure to examine adequately
   b. Burns to the patient due to instruments, hand piece or chemicals
   c. Hazard from need fracture, hematoma, fainting or complication from local anesthesia
   d. Incorrect treatment
   e. Extraction of wrong tooth
   f. Ingestion or inhalation of foreign body
   g. Ill fitting denture.

29 Consumer Protection Act (CPA)

QUESTION

Write a note on Consumer Protection Act.

ANSWER

Consumer Protection Act was passed by parliament in 1986, and came into force on 1987. Under this act, the provision was made for the establishment of Consumer Protection Councils and Consumer Dispute Redressal Forums at National State and District levels for quick and simple settlement of consumer disputes.

It was passed with a view to:

- Provide for a better protection of interest of the consumer
- Creation of authorities for the settlement of consumer dispute
- Establish consumer councils to educate the public
- To provide speedy and inexpensive settlement within a limited time frame as against civil action which are expensive and takes long years.

The Consumer Protection Act is eventually envisaged to cover business and trade, but in a landmark judgment the professional services was brought into the ambit of the Consumer Protection Act .The supreme court ordered professional services rendered by professionals like doctors and dentists to be included into the definition of Sec 2 (o) of the Consumer Protection Act.

Machinery of Consumer Protection Act

1. ***Consumer protection councils***
   - Central councils
   - State councils
2. ***Consumers disputes redressal agencies:*** It is three tier quasi-judicial machinery

a. *District forum:* One district judge (sitting or retired) and two members of repute and integrity, one of whom shall be a women. The forum can entertain complaints where the compensation claimed does not exceed five lakhs.
b. *State commission*
   - One judge (sitting or retired) of High court and two members of repute and integrity, one of whom shall be a women.
   - Jurisdiction above 5 lakhs upto 20 lakhs
   - Also appeals against the order of District Forum
   - Always has revisional powers and appellate jurisdiction.
c. *National commission*
   - One judge (sitting or retired) of Supreme Court .
   - Four members and two members of repute and integrity, one of whom shall be a woman.
   - Jurisdiction above 20 lakhs
   - Also appeals against the order of the State Commission
   - Always has revisional powers and appellate jurisdiction.

Who are Liable?

1. Doctors who render services by way of consultation, diagnosis and treatment on payment by all or for some in free of charge falls within this act
2. Doctors who render services whose charges are borne by an insurance agency or employer falls within this act.

Who are not Liable?

1. Doctors who render services where no charge is taken what so ever treatment is provided for any person (rich or poor).

As provided under section 24(A) of Consumer Protection Act a complaint has to be filed within two years from the date on which the complaint raised. A complaint should be filed in the District forum in which both and or one party resides or where the complaint wholly or in part arose. As far as possible the time limit for deciding an appeal/complaint by the District forum, State Commission and National Commission is 90 days from the date of first day of hearing. It may require 5 months if the complaint requires analysis or testing.

30 Dental Council of India (DCI)

QUESTIONS

1. Dentist Act.
2. Dental Council of India.
3. State Dental Council.
4. The Dentist Amendment Act 1993.
5. Part A/Part B registration.

ANSWER 1

Dentist Act

This act came into force on 29th March 1948. It is an act to uphold dignity, prestige and honor of the dental profession and to regulate dental profession in India. This act contains the following chapters with their sub-sections as contents:

CHAPTER I: INTRODUCTORY

1. Short title and extent
2. a. Interpretation
   b. Construction of references to laws not in force in Jammu and Kashmir.

CHAPTER II: DENTAL COUNCIL OF INDIA

3. Constitution and composition of the council
4. Incorporation of council
5. Mode of elections
6. Terms of office and casual vacancies
7. The President and Vice-President of the council
8. Staff, remuneration and allowances

9. The executive committee
10. Recognition of dental qualifications
11. Qualification of dental hygienists
12. Qualification of dental mechanics
13. Effect of recognition
14. Power to acquire information as to courses of study and, training and examinations

15 a. Inspections
   b. Appointment of visitors

16 a. Withdrawal of recognition
   b. Withdrawal of recognition of recognized dental qualification

17 a. Mode of declarations
   b. Professional conduct

18. The Indian register
19. Information to be furnished
20. Power to make regulations.

CHAPTER III: STATE DENTAL COUNCILS

21. Constitution and composition of State Councils
22. Inter state agreements
23. Composition of Joints 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: REGISTRATION

31. Preparation and maintenance of register
32. First preparation of register
33. Qualifications for entry on first preparation of register
34. Qualification for subsequent registration

35. a. Scrutiny of applications for registration
   b. Special provision for amending the register of dentists

36. Registers of dental hygienists 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 certificates
45. Printing of registers
46. a. Effect of registration
    b. 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 certificate of registration
51. Companies not to engage in dentistry
52. Cognizance of offences
53. a. Payment of part of fees to council
    b. Accounts and audit
54. Appointment of commission of enquiry
55. Power to make rules.

ANSWER 2

The Dental Council of India was formed on 12th April 1949 under the provision of Dentist Act, 1948.

Functions of DCI

1. Basic principles for the maintenance of minimum education standard for the BDS degree.
2. Minimum physical requirements of a dental college.
3. Minimum staff pattern for under-graduate dental studies in colleges with 40, 60 and 100 number of admissions.
4. Basic qualifications and teaching experience required to teach BDS and MDS students.
5. General establishment of dental facilities, its duration of course, select on of students.
6. Migration and transfer rules for students.
7. Regulations of scheme of exam for BDS and MDS

8. Dental curriculum: Time and subject specifications to clinical program and field program, syllabus, etc.

Constitution and Composition of the Council

The central government shall constitute a council consisting of the following members, namely:

- One registered dentist possessing a recognized dental qualification elected by the dentists registered in part A of each state register
- One member elected from amongst themselves by the members of the Medical Council of India
- Not more than four members elected from among themselves by:
  - Principals, deans, directors and vice-principals of dental colleges in the state training students for recognized dental qualifications, provided that not more than one member shall be elected from the same dental college
  - Heads of dental wings of medical colleges in the states training students of recognized dental qualification
  - One member from each university established by law in the states which grants a recognized dental qualification, to be elected by the members of the Senate of the University
- One member to represent each state nominated by the Government of each such state from among persons registered either in a medical or dental register of the state
- Six members nominated by the Central Government of whom least one shall be a registered dentist possessing a recognized dental qualification and practicing or holding an appointment in an institution for the training of dentists registered in part B of state register
- The Director General of Health Services (ex-officio).

Incorporation of Council

The council shall be a body corporate by the name of the dental council of India having perpetual succession and a common seal.

Mode of Elections

Election shall be conducted in the prescribed manner and where any where any dispute arise regarding any such election, it shall be referred to central government whose decision shall be final.

Term of Office and Casual Vacancies

1. An elected or nominated member shall hold office for a term of five years from the date of his election or nomination or until his successor has been duly elected or nominated, whichever is longer.
2. An elected or nominated member may at a time resign his membership by writing (under his hand addressed) to the president and the seat of such member shall thereupon become vacant.
3. An elected or nominated member shall be deemed to have vacated his seat if he is absent, without excuse, from three consecutive ordinary meetings of the council or in a case of a member who was elected among the principals and deans of the dental colleges, if he ceases to hold his appointment as the dean or principal, or as the case may be.
4. A casual vacancy in the council shall be filled by fresh "election or nomination'' as the case may be, and the person "elected or nominated'' to fill the vacancy shall hold office only for the remainder of the term for which the member whose place he takes was elected or nominated.
5. Members of the council shall be eligible for re-election or re-nomination.
6. No act done by the council shall be called in question on the ground merely of the existence of any, vacancy in or, defect in the constitution of the council.
7. President and vice-president of council.
   a. The president and vice-president of the council shall be elected by the members, (thereof) from among themselves.
   b. An elected president or vice-president shall hold office for a term not exceeding five years and not extending beyond the expiry of his being a member of the council, he shall be eligible for re-election.

The Executive Committee

1. The council shall constitute from among its members, an executive committee or other committees necessary for carrying out its functions under this act.
2. The executive committee shall consists of the president and vice-president ex-officio and the Director General of Health Services ex-officio and five other members elected by the council.
3. The president and vice-president of the council shall be chairman and vice-chairman, respectively, of the executive committee.
4. A member of the executive committee shall hold office until the expiry of his term of office as member of the council and subject to his being a member of the council, he shall be eligible for re-election.

5. In addition to the powers and duties conferred and imposed on it by this act, the executive committee shall exercise and discharge such powers and duties as may be prescribed.

Recognition of Dental Qualifications

1. The dental qualifications granted by any authority or institution in India, which are included in Part 1 of the schedule shall be recognized dental qualification for the purpose of this act.
2. Any authority or institution in India which grants a dental qualification not included in Part I of the schedule may apply to the central government to have such qualification recognized and included in that part and the central government, after consulting the council, may by notification in the official gazette amend Part I of the schedule so as to include such qualification therein and also direct that an entry shall be recognized only when granted after a specified date.

3a. The dental qualification granted by any authority or institution outside India, which are included in Part II of the schedule shall be recognized dental qualifications only for the purpose of the registration of citizens of India when the register is first prepared under this act.

3b. Where any dental qualification granted by any authority or institution outside India and held by a citizen of India, is recognized for the purposes of the register when it is first prepared, after the commencement of the Dentists (Amendment) Act, 1972, the central government may, after consultation with the council, amend Part II of the schedule so as to include therein the dental qualification so recognized.

4a. The dental qualification granted by any authority or institution outside India, which are included in Part III of the schedule, shall be recognized dental qualifications for the purposes of this act, but no person possessing any such qualification shall be entitled for registration unless he is a citizen of India.

4b. Where any dental qualification granted by any authority or institution outside India and held by citizen of India, is recognized Amendment Act, 1972, the central government may, after consultation with the council, amend Part III of the schedule so as to include therein the dental qualification so recognized.

5. The council may enter into negotiations with any state or country outside India which is entrusted with the maintenance of a register of dentists, for the setting of a scheme of reciprocity for the recognition of dental qualifications and in pursuance of any such scheme, the central

government may declare that such qualification and in pursuance of any such scheme, the central government may declare that such qualification when granted after a specified date, shall be a recognized dental qualification for the purposes of this act.

6. The central government may, after consultation with the council, amend the schedule by directing that an entry be made therein in respect of any dental qualification only when granted before a specified date.

Qualification of Dental Hygienists

Any authority in state which grants a qualification for dental hygienists may apply to the council to have such qualification recognized and the council may, after consulting the government and the state council of the state in which the authority making the application is situated, declare that such qualification when granted after a specified date, shall be recognized dental hygiene qualification for the purposes of this act.

