Indira Gandhi National Open University
SCHOOL OF HEALTH SCIENCE

CHO-0001

Foundations of Community Health

NATIONAL HEALTH MISSION
राष्ट्रीय स्वास्थ्य मिशन
राजस्थान



Introduction to Public Health and Epidemiology

1

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Introduction to Public Health and Epidemiology

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THE PEOPLE'S
UNIVERSITY

Indira Gandhi
National Open University
School of Health Sciences

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Block

1

INTRODUCTION TO PUBLIC HEALTH AND EPIDEMILOGY

UNIT 1
Concepts of Community Health 5

UNIT 2
Health Care Planning and Organisation of Health Care at Various Levels 22

UNIT 3
Environmental Health and Sanitation 43

UNIT 4
Introduction to Epidemiology - Epidemiological Approaches and Processes 70

UNIT 5
Demography Surveillance and Interpretation of Data 93

UNIT 6
Bio-Medical Waste Management and Infection Control 108

Appreciation of Collaborative Efforts

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COURSE INTRODUCTION

Sub Centre is the first level of contact between community and health care system. Therefore, as a Mid level health care provider, you are expected to provide quality primary care to the community at large and play a leadership role in effective delivery of comprehensive Primary health care at sub centre level . You need to understand the community in general, their health and wellness behavior, health problems, environmental health and sanitation etc.so this course on foundation of community health has been designed to improve your knowledge and skills regarding community health, environmental health and sanitation, epidemiology and its approaches, Communicable and non-communicable diseases and their management at sub centre level as per National Health Programmes, surveillance, data interpretation, bio-medical waste management, health management information system, financial management, accounts and computing. This will strengthen your skills in assessing the needs and problems of the people, manage their problems as per protocols of sub centre , make appropriate referrals and provide follow up care so that better health outcomes can be achieved

This course comprises of five blocks as given below. Each block consists of 4-6 units.

Block 1 deals with introduction to Public Health and Epidemiology;

Block 2 focuses on Nutrition;

Block 3 explains Communicable diseases and Management under National Health Programmes;

Block 4 deals withNon-Communicablediseasesand Management under National Health Programmes

Block 5 relates to Communication; Management and Supervision.

We hope you will enjoy reading this course.

BLOCK INTRODUCTION

As a mid level health care provider you are expected to play a key role in strengthening the health care delivery at grass roots level, ensuring quality health care services to community with specific reference to the most deprived and vulnerable sections of society. This block will help you to improve and update your knowledge and skills regarding various aspects of community health , health care delivery system, measures for improving environmental health and sanitation, epidemiological aspects of the diseases, their causes, pattern of occurrence and effects on the health and well being of the population , surveillance, data interpretation, bio-medical waste management and infection control This will enable you to provide effective need based care to community at grass roots level.

This block comprises of 6 units as given below

Unit 1 deals with the concepts of community health

Unit 2 explains about planning and organization of health care services

Unit 3 describes environmental health and sanitation

Unit 4 explains epidemiology, epidemiological approaches and processes

Unit 5 deals with the surveillance and interpretation of data

Unit 6 focuses on bio-medical waste management and infection control.

We hope the information provided in this block may help you to deal with the health problems more efficiently and effectively with an inclusive and evidence based approach at health and wellness centre.

UNIT 1 CONCEPTS OF COMMUNITY HEALTH

Structure

1.0 Introduction

1.1 Objectives

1.2 Public Health in India and its Evolution

1.3 Concepts of Health and Illness

1.4 Dimenshions of Health

1.4.1 Determinants of Health

1.5 Concept of Causation of Disease

1.6 Natural History of Disease

1.7 Levels of Prevention

1.7.1 Primary Prevention

1.7.2 Secondary Prevention

1.7.3 Tertiary Prevention

1.8 Roles and Responsibilities of Mid Level Healthcare Providers (MLHP)

1.9 Let Us Sum up

1.10 Model Answers

1.11 References

1.0 INTRODUCTION

Health is a dynamic concept, which every human being desires to achieve. While health refers to positive end of spectrum; illness, sickness and disease symbolise the negative side of the spectrum. In order to protect, promote, and restore the health of individuals and populations, an integrated discipline of public health or community health came into existence. Public health has evolved in India since independence and we have achieved success in terms of improvement of various morbidity and mortality indicators. However, a lot needs to be achieved and mid level health care providers (MLHP) can play an important role in this regard. In this unit we shall in discuss about basic concepts of health and disease with brief we shall description about role of MLHP.