Effect of Recognition

1. Any recognized dental hygiene qualification shall be a sufficient qualification for enrolment in the approximate register of any state.
2. No person shall be entitled to be enrolled in any register as dental hygienist unless he holds a recognized dental or dental hygiene qualification or as a dental mechanic unless he has undergone training which satisfied the prescribed requirements.

Withdrawal of Recognition

1. When upon report by the executive committee it appears to the council:
   a. That the courses of study and training or the examinations to be undergone or the conditions for admission to such courses are not in conformation with regulations made under this act or fall short of the standards required thereby, or
   b. That an institution does not satisfy the requirements of the council. A statement to the effect may be sent by the council to the Government of the State in which the authority or institution concerned with an intimation of the period within which the authority or institution may submit its explanation to the governments.
2. On receipt of the explanation or on the expiry of the fixed period, the state government shall, after consulting the state council, forward, its recommendations to the council.

a. The council, after considering the recommendations of the state government may declare that the qualification granted by the authority or institution shall be a recognized dental hygiene qualification only when granted before a specified date
b. The council may declare that any recognized dental hygiene qualification granted outside the states shall be recognized as such only if granted before a specified date.

Withdrawal of Recognition of Recognized Dental Qualification

1. When it appears to the council:
   a. That the courses of study and training or the examination to be undergone or the conditions for admission to such courses or the standards of proficiency required from the candidates at such examinations are not in conformity with the regulations made under this act or fall short of the standards required thereby, or
   b. That an institution does not, in the matter of staff, equipment, accommodation, training and other facilities, satisfy the requirements of the council, the council shall send a statement to that effect to the central government.
2. After considering such a statement, the central government may send it to the state government in which the authority or institution is situated and the state government shall forward it to the authority or institution concerned, with an intimation of the period within which the authority or institution may submit its application to the state government.
3. After considering the application, or on the expiry of the fixed period, the state government shall make its recommendations to the central governments.
4. The central government, after considering the recommendations of the state government, may direct that an entry be made in Part I of the schedule against the qualification granted by the authority or institution declaring that it shall be a recognized dental qualification only when granted before a specified date.

Mode of Declarations

All declarations shall be made by a resolution passed at the meeting of the council and shall be published in the official gazette.

Professional Conduct

1. The council may prescribe standards of professional conduct and etiquette or the code of ethics for dentists.

2. Regulation made by the council may specify which violation shall constitute professional misconduct.

The Indian Register

1. The council shall maintain a register of dentists to be known as the Indian Dentists Register and consisting of the entries in all the state registers of India.
2. Each state council shall supply to the council, twenty printed copies of the state register after the first day of April each year and each registrar shall inform the council of all the additions or amendments in the state register.

ANSWER 3

State Dental Councils

Constitution and Composition of State Councils

The state government shall constitute a state council consisting of the following members:

a. Four members elected from among themselves by dentists registered on Part A of the state register.
b. Four members elected from among themselves by dentists registered in Part B of the state register.
c. The heads of dental colleges in the state which train students for any recognized dental qualification included in Part I of the schedule.
d. One member elected from amongst themselves by the members of the medical council.
e. Three members nominated by the state government and,
f. The chief medical officer of the state.

Interstate Agreements

1. Two or more state governments may enter into an agreement, for a joint state council.
2. The agreement may
   a. Provide for the appointment between the participating states of the expenditure in connection with the state council or joint state council.
   b. Determine which of the participating state governments shall exercise the functions under this act.
   c. Provide for consultation between the participating state governments.
   d. Make such incidental and ancillary provisions, not inconsistent which this act, as may be deemed necessary for giving effect to the agreement.

3. The agreement shall be published in the official gazettes of the participating states.

Composition of Joint State Councils

The members are:

a. Two members elected from among themselves by dentists registered in Part A of the register of each of the participating states.
b. Two members elected from among themselves dentists registered in Part B of the register of each participating states.
c. The heads of dental colleges in the participating state which train students for any of the recognized dental qualifications included on Part I of the schedule.
d. One member elected by the medical council of each participating state.
e. Two members nominated by each participating state government.
f. The chief medical officer of each participating state.

President and Vice-president of State Council

1. They shall be elected by the members from among themselves, provided that for five years from the first constitution of the stete council, the President shall, of the state government so decides, be a person nominated by the state government.
2. The president or vice-president shall hold office for a term not exceeding five years and not extending beyond the expiry of his term as a member of the state council.

Mode of Elections

Elections shall be conducted in the prescribed manner and where any dispute arises regarding any such election, it shall be referred to the state government whose decision shall be final.

Term of Office and Casual Vacancies

1. An elected or nominated member shall hold office for a term of five years.
2. An elected or nominated member may at any time resign his membership by writing to the president and the seat of such member shall thereupon become vacant.
3. An elected or nominated member shall be deemed to have vacated his seat:
   a. If he is absent without excuse from three consecutive ordinary meetings of the state council or

b. In the case of a member whose name is required to be included in any state register, if his name is removed from the register.
c. Where he has been elected from among the members of the medical council, if he ceases to be a member.

4. A casual vacancy in the state council shall be filled by fresh election or nomination and that person shall hold office only for the remainder of the term for which the member whose place he takes was selected or nominated.
5. Members of the state council shall be eligible for re-election or re-nomination.
6. Not act done by the state council shall be called in question on the ground merely of the existence of any vacancy in or defect in the constitution of the state council.

Executive Committee

1. The state council shall constitute among its members an executive committee consisting of the president and vice-president ex-officio and the chief medical officer (CMO) of the state or the states concerned.
2. The president and vice-president of the state council shall be chairman and vice-chairman respectively of the executive committee.
3. A member of the executive committee shall hold office until the expiry of his term of office as a member of the state council, but subject to his being a member of the state council, he shall be eligible for re-election.
4. The executive committee shall exercise and discharge such powers and duties as may be prescribed.

ANSWER 4

Dentist Amendment Act 1993 can be retrieved through the internet at http://www.dciindia.org/dentist_act1993_pages/dentistact1993.html?indexposition=1

ANSWER 5

To uphold the dignity and honour of the dental profession and to regulate it, the 1948 Dentist Act was formed. It stated that only graduated qualified dentist should deliver Dental Care to the public at large and those graduated were registered in Dental Council and were placed in Part A registration. Those unqualified persons who were practicing before 1948 were also allowed to continue their practice in order not to deprive their livelihood and they were place in Part B registration in the Dental Council.

(More details of this chapter can be got on www.dciindia.org).

31 Indian Dental Association (IDA)

QUESTIONS

1. Functions of IDA.
2. Office bearers of IDA.
3. Memberships of IDA.
4. IDA Emblem.
5. IDA.

ANSWER 1

Functions of IDA

1. Holding periodical meetings and conferences for the IDA members and dental professionals in general.
2. Publishing and circulating a journal of the association specially adapted to the needs of dental profession and undertake publicity and propaganda of the work of the association.
3. Encouraging opening of libraries and buy books from funds.
4. Publishing time to time papers related to dental researches by the members.
5. Encouraging research in dental and allied sciences by the funds and establishment of scholarships and maintain international contacts with foreign dental associations.
6. Conducting educational campaign amongst masses related to oral hygiene by cooperating with public bodies working for same.
7. Protects public from unethical practice by unqualified practitioners.
8. Trying to set exemption from custom duty for essential dental materials and instruments.

ANSWER 2

Office Bearers of IDA

For the proper management of association, the following members 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 IDA
9. One chairman of the council on dental health (CDH)
10. One Honorary secretary of the council on dental health (CDH)
    a. The general management of the association is by central council.
    b. The management of the local branches is by executive committee.

Central Council

1. Members as office bearers of IDA.
2. Members without portfolios.
    a. Immediate past president.
    b. Representative from state branches.

ANSWER 3

Memberships of IDA

1. ***Honorary members***
    a. Persons of high scientific or literacy attainment
    b. Persons who have rendered conspicuous services to the association
    c. Persons whose connections with the association may be deemed desirable and want to become honorary members are elected according to the rules of the association.

2. ***Ordinary members:*** Dental practitioners and other members of dental profession are eligible to become members.

3. ***Direct members:*** Persons eligible for membership but are not residing or practicing in the area of local branch, these members shall be attached to the state branch or to the central head quarters.

4. ***Student members:*** Only under-graduate students of recognized dental institution are eligible as student members.

5. ***Affiliated members:*** Non-residential foreign dental practitioners having dental qualification according to schedule are eligible to become members and attach directly to head office subject to the approval of central council of IDA.
6. ***Associate members:*** Persons registered with the Medical Council of India.

ANSWER 4

IDA Emblem (Fig. 31.1)

Fig. 31.1: Emblem of IDA

1. ***Head of elephant:*** Represents sagaciousness and thoughtfulness.
2. ***Tusks of elephant:*** Denotes the dental profession.
3. ***The staff of aesculpius:*** Represents the professional authority of the association.
4. ***Serpents entwined around the staff:*** This is a symbol of healing. The emblem has two serpents entwined around the staff in opposite directions.
5. ***Wings on the staff:*** Represents spread of knowledge. The emblem has six small and three large divisions on the wings on either side of the staff.

ANSWER 5

1. IDA was formed in 1949.
2. Before it was known as All Indian Dental Association.
3. IDA was registered in 1967 in New Delhi (Reg. No.S/265).

(Also add Ans 1, 2, 3 and 4)

32 Occupational Hazards in Dentistry

QUESTION

Discuss the occupational hazards in dentistry.

ANSWER

The occupational hazards can be studied under the following headings:

1. ***Biological health hazards***
   a. *Infections:*
      i. HIV/AIDS
      ii. Tuberculosis
      iii. Hepatitis
      iv. Parotitis
      v. Syphilis
      vi. Gonorrhea
      vii. Sore throat
      viii. Herpes simplex
      ix. Pneumonia.
   b. *Hypersensitivity reactions*
      i. Urticaria
      ii. Conjunctivitis
      iii. Mucous rhinitis
      iv. Bronchial-asthma
      v. Anaphylactic shock
      vi. Allergic contact dermatitis
         - Due to latex allergy or acrylic monomer.
   c. *Intoxication (Mercury toxicity)*
      i. Gastric disturbances

ii. Diarrhea
iii. Excitability
iv. Insomnia
v. Headache
vi. Mental depression
vii. Ptyalism
viii. Metallic taste
ix. Enlarged salivary gland and tongue
x. Pigmentation of gingiva.

d. *Ergonomic (Musculoskeletal disorders):*
i. Spondylitis
ii. Back pain syndrome
iii. Pain of wrist and elbows
iv. Varicose veins.

e. *Auditory defects*
i. Temporary/permanent hearing defects

f. *Radiation hazards*
i. Somatic effects
- Radiation sickness, acute radiation sickness
- Leukemia, carcinogenesis
- Genetic defects.

2. *Psychological factors*

a. *Hazards related to work load*
i. Frustration, emotional tension
ii. Hypertension
iii. Depression, insecurity
iv. Insomnia
v. Lack of job satisfaction.

3. Litigation

33 Health Care System in India

QUESTIONS

1. Discuss the health system in India.
2. Discuss the health problems in India.
3. Define primary health care.
4. Elements of primary health care.
5. Principles of primary health care.
6. Levels of health care.
7. Health care system in India.
8. Primary health care in India.
9. Primary health center. (Refer Ans 8)
10. Community health center. (Refer Ans 8)

ANSWER 1

Health System in India

Under the constitution of India, the states are largely independent in matters related to the delivery of health care to the people. Each state has therefore 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. The health system in India has three main links:

1. Central.
2. State.
3. Local or peripheral.

The official organs of the health system at the various links are as follows:

At the Center

1 The Ministry of Health and Family Welfare
2 The Directorate General of Health Services
3 The Central Council of Health and Family Welfare.

At the State

1. State Ministry of Health
2. State Health Directorate.

At the District Level

1. Sub-division (Incharge is Assistant Collector or Sub-Collector.)
2. Tehsil (Incharge is Tehsildar)
3. Community development blocks ((Incharge is Block Development Officer)
4. Municipalities and Corporations (Incharge is Chairman/President Elect and Mayor)
5. Villages (Rural local self government)
6. Panchayat
   a. Panchayat Raj at village level consists of:
      i. The Gram Sabha
      ii. The Gram Panchayat
      iii. The Nyaya Panchayat.
   2. Panchayat at the block level.
      i. Panchayat Samithi/Janpada Panchayat.
   3. Panchayat at the district level.
      i. Zilla Parishad/Zilla Panchayat.

ANSWER 2

Health Problems in India

The health problems in India may be conveniently grouped under the following heads:

1. Communicable disease problems
2. Nutritional problems
3. Environmental sanitation problems
4. Medical care problems
5. Population problems.

Communicable Disease Problems

The communicable diseases continue to be a major problem in India. Disease considered to be of great importance are–Malaria, tuberculosis diarrheal diseases, acute respiratory diseases, leprosy, filaria, AIDS and others like

meningitis, viral hepatitis, enteric fever, guinea worm disease, helminthic infestations.

Nutritional Problems

From this point of view, the Indian society is a dual society, consisting of small group of well fed and large group of undernourished. The high income groups are showing diseases of affluence. The specific nutritional problems are protein energy malnutrition, nutritional anemia, low birth weight, xeropthalmia (nutritional blindness), Iodine deficiency disorders and others like lathyrism and endemic fluorosis.

Environmental Sanitation

The most difficult problem to tackle in India is the sanitation problem. The twin problems are lack of safe drinking water and management of excreta disposal. Population explosion, industrialization and urbanization are creating greater impact on the sanitation problem.

Medical Care Problems

There is unequal distribution of health care facilities in the urban and the rural areas. 80% facilities are available in the urban area where 20% of the population resides and 20% facilities are available in the rural areas where 80% population exists. With the available disease oriented health care model, benefits are provided only to the elites of the society. Though national health policy exists there is very little financial resources to meet the health needs of the people. The primary health care approach which lays stress on equity, intersectoral co-ordination and community participation will seek to redress these imbalances.

Population Problems

The population problem is one of the biggest problems facing the country, with its inevitable consequences on all aspects of development, especially employment, education, housing, health care, sanitation and environment. The population size plays an important role and is the single factor among other factors which influences the economic development of the country.

ANSWER 3

The Alma-Ata Conference defined primary health care as follows:
Primary Health Care is defined as "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."

ANSWER 4

Elements 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 and
8. Provision of essential drugs.

ANSWER 5

Principles of Primary Health Care

1. ***Equitable distribution***

a. Health services must be shared equally by all the people irrespective of their ability to pay and all (rich, poor, urban or rural) must have access to health services

b. At present, health services are mainly concentrated in major towns and cities resulting in inequality of care to the people in rural area this is social injustice, which is mainly due to inaccessibility.

c. Aim of this is to bring these services as near to people's home as possible (rural areas and urban slums).

2. ***Community participation***

a. Apart from central and state government responsibilities, involvement of individuals, families and communities in promotion of their own health and welfare is an essential ingredient

For example (In India, use of village health guides, trained dias are selected from local communities and trained in the delivery of Primary Health Care.

b. There must be a continuing effort and involvement of the community in the planning, implementation and maintenance of health services, local resources such as manpower, money and materials.

3. ***Intersectoral coordination***

a. Components of primary health care cannot be provided by the health sector alone

b. The declaration of Alma-Ata states that primary health care, besides health sector involves all related sectors like, agriculture, animal

husbandry, food industry, education, housing, public works, communication and other sectors

c. Such co-ordination requires strong political will to translate into action.

4. ***Appropriate technology***

a. Defined as "technology that is scientifically sound, adaptable to local needs and acceptable to those who apply it and those for whom it is used and that can be maintained by the people themselves in keeping with the principle of self reliance with the resources the community and country can afford"

b. Appropriate is emphasized because in some countries, large luxurious hospitals that are totally inappropriate to the local needs, also using costly equipment, procedures and techniques when cheaper, scientifically valid and acceptable ones are available. For example: Oral dehydration fluid, standpipes. Neem Stick and Mango leaf for tooth brushing, salt and oil as mouthwashes.

ANSWER 6

There are three levels of health care:

1. Primary care level
2. Secondary care level
3. Teritary care level

Primary Care Level

1. First level of contact of individuals, the family, community and the health system
2. In India, it is provided by the primary health centers and subcenters through multipurpose workers (MPW), village health guides and trained dais
3. This village "health teams" fills the communication and cultural gap between the rural people and organized health sector. Most of the health problems can be dealt and resolved.

Secondary Care Level

1. More complex problems are dealt.
2. It is first referral level.
3. In India, it is provided in district hospitals and community health centers.

Tertiary Care Level

1. More specialized level than secondary care level.
2. Requires specific facilities and attention of highly specialized health workers.
3. This care is provided by the regional or central level institutions, e.g. Medical college hospitals, All India Institutions, Regional hospitals, specialized hospitals, etc.

ANSWER 7

Health care systems in India are represented by five major sectors:

1. ***Public health sector***
   a. Primary health care
      Primary health centers
      Sub-centers.
   b. Hospitals/health centers
      Community health centers
      Rural hospitals
      District hospital/health centers
      Specialist hospitals
      Teaching hospitals.
   c. Health insurance schemes
      Employees state insurance
      Central government 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 programs.***

ANSWER 8

Primary Health Care in India

In 1977, the government of India launched a rural health scheme, based on principle of "placing people's health in people's hands." recommended by Shrivastav committee in 1975. Keeping in view of Health for All by 2000 AD, Govt. of India evolved a National Health Policy based on primary health care approach and was approved by parliament in 1983.

1. ***Village level:*** One of the principles of Primary Health Care is universal coverage and equitable distribution of health resources, Health care must penetrate into the farthest reaches of rural areas so that everyone can access it. To implement this the following schemes were made at the village level.
   a. Village Health Guides Scheme.
   b. Training of Local Dais.
   c. ICDS (Integrated Child Development Scheme) Scheme.
   a. *Village health guide* is a person for social service not a full time government employee. It was introduced in 2nd Oct. 1977. These are mostly women. They are trained for 200 hours over 3 months in Primary Health Center or subcenters, paid a stipend of Rs.200/month during training. Their duties are treatment of simple ailments, activities in first aid, mother and child health including family planning, health education and sanitation.
   b. *Training of local dais:* Most of the deliveries in rural areas are handled by untrained dais. Under Rural Health Scheme, these dais are trained in Primary Health Center, subcenter and MCH center for 30 working days and paid a stipend of Rs. 300 during training. These are trained for maternal and child health, sterilization besides obstetric skills.
   c. *Anganwadi worker:* Under the (Integrated child development scheme) ICDS project, there is one Anganwadi worker for 1000 population. She is selected from the community, she is expected to serve and is trained in various aspects of health, nutrition and child development for 4 months. Her services include health education, non formal pre school education and referral services. Target population are nursing mothers, children below the age of 6 years and women between (15–45 years).
2. ***Sub-center level***
   - One sub-center is established for every 5000 population in general and one for every 3000 in hilly, tribal and backward areas
   - *Functions are:* Mother and child health care, family planning and immunization. But proposed to extend for IUD insertion, simple laboratory investigations like urine albumin and sugar

- One sub-center is supervised by male and female health assistants. One female health assistant supervises 6 female health workers.

3. ***Primary health center:*** National Health Plan (1983) proposed to have one Primary Health Center for every 30,000 rural populations and for every 20,000 population in hilly, tribal and backward areas.

   Functions of primary health center:

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

   Staff Pattern

Medical officer	- 1
Pharmacist	- 1
Nurse midwife	- 1
Health worker (female)/ANM	- 1
Block extension educator	- 1
Health assistant (male)	- 1
Health assistant (female)/LHV	- 1
UDC	- 1
LDC	- 1
Lab Technician	- 1
Driver (subject to availability of vehicle)	- 1
Class IV	- 4

4. ***Community health centers:***
   - One community health center should cover a population of 80,000 to 1.20 lakh. (One in each community development block)
   - Established with 30 beds and specialties in surgery, medicine, obstetrics and gynecology and pediatrics with radiography and laboratory facilities
   - Community health officer (non-medical post) has been created at each center for strengthening preventive and promotive services.

Staff

Medical officer	- 4
Pharmacist	- 1
Nurse mid-wives	- 7
Lab. Technician	- 1
Dresser	- 1
Radiographer	- 1
Ward boys	- 2
Dhobi	- 1
Sweepers	- 3
Mali	- 1
Choukidar	- 1
Aya	- 1
Peon	- 1

34 Environment and Health

QUESTIONS

1. Potable water.
2. Water borne diseases.
3. Different methods of water purification.
4. Water purification on large scale.
5. Rapid sand filtration. (Refer Ans 4)
6. Differences between rapid sand filtration and slow sand filtration.
7. Vital/biological/zoogleal/schmutzdecke layer. (Refer Ans 4)
8. Chlorination. (Refer Ans 4)
9. Break point of chlorination. (Refer Ans 4)
10. Water purification on small scale.
11. Sound/noise pollution.
12. Radiation pollution.
13. Methods of solid waste disposal.
14. Hospital waste management.
15. Incineration. (Refer Ans 13)
16. Composting. (Refer Ans 13)
17. Dental waste management.