1.1 OBJECTIVES

After completing this unit, you should be able to:

- define health and differentiate between illness, sickness and disease;
- describe various dimensions of health and enumerate determinants of health;
- draw epidemiological triad with the help of example;
- describe the natural history of disease; and
- enumerate and apply the levels of disease prevention in control of diseases.

1.2 PUBLIC HEALTH IN INDIA AND ITS EVOLUTION

'Public Health' is defined as organised community efforts aimed at prevention of disease and promotion of health. In other words, it is the science and art of preventing disease, prolonging life and promoting health and efficiency through organised community efforts. The organised community efforts that promote health and prolong life are:

- control of communicable infection,
- improved environment– access to safe water and sanitation,
- personal hygiene improvement through education,
- organisation of medical and nursing services for the early diagnosis and preventive treatment of disease,
- development of the social machinery to ensure everyone a standard of living adequate for the maintenance of health.

Public health incorporates the inter-disciplinary approaches of epidemiology, biostatistics and health services. Environmental health, community health, behavioural health and occupational health are other important subfields.

Public health in India dates back to ancient times. Excavations in the Indus valley (Harappa culture) show evidence of planned cities, with drainage and practices of environmental sanitation. Ayurveda and Siddha systems of medicine came into existence in 1400 B.C. Medical education was introduced in the ancient universities of Taxila and Nalanda during the post-vedic period. The Greek system of medicine known as Unani was introduced by Muslims when they entered India around 1000 A.D. Another phase in evolution of public health came when British empire conquered India by middle of 18th century. Many legislative measures for disease control and prevention were taken during this time. Quarantine act (1825), the Births and Deaths Registration Act (1873), Vaccination act (1880), Factories act (1881), Local self-government act (1885), Epidemic disease act (1897), and the Madras Public Health Act (1939) were promulgated and passed.

Just before independence, Bhore committee was constituted in 1943 to survey the existing health conditions and organisations. The committee recommended integration of preventive and curative services at all levels and also emphasised the social orientation of medical practice. The report formed the basis of health planning in India. The constitution of India came into force in 1950 and first five-year plan began with allocated budget for launch of national health programme. The community development programme was launched in 1952 with the aim of overall development of rural areas. The National Malaria Control programme was started in first five-year plan. Important public health institutes like Central Health Education Bureau (CHEB) in Delhi and the Central Leprosy Teaching and Training Institute in Chennai were also started during this time.

India has evolved a lot since the time of independence. Over the past six and half decades public health infrastructure and services have expanded, particularly after the inception of National Rural Health Mission (NRHM) in 2005. The progress has been further accelerated with combining of rural and urban components as National Health Mission in 2013 and launch of RMNCH+A strategy (Reproductive Maternal Neonatal Child Health plus Adolescence) that stress on provision of continuum of care through every phase of life.

1.3 CONCEPTS OF HEALTH AND ILLNESS

Health means differently to different people. While some feel health is freedom from any disease, others consider it harmonious working of all organs of the body.

World Health Organization (WHO) defines health as **"state of complete physical, mental and social well-being and not merely an absence of disease or infirmity".**

What constitutes the disease, requires careful distinction from related but distinct concepts like illness, sickness and disease:

'Illness' refers to the subjective sense of feeling unwell; it does not define a specific pathology, but refers to a person's subjective experience of it, such as discomfort, tiredness, or general malaise.

'Sickness' refers to socially and culturally held conceptions of health conditions (e.g., the dread of cancer or the stigma of mental illness), which in turn influence how the patient reacts.

'Disease' refers to physiological or psychological dysfunction. In other words, disease implies a focus on pathological processes that may or may not produce symptoms and that result in a patient's illness. For example, a patient complains of easy fatigueability–his illness as he experiences it. He consults a doctor about it because he believes that he might have a sickness. The doctor might attribute the patient's symptoms to Anaemia–which is a physiological dysfunction.