ANSWER 1

Potable Water

The water that we consume should be both safe and wholesome. Potable water is defined as the water with the following qualities:

- Should be free from pathogenic agents,
- Should be free from harmful chemical substances,
- Pleasant to taste, i.e. free from color and odor,
- Usable for domestic purposes.

Water quality—criteria and standards

Tests	*Standards*	*Maximum permissible limit (Domestic)*
Physical	Turbidity (Units)	5-10
	Color (Units)	15-25
	Taste and odor	Nil
Chemical	pH	6.5-8.5
Organic	Total solids (ppm)	500-1000
	Hardness	75-115
	Aluminum (mg/l)	0.2
	Chloride (mg/l)	200
	Hydrogen sulphide (mg/l)	1
	Iron (mg/l)	0.05-0.1
	Sulphate (mg/l)	0.3
	Nitrate (mg/l)	250
	Sodium (mg/l)	45
	Zinc (mg/l)	200
	BOD	3
Inorganic	Antimony (mg/l)	0.005
	Arsenic (mg/l)	0.01
	Barium (mg/l)	0.7
	Boron (mg/l)	0.3
	Cadmium (mg/l)	0.003
	Chromium (mg/l)	0.05
	Copper (mg/l)	2
	Cyanide (mg/l)	0.07
	Fluoride (mg/l)	1.5
	Lead (mg/l)	0.01
	Manganese (mg/l)	0.5
	Mercury (mg/l)	0.001
	Molybdenum (mg/l)	0.07
	Nickel (mg/l)	0.02
	Nitrate (mg/l)	50
	Nitrite (mg/l)	3
	Selenium (mg/l)	0.01
Biological	MPN (Most Probable Number)-	
	Coliforms (no./ml)	10
	Escherichia coli	0
Radiological	Gross alpha activity	0.1 Bq/L
	Gross beta activity	1.0 Bq/L

ANSWER 2

Water Borne Diseases

Water borne diseases are mainly seen in developing countries most common been diarrheal diseases. These are classified as Biological and Chemical.

1. ***Biological diseases are classified as:***
   a. *Presence of an infective agent*

i. *Viral:* Viral hepatitis A, hepatitis E, poliomyelitis, rotavirus, diarrhea in infants.
ii. *Bacterial:* Typhoid and paratyphoid fever, bacillary dysentery, E.coli, diarrhea, cholera.
iii. *Protozoal:* Amoebiasis, giardiasis.
iv. *Helminthic:* Roundworm, threadworm, hydatid disease.
v. *Leptospiral:* Weil's disease.

b. *Presence of an aquatic host*
i. *Snail:* Schistosomiasis
ii. *Cyclops:* Guinea worm, fish tapeworm.

2. ***Chemical:*** Mainly the presence of chemical pollutants like cyanides, heavy metals, minerals, organic acids, bleaching agents, dyes, pigments, nitrogenous substances, sulphides, ammonia, toxic and biocidal organic compounds may have effect on human health. For example:

a. *Dental health:* Presence of high levels of fluoride causes mottling of dental enamel.
b. *Cyanosis in infant:* Presence of high nitrates is associated with methemoglobinemia.
c. *Diseases due to inadequate use of water:* Scabies, Shigellosis, trachoma and conjunctivitis, ascariasis.
d. *Diseases due to disease carrying insects in the water:* Malaria, filaria, arboviruses, etc.

ANSWER 3

Methods of water purification:

1. Large Scale
   - Rapid sand filtration
   - Slow sand filtration.
2. Small scale:
   Household
   - Boiling
   - Chemical disinfection
   - Filtration.

   Disinfection of wells.

(For detailed description refer Ans 4 and 10).

ANSWER 4

Purification of Water on Large Scale

There are three stages:

1. ***Storage***
2. ***Filtration:*** It is of two types
   a. Slow sand filtration
   b. Rapid sand filtration.
3. ***Disinfection***

Storage

Storage of water has three functions:

1. *Physical:* It allows the suspended particles to settle down in 24 hours.
2. *Chemical:* Content of free ammonia is reduced and rise in nitrates because of aerobic bacteria which oxidizes the organic matter occurs.
3. *Biological:* Bacterial count is dropped down.

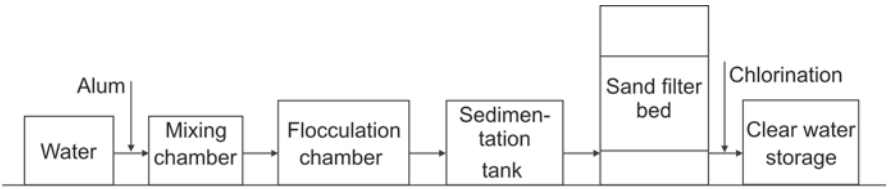
Filtration

Two types of filtration process are available:

1. Rapid sand filtration.
2. Slow sand filtration.

1. ***Rapid sand filtration (Flow chart 34.1):*** The following steps are involved:
   a. *Coagulation:* Raw alum is added to raw water of about 5–40 mg or more/litre depending upon the color, turbidity, temperature and pH.
   b. *Rapid mixing:* Water is subjected to violent agitation in mixing chamber for few minutes so that alum is properly disseminated in water.
   c. *Flocculation:* In flocculation chamber water is stirred slowly and gently which results in formation of flocs of aluminum hydroxide.
   d. *Sedimentation:* The coagulated water is allowed to settle the precipitated flocs in sedimentation chamber for 2–6 hours. 95% of the precipitate is allowed to settle before it is subjected to filtration. Then the supernatant water subjected to filtration.

Flow chart 34.1: Schematic diagram of a rapid sand filtration plant



e. *Filtration:* The water is passed through the filter beds. The alum floc, which is not removed by sedimentation, settles on the sand bed. It forms a slimy layer, which is similar to zoogleal layer in slow sand filters which helps to adsorb bacteria. Even oxidation of ammonia also takes place. As this process proceeds the bacteria and suspended impurities clogs the surface of the filter beds and reduces its filtration capacity. When the loss of head approaches 7–8 feet, filtration is stopped and the filters are subjected to "Back-washing".

f. *Back-washing:* This is a washing procedure accomplished by reversing the flow of water through the sand bed, which helps to dislodge the impurities and cleans up the sand bed. Compressed air is sometimes used along with the reversing of water flow. The whole process of washing takes about 15 minutes and is stopped when clear sand is visible and the wash water is sufficiently clear.

2. ***Slow sand filtration/Biological filtration:*** It includes:

a. Supernatant (raw) water.
b. A bed of graded sand.
c. An under-drainage system; and
d. A system of filter control valves.

a. *Supernatant (raw) water:* It is the water above the sand bed whose depth varies from 1 to 1.5 m and level is always kept constant. It serves two purposes: it provides constant head of water and secondly, it provides waiting period of some hours and allows partial purification by sedimentation, oxidation and particle agglomeration.

b. *Sand bed (Fig. 34.1):* The thickness of the sand bed is about 1 m. The sand grains are preferably rounded with the diameter of 0.2 to 0.3 mm. It should be free from clay and organic matter. A layer of graded gravel of 30–40 cm deep supports the sand bed , which prevents the fine grains being carried into the drainage pipes. Water is passed very slowly through the sand bed during which water is subjected to mechanical straining, sedimentation, adsorption, oxidation and bacterial action. Normally the rate of filtration lies between 0.1 and 0.4 m^3/hour/per square meter of sand bed surface.

Vital layer: Initially filter acts as a mechanical strainer, but soon the surface is covered with a slimy growth known as **Vital/Biological/ Zoogleal/Schmutzdecke layer**. Formation of this layer is also known as ripening of the filter. This layer is slimy and gelatinous and consists of threadlike algae and numerous forms of life including plankton, diatoms and bacteria. It takes several days to form and fully formed

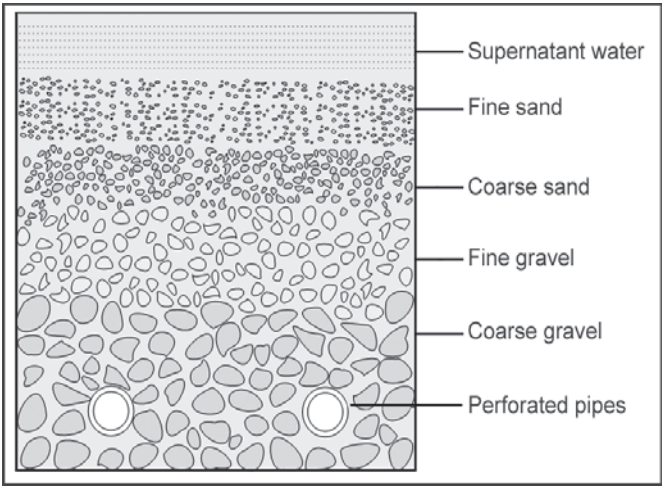


Fig. 34.1: Schematic representation of the section of filter bed

layer extends for 2 to 3 cm on the sand bed. This layer removes organic matter, holds back bacteria and oxidizes ammoniacal nitrogen into nitrates. The first few days filtrate is usually run waste till vital layer is fully formed.

c. *Under drainage system:* Under drainage system lies below the filter bed which cannot be seen. It consists of porous or perforated pipes which provides an outlet for filtered water and also supports the filter medium above.

d. *Filter control:* The filter is equipped with certain valves and devices that are incorporated into the outlet pipe system. The purpose of these devices is to maintain a constant rate of filtration. The important part in this system is "Venturi meter" which measures bed resistance or loss of head. If loss of head exceeds 1.3 m it is uneconomical to run the filter. When bed resistance increases it reduces filtration rate, so it has to be cleaned. To clean the filter bed, first drain the supernatant water and the sand bed is cleaned by "scraping" off the top portion of the sand layer to a depth of 1 or 2 cm. After 20 –30 scrapings, the thickness of the sand bed reduces and new bed is constructed.

Disinfection

Chlorine is widely used for disinfection of water. It is used as chlorine gas, chloramines or perchloron. Chlorine kills pathogenic bacteria and also oxidizes iron, manganese, hydrogen sulphide, destroys some taste and odor producing constituents, controls algae and slime organisms and aids in coagulation.

For proper chlorination

a. The water should be clear and free from turbidity.
b. The chlorine demand of water is estimated. It is the difference between the amount of chlorine added and the residual chlorine the remains at the end of specific period of contact, at a given temperature and pH of the water.
c. Contact period (the residual chlorine should be in contact for atleast one hour to kill the bacteria and viruses).
d. The minimum concentration of free chlorine should be 0.5 mg/L/one hr.
e. Sum of chlorine demand plus free residual chlorine of 0.5 mg/L/one hr is the correct dose of chlorine to be added.