Health is not a static state. It keeps on fluctuating across the spectrum. It ranges from complete well-being to uneasiness, disease, disability and death. Four levels in broadened spectrum of health and illness have been defined as shown in Fig. 1.1(A). They are as follows:

1) Mortality–prevention of health,
2) Serious morbidity– the prevention and control of conditions that produce disability or chronic illness,
3) Minor morbidity– the handling of lesser illnesses (in terms of death and disability), environmental conditions that create inconveniences and nuisances, and
4) Positive health– the attainment of a full sense of personal vigour and mental well-being, as well as constructive relationships with others in an environment that promotes longevity and happiness.

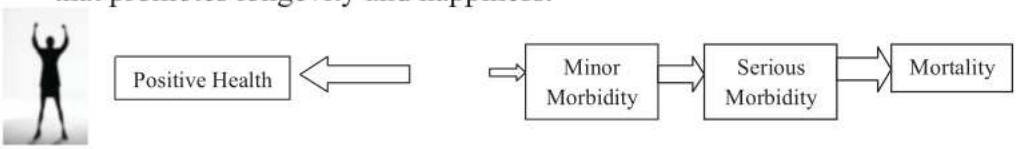


Fig. 1.1(A): Spectrum of health

Spectrum of health can also be expressed from positive health till death as shown in Fig. 1.1(B).



Fig. 1.1(B): Spectrum of health

1.4 DIMENSIONS OF HEALTH

Health encompasses a broader concept than the three components described in WHO definition of health. Pursuit of optimal health includes physical, emotional, intellectual, spiritual, occupational, financial, social, and environmental dimensions. as shown in Fig. 1.2.



Fig. 1.2: Dimensions of health

Let us now go through each dimension of health briefly:

Physical health refers to the state of the body its compositions, development, functions, and maintenance. It is exhibited by individual's optimum physical abilities of all his body parts being intact and working in coordination. It can be attained by eating well, exercising, avoiding harmful habits (such as smoking), getting enough sleep, recognising the signs of disease, getting regular physical exams, and taking steps to prevent injury.

Emotional health is a complex dimension of health. Our ability to accept and cope with our own and others feelings is defined as emotional well-being. Emotions contribute to almost all aspects of our life, at times, even setting course of actions. An emotionally healthy person has (1) a well adjusting mind-set, (2) does not get agitated easily, (3) has freedom from internal conflicts, (4) looks for his personal identity, (5) has a strong self esteem, (6) knows his limitations and capabilities, (7) is not carried away by unnecessary emotions, and (8) is able to cope up well with the situations of stress and anxiety.

Intellectual health encompasses cognitive ability to develop skills and knowledge to enhance one's life. Intellectual health encourages creative, stimulating mental activities. It helps to stimulate our creativity and improve our decision-making ability.

Spiritual health is not included in the definition of health. But it is practiced by most of the people throughout the world for self-realisation and peace of mind. Spiritual health refers to our personal beliefs and values. It is attained by seeking one's values, rights, and responsibilities, ethics, and code of living (may or may not be part of formal religion) and it is the capacity to love, have compassion for others, forgiveness, joy, and fulfilment.

Occupational health recognises personal satisfaction and enrichment in one's life through work. The choice of profession, job satisfaction, career ambitions, and personal performance are all important components of occupational wellness.

Financial health focuses on one's attitude toward money and a commitment to setting goals for future needs, developing good money habits and effectively using tools to manage financial resources. In order to be financially healthy, one does not need to be wealthy; however, one must sensibly manage money. While financial well-being is not often considered when discussing health, it can be a significant source of stress which can have major effects on the other dimensions.

Social Health encourages contributing to one's environment and community. It emphasises the interdependence between others and nature. It deals with having a supportive social network, contributing to society, and valuing cultural diversity. It can also be defined as the "quantity and quality of an individual's interpersonal ties and extent of his involvement with the community". How well a person mixes and interacts with others in family, society, community and world and considers him as a part of these, is witnessed as social dimension of his health.

Environmental Health is learning and contributing to the health of the planet and a sustainable lifestyle. The key to human health largely lies in his external environment. Much of human being's ill health can be traced to adverse environmental factors such as water pollution, soil pollution, air pollution, poor housing conditions, presence of animal reservoirs and insect vectors of diseases. Thus, it is pertinent to control all the factors that exert deleterious effect on the health.

Check Your Progress 1

1. Define Health according to WHO.

   .....

   .....

2. Draw the Health Septrum.

   .....

   .....

3. Enumerate any 3 dimensions of health.

   .....

   .....