Mechanism of action of chlorine: When chlorine is added to water it forms hydrochloric acid and hypochlorus acid. Hydrochloric acid is neutralized by alkalinity of water. Hypochlorus acid is mainly responsible for disinfection of water. When pH exceeds 8.5 hypochlorus acid gets ionized into hypochlorite ions which are weak disinfectants than hypochlorus acid. So chlorine acts as best disinfectant when pH of water is around seven because of high concentration of hypochlorus acid.

Break-point of chlorination: This is that point at which the residual chlorine starts appearing after the amount of chlorine added is utilized to destroy bacteria and to oxidize all organic and ammonial substances.This residual chlorine or free chlorine is necessary to provide margin of safety against further bacteria contamination as may occur during storage and distribution.

There is a test to detect the free chlorine in water called orthotolidine test (OT): The reagent used is analytical grade-0-toluidine dissolved in 10% solution of hydrochloric acid. It is carried out by adding 0.1 ml of reagent to 1ml of water. The yellow color is produced due to reaction of reagent with free chlorine and also combined chlorine which is compared to the suitable standards or color discs. To estimate free chlorine the reading is taken within 10 sec after the addition of reagent.

To determine the free and combined chlorine separately the OT test is modified to orthotolidine arsenite test (OTA).

Other agents used in disinfection: Chlorine is the most commonly used disinfectant because of its germicidal properties, low cost and ease of application. It is discovered that use of chlorine can lead to formation of "halogenated compounds" some of which are either known or suspected carcinogens. As a result many chlorine alternatives like bromine, iodine, chlorine dioxide, ozone and ultraviolet irradiation have been tried.

a. *Ozonation:* Ozone is relatively unstable gas. It is powerful oxidizing agent. It eliminates undesirable odour, taste, colour and removes all chlorine from water. It has a strong virucidal effect. It inactivates viruses in seconds. Disadvantage of ozone is that, that there is no residual germicidal effect. Thus best results can be obtained by employing ozonation in combination with chlorination. Ozone is used for pre-treatment of water to destroy viruses, bacteria and also organic compounds that reacts with chlorine when added, then controlled minimum dose of chlorine is added and, to water before it is pumped into the distribution system. Ozone dosage required for potable water treatment varies from 0.2 to 1.5 mg/liter.
b. *Ultraviolet irradiation:* It is effective against most of the microorganisms that are known to contaminate water including viruses. This method involves exposure of film of water, up to 120 mm. thick to ultraviolet radiation with wavelength in the range of 200 to 295 mm.

The water should be free from turbidity and suspended/colloidal particles for efficient disinfection. Advantages are, exposure is for short period, no taste and odor produced, overexposure does not leads to any harmful effects. Disadvantages are there is no residual effect, lack of rapid field test for assessing the treatment efficiency and expensive.

ANSWER 6

Differences between Rapid sand filtration and Slow sand filtration

		Rapid sand filtration	*Slow sand filtration*
1	Space	Occupies very little space	Occupies large space
2	Rate of filtration	200 mgad	2–3 mgad
3	Effective size of sand	0.4–0.7 mm	0.2–0.3 mm
4	Preliminary treatment	Chemical coagulation and sedimentation	Plain sedimentation
5	Washing	By Back-washing	By scraping the sand bed
6	Operation	Highly skilled	Less skilled
7	Loss of head allowed	6–8 feet	4 feet
8	Removal of turbidity	Good	Good
9	Removal of color	Good	Fair
10	Removal of bacteria	98–99%	99.9–99.99%

ANSWER 10

Purification of Water on Small Scale

1. ***Household purification of water:*** This can be done by following methods:
   a. *Boiling:* It is effective when water is brought to rolling boil for 5–10 minutes. It kills bacteria spores, cysts, ova and also removes

temporary hardness by removing carbon dioxide and precipitating calcium carbonate.

b. *Chemical disinfection:*
   i. *Bleaching powder:* Bleaching powder or chlorinated lime ($CaOCl_2$) is used. It contains about 33% of "available chlorine".
   ii. *Chlorine solution:* Chlorine solution may be prepared from bleaching powder. Ready made chlorine solutions in different strengths are available.
   iii. *High test hypochlorite:* High test hypochlorite or perchloron contains 60 to 70% available chlorine. It is stable than bleaching powder.
   iv. *Chlorine tablets:* Available under various trade names like halazone tablets. They are good for disinfecting small quantities of water and are very costly. NEERI has developed tablets which are 15 times better than halazone tablets.A single tablet of 0.5 g in sufficient to disinfect 20 litres of water.
   v. *Iodine:* It is used for emergency disinfection of water Two drops of 2% ethanol solution of iodine will be sufficient for one litre of clear water for a contact period of 20 to 30 min for effective disinfection.
   vi. *Potassium permanganate:* Once was widely used, but now no longer recommended for water disinfection. It alters color, taste and smell of water.

c. *Filtration:* On a small scale, water can be purified by using ceramic filters such as pasteur chamber land filter, Berkefeld filter and Katadyn filter. Candle is the essential part of filter which are made of materials like porcelain, kieselgurh or infusorial earth.

2. ***Disinfection of wells:*** In rural areas, wells are the main source of drinking water. In cases of epidemics of cholera and gastroenteritis may need to disinfect wells on a mass scale. So, bleaching powder is used which is effective and cheapest method.

ANSWER 11

Noise Pollution

Noise is often defined as "unwanted sound" .It is defined as 'wrong sound, in the wrong place, at the wrong time.' Sources of noise is from automobiles, factories, industries, aircraft, etc. Noise levels are acute near railway junctions, bus terminuses and airports. Other domestic noises are from radios, transistors, and TV sets. A daily exposure upto 85 dB is the limit. People can tolerate without substantial damage to their hearing

The recommended maximum loudness is 85 dB and frequency is from 20–20,000 Hz.

Effects of Noise are of Two Types

Auditory Effects

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

Non-auditory Effects

1. ***Interference with speech:*** Noise interferes with speech communication.
2. ***Annoyance:*** It is primarily a psychological response. Neurotic people are more sensitive to noise. They often get irritated, short tempered and impatient.
3. ***Efficiency:*** Reduction in noise has been found to increase work output.
4. ***Physiological changes:*** Rise in blood pressure, an increase in heart rate and, breathing, and increase in sweating, a rise in intracranial pressure. General symptoms like giddiness, nausea and fatigue and may also cause visual disturbance.
5. ***Noise*** is also a significant factor in economic losses.

Control of Noise

1. ***Careful planning of cities***
   a. Separation of cities from industries and transports.
   b. Separation of residential areas from main streets.
   c. Widening of main streets to prevent penetration of noise into dwellings.
2. ***Control of vehicles:***
   a. Heavy vehicles should not be routed into narrow streets.
   b. Vehicular traffic on residential streets should be reduced.
3. To improve acoustic insulation of buildings.
4. ***Industries and railways:*** Special areas must be earmarked for industries and railways outside residential areas, if not possible green belts must be laid down between such installations and residential areas.
5. ***Protection*** of exposed persons with use of earplugs, earmuffs.
6. ***Legislation:*** Many states have adopted legislation providing for controls which are applicable to a wide variety of sources.
7. ***Education*** of the people through media and their participation is needed to highlight the importance of noise as a community hazard.

ANSWER 12

Radiation Pollution

Sources for radiation are of two types:

1. ***Natural sources***
   a. *Cosmic rays:* which originate in outer space.
   b. *Environment:*
      i. *Terrestrial radiation:* like thorium, uranium, radium present in soil, rocks and buildings.
      ii. *Atmospheric radiation:* radioactive gases radon and thoron in atmosphere.
      iii. *Internal radiation:* these are radioactive matter stored in body tissues. These are in minute quantities like uranium, thorium, potassium, strontium (Sr 90) and carbon (C 14).
2. ***Man-made sources***
   a. X-rays
   b. Radioactive fall-out like nuclear explosions.
   c. Miscellaneous, e.g. TV sets, luminous wrist watches.

Types of Radiation

1. ***Ionizing radiation*** is harmful as it penetrates through tissues and deposits its energy within them. They are of two types:
   a. *Electromagnetic radiation:* X-rays and gamma rays.
   b. *Corpuscular radiations*: α-particle, β-particle and protons.
2. ***Non ionizing radiation*** refers to several forms of electromagnetic radiation of wavelength longer than those of ionizing radiation.
   For example: UV radiation, visible light, infrared radiation, microwave radiation and radio frequency radiation.

The amount of radiation received from natural sources is estimated to be 0.1 rad/yr. which at present is not hazardous. Additional permissible dose from man-made sources should not exceed 5 rad/yr.

Biological Effects of Radiation

1. ***Somatic effects are immediate and delayed:***
   a. *Immediate effects* are radiation sickness and acute radiation syndrome.
   b. *Delayed effects* are leukemia, carcinogenesis, foetal developmental abnormalities and shortening of life.
2. ***Genetic effects*** are chromosome mutations and point mutations.

ANSWER 13

Solid Waste Disposal

Different methods of solid waste disposal

1. Dumping
2. Controlled tipping or sanitary landfills
3. Incineration
4. Composting
5. Manure pits
6. Burial.

Dumping

Refuse is dumped in low-lying areas partly as a method of reclamation of land, but mainly as a method of disposal of dry refuse.

Disadvantages

Waste is allowed to accumulate, it decomposes and favors fly breeding, attracts rodents and vermin, man's food is contaminated by pathogens through flies and dust, possibility of water and soil pollution, produce bad odors and unsightly appearance.

Controlled Tipping

This method is suitable for disposal when suitable land is available. In this, material is placed in a trench or prepared area, adequately compacted and covered with earth. There are three methods.

1. ***Trench method:*** Trench of 2 to 3 m deep and 4 to 12 m in width is dug where level ground is available. Refuse is dumped and covered with excavated earth. It is estimated that one acre of land/per year will be required for 10,000/- population.
2. ***Ramp method:*** This method is chosen when land is moderately sloping and some excavation is done to cover the material.
3. ***Area method:*** This method is used for filling land depressions, disused quarries and clay pits. The refuse is packed in uniform layers upto 2 to 2.5 m deep and each layer is sealed on its exposed surface with mud cover at least 30 cm thick.

Incineration

It is widely used method of waste disposal especially for most hazardous health care wastes. This method is selected when wastes cannot be recycled, reused or disposed-off in a landfill site. It is a high temperature dry oxidation process that reduces organic and combustible waste to inorganic incombustible matter with significant reduction of waste volume and weight.

Types of Incinerators

Incinerators should be chosen on the basis of available resources, the local situation and the risk-benefit consideration.

1. ***Double chamber pyrolytic type:*** Mainly designed to burn infectious health care waste. It needs a fuel burner to initiate the process. It comprises of pyrolytic chamber where, waste is thermally decomposed in an oxygen deficient medium temperature combustion process (800-900° C) producing ashes and gas. The gases (Flue gas) which are produced are burnt at high temperature (900–1200°C) in post-combustion chamber by a fuel burner, using an excess of air to minimize smoke and odor. The by-products are exhaust gas released into the atmosphere and ashes disposed by burial/ landfilling.
2. ***Single chamber:*** Used when pyrolytic type are not affordable. This should be used as a last option as it is difficult to burn the waste completely without generating potential harmful smoke. It consists of a steel drum with both ends removed and fine screen is placed on the top to prevent ash blowing out. Fine screen is also placed at the bottom and a chimney is placed on the top. Good fire is generated underneath the drum, wood is used to the fire till the waste is completely burnt. After burning is complete the ash both from fire and waste is buried safely. Loading and de-ashing operations are performed manually.
3. ***Rotary kilns:*** Operated at high temperatures, can decompose genotoxic substances, sharps , pathological wastes and heat resistant chemicals. It consists of a rotating oven and a post- combustion chamber.

   Rotary kiln is inclined to an single angle to the vertical (3–5% slope). Waste is charged from the top of the kiln and kiln rotates at 2–5 times/ minute. Ash is collected from the bottom and gases which are produced are burnt at high temperature in post-combustion chamber.

Wastes that can be Incinerated are

Infections wastes (including sharps) and pathological wastes like human and animal tissues, organs, body parts, experimental animals, items contaminated with blood and fluids including cotton, dressings, soiled plaster casts, linen beddings, etc.

Wastes that cannot be Incinerated are:

- Pressurized gas containers,
- Large amount of reactive chemical wastes,
- Halogenated plastic such as PVC,
- Waste containing high mercury or cadmium contents like broken thermometers, used batteries, lead-linen wooden panels, sealed ampules, ampules containing heavy metals.

Composting

In this method combined disposal of refuse and night soil or sludge is used. The organic matter breaks down under bacterial action resulting in formation of stable humus like material called compost. Because of the heat (60° C or higher) which is produced as a by-product, makes this compost sterile with few or no microorganisms.

There are two methods:

1. ***Bangalore method:*** Also called hot fermentation process. This was developed by Indian Council of Agricultural Research at the Indian Institute of Science, Bangalore recommended for disposal of town wastes and night soil.Trenches are dug of 90 cm deep and 1.5 to 2.5 m in width and 4.5 to 10 m long depending upon amount of refuse and night soil. These trenches are located about 800 m away from city limits. First 15 cm. of refuse in spread out and above that give 5 cm night soil, put same amount of refuse and night soil alternately and top layer should be of refuse with 25 cm. thickness and covered with excavated land. Within seven days, decomposition of material starts by bacterial action and heat in generated over 60° C. This heat persists over 2–3 weeks and decomposes night soil and refuse and also destroys all pathogenic and parasitic organisms. After four to six months decomposition is complete and manure developed is used for cultivation.
2. ***Mechanical composting:*** In this method compost is manufactured on a large scale. The refuse is cleared of with salvageable materials such as rags, bones, metal, glass and any other materials, which interferes with grinding operation. Then it is pulverized in a pulverizing equipment in order to reduce the particle size to less than two inches and mixed with sewage, sludge or night soil in a rotating machine and incubated. The entire process is complete in 4-6 weeks. The Government of India is considering the installation of mechanical composting in selected cities like Delhi, Nagpur, Mumbai, Chennai, Pune, Allahabad, Hyderabad, Lucknow and Kanpur. This method is already installed in developed countries like, Holland, Germany, Switzerland and Israel.

Manure Pits

In this method, pits are dug by individual householders. Refuse like garbage, cattle dung, straw and leaves are dumped into the pit and covered with earth after each day's dumping. Two pits are dug, one can be in use and one be closed. After five to six months time refuse is converted into manure and can be used in fields. This is most effective and simple method to be used in rural areas in India, where there is no system for collection and disposal of refuse.

Burial

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

ANSWER 14

Hospital Waste Management

Biomedical waste (Management and Handling) Rule 1998, prescribed by the Ministry of Environment and Forests, Government of India, came into force on 28th July 1998.This is applied to those who generate, collect, receive, store, dispose, treat or handle bio-medical waste in any manner.

According to Biomedical waste (Management and Handling) Rule 1998 of India, "Biomedical waste" means any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biologicals and including categories as mentioned below:

Option	*Waste category*	*Treatment and disposal*
Category No.1	Human anatomical waste (human tissues, organs, body parts)	Incineration[2]/ deep burial
Category No.2	Animal waste (animal tissues, organs, body parts carcasses, bleeding parts, fluids, blood and experimental animals used in research, waste generated by veterinary hospitals colleges, discharge from hospital, animal house).	Incineration[2]/ deep burial
Category No.3	Microbiology and biotechnology waste (waste from laboratory cultures, stocks or specimens of micro-organisms, live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, waste from production of biologicals, toxins, dishes and devices and for transfer of cultures.	autoclaving/microwaving/ incineration[2]
Category No.4	Waste sharps (needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts. This includes both used and unused sharps)	disinfection(chemical treatment @/autoclaving/microwaving and mutilation/ shredding)
Category No.5	Discarded medicines and cytotoxic drugs (wastes comprising of outdated, contaminated and discarded medicines).	incineration @ destruction and drugs disposal in secured landfills

Contd...

Option	*Waste category*	*Treatment and disposal*
Category No.6	Solid waste (Items contaminated with blood and fluids including cotton, dressings, soiled plaster casts, linen, beddings, other material contaminated with blood)	incineration @ autoclaving/ microwaving
Category No.7	Solid waste (wastes generated from disposable items other than the waste sharps such as tubings, catheters, intravenous sets, etc).	disinfection by chemical treatment @@ autoclaving/ micro waving and mutilation/ shredding ##
Category No.8	Liquid waste (waste generated from laboratory and washing, cleaning, house keeping and disinfecting activities)	disinfection by chemical treatment @@ and discharge into drains
Category No.9	Incineration ash (ash from incineration of any biomedical waste)	disposal in municipal landfills
Category No.10	Chemicals used in production of biologicals, chemicals used in disinfection, as insecticides, etc.	chemical treatment @@ and discharge into drains for liquids and secured landfill for solids

@@ - Chemical treatment using at least 1% hypochlorite solution or any other equipment chemical reagent. It must be ensured that chemical treatment ensures disinfection.
- Mutilation/shredding must be such so as to prevent unauthorized reuse.
@ - There will be no chemical pretreatment before incineration. Chlorinated plastics shall not be incinerated.
2 - Deep burial shall be an option available only in towns with population less than five lakhs and in rural areas

The biomedical waste should be segregated into containers/bags at the point of generation of the waste. The color coding and the type of containers used for disposal of waste are as shown in the table below:

Color coding	*Type of container*	*Waste category*	*Treatment options*
Yellow	Plastic bag	Cat.1,Cat.2, and Cat.3, Cat.6	Incineration/deep burial
Red	Disinfected container/ plastic bag	Cat.3, Cat.6 Cat.7.	Autoclaving/microwaving/ chemical treatment
Blue/White translucent	Plastic bag/puncture proof container	Cat.4, Cat.7	Autoclaving/microwaving/ chemical treatment and destruction/shredding
Black	Plastic bag	Cat.5,Cat.9, and Cat.10 (solid)	Disposal in secured landfill

ANSWER 17

Dental Waste Management

Dental waste disposal.

Color coding/type of container	*Waste category*	*Treatment options*
Yellow bag	Teeth, excised tissues, biopsy specimen, material contaminated with blood/saliva (cotton, gauze, dressing), impression material (compound, alginate, shellac), waste from laboratory cultures, soiled dental casts.	Incineration/Deep burial.
Red bag	Plastic (suction tips, tubing, celluloid strips, radiographic films), metal (crowns, orthodontic bands and brackets, matrix bands), glass bottles, lead foils, gloves, disinfected dental casts.	Autoclaving/ chemical treatment , recycling and re-using
Blue/White bag /Puncture proof container	Sharp wastes (needles, syringes, blades, endodontic reamers, files, broken glass, etc.)	Disinfection/mutilation/Shredding.
Black bag	Discarded medicine, chemical waste, expired dental materials.	Incineration, liquids discharged into drains and solid waste disposed in secured landfill.

35 Health Agencies

QUESTIONS

1. Classify health agencies.
2. World Health Organizations (WHO). (Ans 2, 3, 4 and 5)
3. Functions/work of WHO.
4. WHO Regional Organizations/Centers.
5. WHO Oral Health Unit.
6. Colombo plan.
7. Rockefeller Foundation.
8. Ford Foundation.
9. CARE.
10. UNICEF.
11. ILO.
12. FAO.
13. USAID.

ANSWER 1

Health agencies are classified into:

1. International health agencies.
2. Voluntary health agencies (in India)

International Health Agencies under the United Nations

1. WHO
2. UNICEF
3. UNDP
4. UNFPA
5. FAO

6. World Bank
7. ILO.

Bilateral Agencies

1. USAID
2. Colombo Plan
3. Public Law Scheme.

Non-governmental Agencies

1. Ford Foundation
2. Rockefeller Foundation
3. CARE (Co-operative for Assistance and Relief Everywhere)

Voluntary Agencies

Voluntary Agencies involved with Maternal and Child Health

1. Indian Council of Child Welfare
2. Family Planning Association of India
3. Kasturba Memorial Fund.

Voluntary Agencies involved with the Control of Specific Disease or Problems

1. TB Association of India
2. Hind Kusht Nivaran Sangh
3. Indian Cancer Society
4. Indian Blind Relief Society.

Professional Bodies involved with Voluntary Health Work

1. IDA
2. IMA
3. Trained Nurses Association.

Voluntary Agencies involved with General Health Care

1. The Red Cross Society of India
2. The All India Women's Conference
3. The Central Social Welfare Board
4. The Voluntary Health Association of India.

ANSWER 2

World Health Organization (WHO)

- Non-political and specialized agency under United Nations
- Officially born on 7th April 1948 and since then 7th April every year is celebrated as "World Health Day" with a theme for global focus.

Memberships in WHO

- Open to all countries
- Territories as associate members
- In 1948, there were 56 members and in 1996, there were 190 member states and two associate members. India became a member of WHO on 12th January 1948.

Objective of WHO

"The attainment by all people of the highest level of health".

ANSWER 3

The Work of WHO

Broadly classified into three divisions:

1. ***The first division:*** Work which caused International Health Organizations to come into existence, such as, epidemic intelligence and quarantine and "standardization work" in biologicals, statistics and nomenclatures.
2. ***The second division:*** Direct services to the governments.
3. ***The third division:*** Education and information.