1.4.1 Determinants of Health

Health of an individual is a complex subject influenced by a variety of factors which may lead to either a healthy outcome to promote health or an unhealthy outcome to have deleterious effects on health. Since these factors are largely responsible to determine health of a person, they are termed the determinants of health. The main determinants of health are:

1) **Age:** There is close relationship of diseased status with age. While some diseases are common in younger age group, chronic diseases such as hypertension, diabetes, osteoarthritis are predominant in older age groups. Age is also an important factor in determining the prognosis of diseases.

2) **Gender:** Women are considered to be biologically stronger than men. Consequently, the life expectancy of women is relatively more than men. Further, some diseases differ according the gender. While oral cancers are more common among men, breast cancer and cervical cancer affect large number of women. Similarly, inguinal hernias have gender predisposition towards males. Due to the gender differences in pattern of a distribution of a particular disease, you as a Midlevel Health Provider (MLHP) should keep in mind while dealing with gender.

3) **Genetics:** The traits transferred from parents during conception as genetic configuration are permanent and remain unaltered till end of the life. His physique, intelligence, temperament and response to diseases agents usually resembles in many respects to either of his parents or grandparents. Many diseases in humans like chromosomal anomalies, errors of metabolism, mental retardation, diabetes etc. are known to be of genetic origin.

4) **Race, ethnicity:** Members of non-white racial and ethnic groups tend to experience more ill health and disease than their white counterparts.

5) **Literacy status:** Literacy and education status of the people also have an indirect impact on health as these are interrelated with occupation, economic and hygiene standards. People with good educational background have an understanding to practice better ways and means of living improving their health standard.

6) **Nutrition:** Diet has been scientifically and extensively linked to disease. The relation between high fat diet and coronary heart disease is well established. Similarly, under-nutrition predisposes the person to multitude of infections. Thus, the health of a community depends both on the adequate availability of safe food and the intelligent consumption of it.

7) **Environment:** A person is fully dependent on external environment for his body needs in day to day life, but its adverse conditions are responsible for a very large number of health related problems and diseases. All the diseases caused by physical and biological agents are the result of adverse conditions of the external environment. Internal environment of a person is comprised of his own anatomical body parts and physiological activities which comes under internal medicine.

8) **Socio-economic status:** Economic status of the country, community and of an average individual has an impact on the purchasing power and thus affects the living standard of a person. Daily needs of nutrition, education, housing, clothing and standard of life are all dependent on per capita income. Further, access to health services, are also largely dependent upon the income. Certain diseases such as lifestyle disorders have been found to be associated among the group belonging to higher socio-economic status while infectious diseases such as tuberculosis, leprosy are considered to be diseases of poor.

9) **Socio-cultural conditions:** Culture is a learned behaviour which has been socially acquired. A person learns and develops the qualities to interact with others in the society in his early developmental stage. On interaction with a person, one can easily think of the culture and a society which he belongs to. These are all behavioural traits displayed by him during interaction. Development of such qualities is mostly by learning from prevailing behavioural and socio-cultural conditions in the society. The health behaviour of person is also influenced by his socio-cultural environment.

10) **Health care system/services:** Care of people provided through effective system of medical and health care services creates a positive influence on health of the people. Infant mortality rate, maternal mortality rate and expectation of life at birth are affected by the kind of health services available in the state or country.

11) **Other factors:** The development of newer technologies of information and communication offer tremendous opportunities in providing an easy and instant access to medical information. Other determinants include adoption of policies in the economic and social fields that would assist in raising the standards of living and hence indirectly affecting the health.

Check Your Progress 2

i) List 5 determinants of health.

.....

.....

ii) What do you understand by socio-economic determinants of health?

.....

.....

iii) How literacy status affects health?

.....

.....

1.5 CONCEPT OF CAUSATION OF DISEASE

Let us now read concept of causation of disease.

Since disease has always been a constant accompaniment of human, right from the pre-historic times onwards, he has been trying to find out the causes of disease. The various theories prevalent in different civilisations were:

- **Supernatural causes** like being possessed by evil spirits, wrath of gods, punishment for evil deeds during previous births etc. cause diseases.
- **Contagion theory:** Diseases are spread through "bad air" or to various forms of close contacts with diseased person.
- **Germ theory:** In 19th century, bacteria was discovered as a cause of human disease by Robert Koch and Louis Pasteur. It was believed that every human disease to a specific microbe or "germ", to the extent that the germ theory of the human disease emphasised that each and every human disease has to be caused by a microbe or germ, which is specific for that disease and one must be able to isolate the microbe from the diseased human being. This was the central philosophy of the famous Koch's postulates, formulated by Robert Koch (now also known as Henle-Koch postulates).