Work of WHO

- Prevention and control of specific diseases
- Development of comprehensive health services
- Family health
- Environmental health
- Health statistics
- Biomedical research
- Health literature and information
- Co-operation with other organizations.

WHO has Wide Range of Books and Journals,
Topics Related to Public Health

- Information containing advice of international groups of experts convened by WHO, the results of scientific work supported or promoted by

organization, studies on subjects of public heath importance, information obtained from member countries
- Publishes primary health care material including training manuals, policy papers, articles about new approaches to health care and services.

Publications includes:
- Handbooks on ***"Basic Documents and Resolutions and Decisions"***
- Monthly ***"Chronicle"***—current activities
- The ***"Bulletin"***—scientific articles on subjects with which WHO is concerned
- The ***"Monographs and Technical Report Series"***—contains scientific studies and report of expert committees and study groups
- ***"Public Health Papers"*** occasional papers prepared as contribution to the study of a particular subject by WHO
- ***"International Digest of Health Legislation"***
- A series of weekly, monthly and annual "***Epidemiological Records"***
- ***"World Health"***—news sheet published
- ***"The first ten years of WHO."***

Structural Organization

Consists of:
1. World Health Assembly (or Parliament).
2. The Executive Board (or Cabinet).
3. The Secretariat (or Civil Service).

World Health Assembly (Health Parliament)
- It is the supreme governing body of the organization
- Composed of members representing all member states
- Meets annually, usually in May, generally at the Head Quarters in Geneva.

Functions
- To determine International Health Policy and Programmes
- To review the work of the past year
- To approve the budget needed for the following year
- To elect member states to designate a person to serve for three years on executive board and replace retiring members
- Appoints Director General on the nomination of Executive Board.

The Executive Board
- Originally had 18 members then raised to 24 and 30 then to 31
- Technically qualified in the field of health
- Meets twice a year generally in January

Functions

- To give effect to the decisions and policies of the assembly
- Has power to take action itself in an emergency, like epidemics, earthquakes, floods where immediate action is necessary.

The Secretariat

- Headed by Director General (chief technical and administrative officer) assisted by one Deputy Director General
- Six Regional Directors
- Main function is to provide Member States with technical and managerial support for their national health development programs.
- At WHO Headquarters in Geneva, there are five Assistant Director Generals responsible to look after divisions as assigned by Director General.

ANSWER 4

WHO Regional Organization

	Region	*Headquarters*
1.	South East Asia Region	New Delhi (India)
2.	African Region	Harare (Zimbabwe)
3.	Regions of America	Washington DC (USA)
4.	European Region	Copenhagen (Denmark)
5.	Eastern Mediterranean Region	Alexandria (Egypt)
6.	Western Pacific Region	Manila (Philippines)

ANSWER 5

The WHO Oral Health Unit

- Established in 1956
- Postgraduate education and training at advanced institutions all over the world
- WHO consultants are sent to countries requesting technical assistance
- Reports of expert committees on various topics of oral health are published in the form of "WHO Technical Report Series"
- Standard methods of collection of data on global basis have been developed
- "WHO Global Oral Epidemiology Program"—designed to facilitate comparison of data
- "Global Oral Epidemiology Data Bank"
- WHO International Collaborative Study on Dental Manpower Systems
- Establishment of WHO Oral Disease Preventive Program in 1976.

Publications

- "Oral Health Surveys: Basic Methods"
- "Guide to oral health epidemiological investigations"
- "Application of the international classification of diseases to dentistry and stomatology"

The theme for the "**World Health Day"** on 7th April 1994 was: **Oral Health for a Healthy life.**

ANSWER 6

The Colombo Plan

- This program was drawn up for Co-operative economic development in South and South East Asia at Colombo in January 1950
- The membership comprises of 20 developing countries within the region and six non-regional members—Australia, Canada, Japan, New Zealand, UK and USA
- Mainly gives assistance into industrial and agricultural development
- Some support related to health promotion through fellowships
  - AIIMS, at New Delhi established with financial assistance from New Zealand.
  - Canada supplying Cobalt Therapy units to medical institutions in India is an important aid under the plan.

ANSWER 7

Rockefeller Foundation

- Founded in 1913, by Mr. John D Rockefeller
- In the early years, was active chiefly in public health and medical education then included the advancement of life sciences, the social sciences, the humanities and agricultural sciences
- In India, began in 1920, with a scheme for control of hookworm disease.
- Establishment of All India Institute of Hygiene and Public Health at Kolkata
- Training of competent teachers and research workers
- Training abroad of candidates from India through fellowships and travel grants
- Sponsoring of visits of a large number of medical specialists from USA
- Development of medical college libraries, population studies, assistance to research projects and institutions [National Institute of Virology at Pune, Setting up of field demonstration area (Ballabhgarh) in connection with Department of Preventive and Social Medicine and AIIMS]

- At present the foundation is giving support to improvement of agriculture, family planning and rural training centers, medical education.

ANSWER 8

Ford Foundation

Mainly involved with the development of rural health services and family planning

Ford foundation has helped India in the following projects:

1. ***Orientation training centers:*** At Singur, Poonamalle, Najafgarh—Provide training courses in public health for medical and paramedical personnel from all over India.
2. ***Research cum action projects:*** Projects mainly aimed to solve basic problems in environmental sanitation.
3. **Pilot project** in Rural Health Services, Gandhigram (Tamil Nadu) attempt was made to develop co-ordinate type of health services.
4. ***Establishment of NIHAE:*** National Institute of Health administration and Education at Delhi.
5. Calcutta water supply and Drainage Scheme.
6. Family planning programs.

ANSWER 9

CARE: (Co-operative for Assistance and Relief Everywhere)

- Began in India in 1950
- In the 1980's, the primary objectives was to provide food for children in age group of 6–11 years
- Then focused its food support for the Integrated Child Development Scheme(ICDS) program
- Helped in following projects: Integrated nutrition and health project, Better health and nutrition project, Anemia control project, Improved health care for adolescent girl's project, Improving women's health project, Child survival project, Konkan integrated development project.

ANSWER 10

United Nations International Children's Emergency Fund (UNICEF)

Origin: Created by United Nations General Assembly in 1946.

Purpose: To meet the emergency needs of children around the world.

- Headquarters is in New York
- South Central Asian Region—Headquarters is in New Delhi.

Functions of UNICEF

Content of services

1. Child health
2. Maternal health
3. Nutrition
4. Water and sanitation
5. Education
6. Children in especially difficult circumstances
7. Advocacy and people's participation
8. Promotion of GOBIFF campaign for a child health revolution.
   G—Growth charts to better monitor child development.
   O—Oral rehydration.
   B—Breastfeeding.
   I—Immunization against DPT, TB, Polio, measles.
   F- Family planning
   F- Food supplements.

ANSWER 11

International Labor Organization (ILO)

- Formed in 1919
- Headquarters in Switzerland, Geneva
- Purpose: Improving the living and working conditions of the working population in different parts of the world.

Functions

1. Establishment of peace by promoting social justice.
2. To improve the living standards and labor conditions of working people around the world.
3. To promote economic and social stability.

ANSWER 12

Food and Agriculture Organization (FAO)

- Formed in the year 1945
- Headquarters in Rome
- Concerned with human diseases of animal origin, with nutrition and with rural hygiene.

"Most important aspect is towards ensuring that the food is consumed by the people who need it, in sufficient quantities and in right proportions, to develop and maintain a better state of nutrition throughout the world."

Functions of FAO

- To improve nutrition of the people of all countries
- To help nations raise living standards
- To increase the efficiency of farming, forestry and fisheries
- To better the condition of rural people and widen the opportunity of all people for productive work
- Campaigning for the freedom from hunger in all nations.

ANSWER 13

United States Agency for International Development (USAID)

- Was created in 1961
- Incharge of activities previously administered by the Technical Co-operation Mission (TCM)
- USAID Mission functions in New Delhi.

Assists the projects to improve the health of Indians

- Malaria eradication
- Medical education
- Nursing education
- Health education
- Water supply and sanitation
- Control of Communicable diseases
- Nutrition
- Family planning.

36 National Oral Health Survey/National Oral Health Care Program

QUESTIONS

1. Write a report on the National Oral Health Survey.
2. Write a note on National Oral Health Care Program.

ANSWER 1

To formulate the Oral Health Policy and implement appropriate programs, to improve the awareness and knowledge of general public about the preventive aspects of oral health, to create the required services and to train the necessary dental manpower to meet these needs gave rise to the national level epidemiological study called as "**National Oral Health Survey and Fluoride Mapping" 2002–2003.** This was undertaken by Dental Council of India, Ministry of Health and Family Welfare and the project was supported by Colgate-Palmolive Ltd. The scope of the survey was to collect information about the following dimensions of health:

1. Prevalence of oral health problems
2. Fluoride levels in drinking water
3. Eating habits affecting oral health
4. Dental cleaning practices
5. Awareness and knowledge of people on factors affecting oral health
6. Treatment seeking behavior of people for their oral health problems.

This survey was conducted among people of 5 years, 12 years, 15 years, 35–44 years and 65–74 years. This study was conducted in 16 states and 3 union territories.

Sample Selection

Each state was divided into few homogenous regions based on agro-climatic and physio-geographic factors, 315 households out of which 210 from rural

and 105 from urban were selected from each homogenous area, with equal distribution of males and females was done. 315 people in each age-group were proposed for the examination . In total 19,845 households and 92,225 examinations were done. WHO(1997) proforma and individual questionnaire were used in the study. Training and calibration of the manpower was carried out before the survey. The summary of the findings are given in the following Table.

Summary of Findings of Important Oral Health Conditions and Practices by Age in India

	Findings	*Age in years*				
		5	*12*	*15*	*35-44*	*65-74*
1	**Oral disease conditions**					
1.1	Mean number of teeth present	19.9	27.3	27.9	30.0	18.9
1.2	Dental caries					
	% Prevalence	51.9	53.8	63.1	80.2	85.0
	Mean DMFT	2.0	1.8	2.4	5.4	14.9
	SiC	5.5	3.0	4.1	9.7	29.7
1.3	Periodontal disease					
	Bleeding, calculus or pockets					
	% Prevalence	11.7	57.0	67.7	89.6	79.9
	Mean no. of sextants affected	1.8	3.1	3.0	1.2	0.4
1.4	Loss of attachment					
	% Prevalence	NA	NA	6.9	58.1	22.3
	Mean no. of sextants affected	NA	NA	0.2	1.3	1.6
1.5	Malocclusion (%)	0.6	23.6	23.9	43.1	NA
1.6	Dental Fluorosis (%)	5.0	10.2	9.9	7.2	3.7
1.7	Oral mucosal conditions (%)	0.8	1.4	2.3	7.1	10.3
1.8	Oral Cancer (%)	0.2	0.2	0.3	0.3	0.4
1.9	Edentulousness (%)	NA	NA	NA	0.8	29.5
2	**Oral health practices**					
2.1	Sugar intake in last 24 hours					
	Once	22.1	24.0	26.2	26.4	24.1
Two and more times		47.6	43.2	39.3	31.4	25.8 2.2
Clean teeth with						
	Tooth brush	62.5	68.1	68.9	61.0	33.3
Fingers		28.0	22.0	20.8	23.4	33.6 2.3
Rinsing mouth						
	Always	38.0	46.1	51.2	58.8	63.0
Sometimes		35.4	36.8	36.5	31.9	28.3 2.4
Tobacco smoking		NA	NA	NA	22.9	23.9 2.5
Frequency of tobacco smoking						
	Less than 10 times	NA	NA	NA	85.3	76.0
10 or more times		NA	NA	NA	14.1	23.5

NA—not applicable. SiC- significant caries index.