However, with turn of the century, it was being realised that germ theory could not fully explain the causation of disease. It was being considered that there were other factors that played the role in accentuation or attenuating the effect of "germ" or "agent" in causation of disease. This formed the basis for **Epidemiological Triad theory**.

Epidemiological Triad Theory

Complex interactions among people, their characteristics and the environment influence health. It, thus, involves a state of interaction between self and environment. This theory, known as **Epidemiological triad theory** hypothesizes that there are 3 important determinants of state of health or disease in human being namely: agent factors-related to various characteristics of the "agents" which cause the disease; **host** factors which relate to various characteristics of human being like age, gender, ethnicity etc.; **environmental** factors which describe the various characteristics of the environment in which human being is living. As per the theory, as long as a state of fine balance or equilibrium is maintained between the various agent, host and environmental factors, the person stays in a state of health. On the other hand, the moment this fine balance is disturbed due to change in any one or more of the agent, host and environment related factors, a departure from the state of health occurs as shown in Fig. 1.3 (A.B.C).

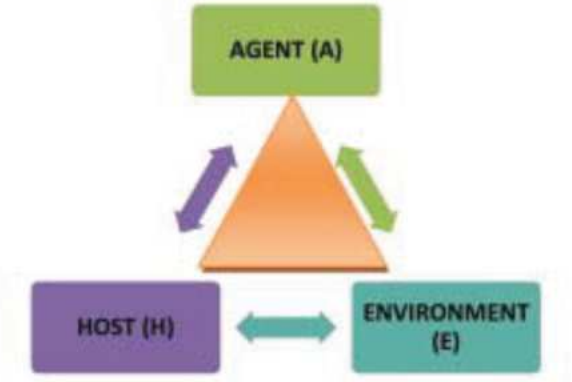


Fig. 1.3(A): Epidemiological Triad

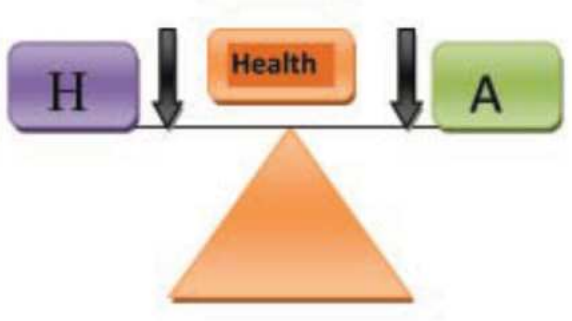


Fig. 1.3(B): Balance

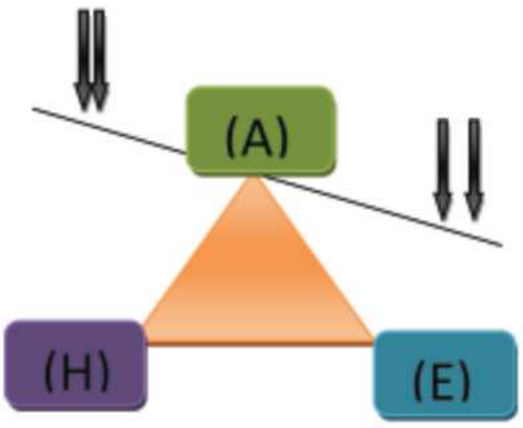


Fig. 1.3(C): Disturbed balance

Fig. 1.3: (A) (B) (C) Epidemiological Triad

Difficulties come up when an attempt is made to explain the causation of non communicable diseases like Ischemic Heart Disease (IHD) or road accidents on the basis of epidemiological triad. For example, no single agent can be ascribed for road accidents, there is complex interaction of numerous causative factors such as lack of driving experience, intake of alcohol while driving, not wearing of seat belts, poor implementation of legislation. Therefore, for explaining the causation of non-communicable diseases in particular, theory of web of causation was postulated. Various factors related the disease, are like an interacting web of spider. Each factor has its own relative importance in causing the final departure from the state of health, as well as interacts with others, modifying the effect of each other.

1.6 NATURAL HISTORY OF DISEASE

Complete course of a disease from the time a human host is exposed to the disease agent in an environment to its final outcome is termed the natural history of disease. Let us take an example of a common disease like hepatitis A. After the infecting organism enters our body by way of food or drinks, there is an incubation period of about 28 days, after which we have clinical manifestations in the form of fever, malaise, anorexia, nausea and abdominal discomfort, followed by dark urine and jaundice. Most of the individuals recover by the third week, though variable feeling of weakness may persist for a longer time. However, some patients may develop complications in the third week in the form of relapsing hepatitis, cholestatic hepatitis and fulminant hepatitis.

It is known that hepatitis A is caused by a virus belonging to picornavirus family. Some may not be infected due to their immune status (previous exposure to infection or already received immunisation against hepatitis A). Therefore, another factor to be considered in development of human diseases is, besides the organism (agent), the human being himself too. Now, there is yet another factor which needs to be considered also. There should be water or food which should be contaminated with the faeces of a patient of hepatitis A. Hence, the third thing, besides the microbial organism and the human being, which determines the disease, is the "environment". Despite the presence of these three factors, some may get the disease or may not get the disease. We would therefore agree that the mere presence of agent, host and environment is not enough to cause the disease. As long as the agent, host and environment are in a state of equilibrium disease will not be initiated; the process of human disease would be initiated only if there is an appropriate interaction and a loss in equilibrium, between the agent, host and environment. For example, if we become malnourished due to an attack of severe measles or take on to heavy alcoholism, or become poor and hence forced to consume contaminated food or water, or are exposed to a very heavy dose of infection (for example, drinking raw water in a flood like situation), we would become "susceptible" to developing hepatitis. As shown in the Fig. 1.4, natural history of disease has two phases: pre-pathogenesis (i.e., the process in the environment) and pathogenesis (i.e., the process in man). The pre-pathogenesis period refers to period before the onset of disease in man. The causative agent of disease, has not yet entered man, but the factors (i.e. environmental factors) that are favourable for its interaction with the human host are already existent in the environment. However it must be remembered that mere presence of agent, host and environmental factors in this phase is not sufficient to start the disease. What is required is an INTERACTION between these factors. (Fig 1.5).