ANSWER 2

National Oral Health Care Program

Oral health is an integral part of general health. In developing countries, there is increase in oral health problems like dental caries, periodontal diseases, malocclusion, dental fluorosis and oral cancer. In India, prevalence of oral disease is very high. Majority, of population in the country lack knowledge about dental diseases and its relation to general health. There is maldistribution of dentists (80% of the dentists are crowded in urban areas where 20% of population resides and 80% of the population resides in rural areas where there are only 20% of dentists available), lack of manpower in primary health centers, lack of equipments in community health centers and district hospitals, no organized data recording system for proper oral health care planning and no specific oral budget. Keeping all these problems in mind, the Ministry of Health and Family Welfare, Govt. of India accepted the principle of National Oral Health Policy in 1995 to be included in National Health Policy.

Director General of Health Sciences and Ministry of Health and Family Welfare in collaboration with All India Institute of Medical Sciences, New Delhi implemented **National Oral Health Care Program** as a pilot program in five states, i.e. Kerala, Maharashtra, Delhi, Punjab and Eastern countries.

Goals of National Oral Health Care Program

1. To bring down the incidence of oral and dental diseases to less than 40% from the existing prevalence.
2. To bring down the DMFT in school children between 6-12 years of age to less than two (presently it is four).
3. To reduce high prevalence of periodontal diseases to lower prevalence.
4. At the age of 18yrs, 85% should retain all the teeth.
5. To achieve 50% reduction in edentulous ness between the ages of 35–44 years.
6. To achieve 25% reduction in edentulous ness at the age of 65 years and above.
7. To achieve 50% reduction in the present level of malocclusion and dento-facial deformities.
8. To reduce the number of new cases of oral cancers and precancerous lesions from the existing level.

Proposed Plan for National Oral Health Care Program

1. Oral health education
2. Preventive programs
3. Curative service programs.

Oral Health Education

- Training of trainers
- Oral health education chapters in school curriculum
- Oral health education through mass media.

Preventive Programs

- Promotion of fluoride toothpaste
- Legislation against tobacco products
- Manufacturing of sugar-free chewing gums
- Sugar substitutes in medicinal syrups.

Curative Service Programs

- Oral health care setup
- School dental health programs
- Fulfilling manpower requirements
- Fulfilling equipment requirements.

This program has proposed the following recommendations:

- Setting up of Directorate of Oral Health Services which should have Director General Dental Services, Additional Director, Joint Director, Deputy director and other supporting and administrative staff at Central Government level and at state level
- Every district should have a District Oral Health Officer, Joint/Deputy Director
- Every state should have one oral health training institute under Directorate of Oral Health Services, to train dental surgeons, doctors, paramedical and dental staff, community health workers
- Every dental college should establish Preventive and Community Dentistry Department with qualified staff.

37 Computers in Dentistry

QUESTION

Write a note on uses of Computers in Dentistry.

ANSWER

Computers have become an indispensable tool in virtually every conceivable field and dentistry is no exception. Dentistry has kept itself abreast of these advances and has made use of its information and technology. The first computer program on a large scale in dentistry was started in 1981 by SCICON and was commissioned by British Dental Association. The purpose of using computers was to store a large amount of data, process and retrieve the accurate and reliable data in no time.

Uses of Computers

Administrative Services

1. Patients appointments and recalls (Computerized scheduling)
2. Missed appointment follow-up.
3. Billing accounting correspondence.
4. Purchase and supply order
5. Dental insurance claims
6. Referral information

Uses in Community Dentistry

1. Database for survey
   a. Survey data analysis
   b. Sorting and tabulation
   c. Graphical representation
   d. Statistical analysis (SAS, SPSS)

2. Presentations.
   a. Teaching/Lectures
   b. Health education
   c. Continuing dental education
   d. Research records
   e. Conferences
3. Review of literature
4. Research
5. Medlars services to retrieve literature data.
3. Clinical applications
   a. Patients records
      i. Storage, retrieval, evaluation, examination, diagnosis, treatment planning and motivation
   b. Diagnostic tool.

CAD/ CAM

1. Computerized Imaging
2. Computerized cephalometrics (e.g. JOE, Rocky Mountain Orthodontics [RMO] digigraph, por dios)
3. Computerized growth prediction.
4. Computerized designing of Prosthesis and Restorations.
5. Computerized endodontic apex locators.
6. Diagnosis and treatment planning of orthognathic and other oral and maxillofacial surgeries.
7. Radio visiography.
8. Forensic odontology

Internet Applications

1. Creating homepage
2. Marketing services
3. Journal clubs
4. Discussion groups.
5. Video conferencing.
6. Use of Pubmed and other sites to obtain data and literature instantaneously.

38 The Oral Physician

QUESTION

Write a note on oral physician

ANSWER

The Oral Physician

The oral physician is a dentist who can diagnose oral manifestation of systemic deseases and disease of oral maxillofacial complex and also provide non surgical management, referral and consultation with medical doctors/ specialist and technical/specialist dentist. The concept of oral physician was proposed at the 7th annual conference of the South East Asian Association of Dental Education, held in 1996 at Jakarta, Indonesia which was accepted without any objection. An oral health care team was proposed by WHO, which consisted of the community dental doctor (Oral Physician), Dental hygienist and the dental therapist and also the social worker and community leader. The oral physician should be well versed with the diagnosis of the medical problems associated with the general health as well as oral health through the expertise with oro-maxillofacial complex and one year intership at the community centre and medical hospital is required. This concept was promoted with the realization that the general health cannot be maintained without the oral health and many systemic diseases manifest in the oral cavity. The dentists is probably the first one to diagnose the systemic disease manifestation. Hence, it was felt that intgration between the medical and dental field was required. The oral health care team through public health dentistry can impart community health services.

39 Dental Clinic Setup

QUESTION

Write a note on establishing a dental clinic.

ANSWER

Several factors are taken into consideration while setting up a private dental clinic.

Selection of Place

The selection of the place is depended on the following factors:

1. Place which can offer good facility for setting the clinic.
2. Select the place depending on the number of dental clinics in that area.

Selection of the Location

Selection of the place will depend on the scope, style of practice and convenience.

1. The heart of the city will have advantage of attracting people from all walks of life.
2. Place which is well connected by the transport facilities for the patients.
3. Place with good surroundings (probably closer to the schools, colleges, offices or in the commercial mall itself).

Selection of the Building

A dental clinic on the ground floor is most preferred.

1. Select the location such that there is proper ventilation, water supply and drainage system.
2. Preferably select a newer building compared to the old one.

3. Acquire sufficient area to plan a proper consulting area, reception area, clinic space, laboratory space, toilet and also if needed keep space for expansion.
4. At times, if planned to open dental clinic at home, then proper alteration and renovation has to be done.

Financial Assistance

There are many nationalized banks, private sector and state financial corporation which render financial help for setting up a clinic.

Designing of Dental Clinic

The dental clinic should be planned such that it has a spacious waiting room with reception, a consulting room, work area, laboratory area/sterilization and toilet. The waiting room should have a television/multimedia which can be used for educating the patients. Informative booklets and brochures should be kept in the waiting room. The walls should be mounted with educative charts. Plan, for "State of art clinic" with all the latest equipments and supplies. In the clinic area all the materials should be well concealed in the cupboard. Proper electrical connection, water system and drainage system should be done.

Equipments

Basic instrument to run the dental office should be present.

Prime importance should be given to the company brand and quality of the instruments.

Make alternate arrangement of the generator in case of the power shut down.

Manpower

1. Dental surgeon/In-house or on-call Specialist Dentist.
2. Receptionist
3. Dental attender
4. Dental surgery assistant/Dental hygienist/Lab technician

Apart from setting up a clinic, the other important things includes clinic administration, manpower, financial and patient management (Practice management).

Private Practice Management

Patient System

1. First appointment
2. Patient flow
3. Preventive program
4. Marketing and practice growth
5. Communication with patients and parents.

Operational System

1. Scheduling
2. Recall system
3. Checking recall effectiveness
4. Broken appointments and purging of patient charts
5. Production and collection
6. Payment policy
7. Dental insurance and other third party plans
8. Insurance assignment
9. Insurance reference guide
10. Predetermination
11. Filing claims
12. Quick claim forms
13. Pending and paid insurance files
14. Direct reimbursement
15. Managed care
16. Dental management companies
17. Fiscal management
18. Billing and accounts
19. Fees
20. Setting a budget
21. Practice-monitors
22. Daily statistics.

Personal System

1. Personal needs
2. Interviewing and hiring
3. Orientation and training
4. Wage and benefit administration
5. Performance and appraisal
6. Personal records
7. Dismissal
8. Communication.

40 Miscellaneous

QUESTIONS

1. Tooth brushing techniques.
2. "Most of the periodontal diseases are preventable". Discuss.
3. "A clean tooth never decays."
4. Psychological development of the child from birth to adolescence.
5. Behavior management.
6. Disclosing agent.
7. Taboo's related to oral health.
8. Misconception in relation to dentistry.
9. Tell show do technique.
10. Tobacco related cancer.
11. Hand over mouth exercise (HOME).
12. Towel over mouth exercise (TOME).
13. Hand over mouth exercise and restriction (HOMAR).
14. Towel over mouth exercise and restriction (TOMAR).
15. Child management in dental clinic.
16. Fear in children.
17. Parent counseling.
18. Oral hygiene habits among Indian people.
19. Prepare a TV talk for improving the oral health of the school children.
20. Health education methods used for the rural population.
21. Plan a health education program for the rural community taking into consideration the barriers in communication and discuss how you will overcome those barriers.
22. Parts of the computer.
23. Difference between Health Education and Propaganda.
24. History of Dentistry.