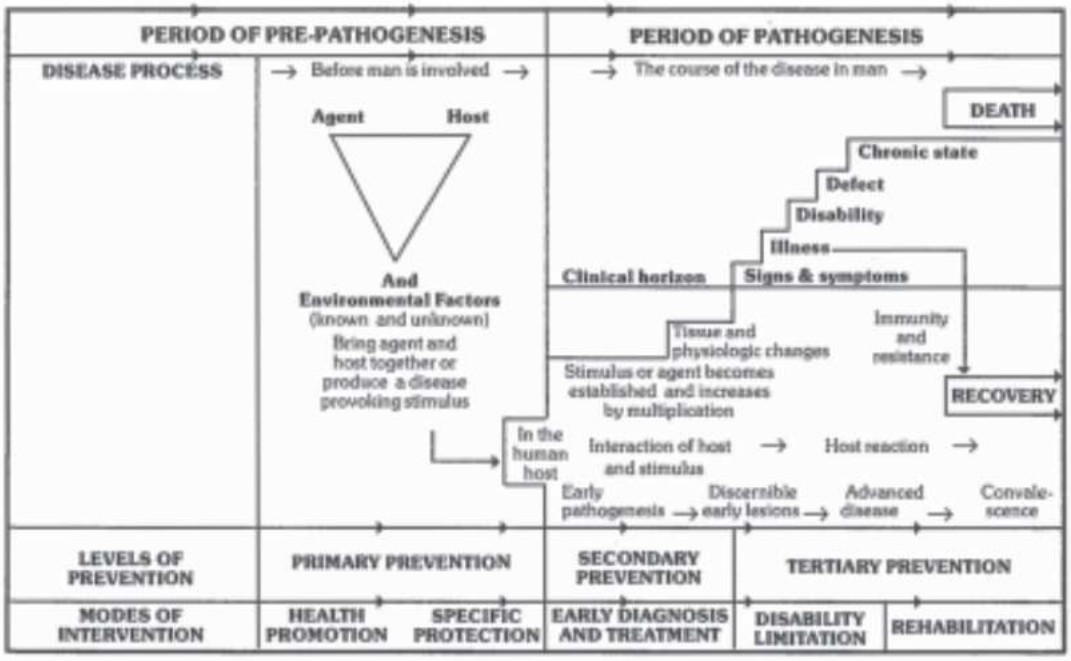


Fig. 1.4: Natural history of disease and level of prevention

Pathogenesis phase: This phase begins with the entry of the disease "agent" in the susceptible human host. In case of infectious diseases, the disease agent multiplies and induces physiological changes. The disease progresses through period of incubation to early and late pathogenesis. The final outcome may vary between recovery, diability or death depending upon the interventions undertaken. In chronic diseases, the early pathogenesis phase is referred to as pre-symptomatic phase as there is no manifestation of disease. The clinical stage begins when recognisable signs or symptoms appear and by this time, the disease is already advanced to late pathogenesis phase.

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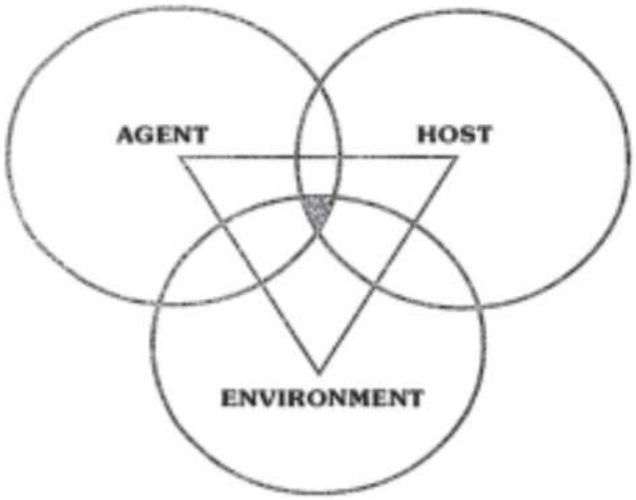


Fig. 1.5: Interaction of Agent, Host and Environment

1.7 LEVELS OF PREVENTION

Prevention and control of diseases is an important concept in preventive medicine. Knowledge about natural history of a disease helps in applying the preventive principles in its prevention and control. It further helps in reducing the burden and morbidity or mortality arising out of the disease occurrence. In general, there are three major levels of prevention, depending on the phase of the natural history

of the disease. Before these three levels of prevention, primodial prevention is applied when action is taken to remove even risk factors to develop for example school children are educated not to smoke as smoking is risk factor for many disease.

1.7.1 Primary Prevention

All measures of prevention that are undertake before the onset of the disease, so that the disease never occurs. Primary prevention involves:

- **Health promotion:** All steps undertaken to improve the level of general health and well-being so that conditions for initiation of disease process are prevented is defined as health promotion. e.g. Cessation of smoking, personal hygiene, attempts to remove hazards, such as insect-breeding sites or polluted waters, by environmental control would also promote health.
- **Specific protection:** These include measures to prevent the initiation of specific diseases or a group of diseases. e.g. Vaccination, food fortification (e.g. iodine fortification of salt).

1.7.2 Secondary Prevention

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

The specific interventions are: early diagnosis (e.g. screening tests, and case finding) and adequate treatment.

1.7.3 Tertiary Prevention

It is defined as "all the measures available to reduce or limit impairments and disabilities, and to promote the patients' adjustment to irremediable conditions."

- Disability limitation:The prevention of complications of a disease before irreversible changes set in would limit disability. For example, careful attention to skin care daily, particularly of the feet of a diabetic patient, would prevent the development of ulcers and subsequent gangrene of the feet. Careful avoidance of injury from cuts, burns, and scalds to the part of the body with sensory loss, particularly the hands and feet, of leprosy patients could also avoid the loss of fingers and toes consequent to injury. Disease turns into a handicap as follows:
  - **Disease:** This is a pathological process and it's manifestations which indicate a departure from the state of perfect health.
  - **Impairment:** This is the actual loss or damage of a part of body anatomy or an aberration of the physiological functions that occurs consequent to a disease.
  - **Disability:** This is defined as the inability to carry out certain functions or activities which are otherwise expected for that age / sex, as a result of the impairment.
  - **Handicap:** This is the final disadvantage in life which occurs consequent to an impairment or disability, which limits the fulfilment of the role a person is required to play in life.
- Rehabilitation: When a defect or disability has already occurred, tertiary prevention can be instituted to restore as much functions as is possible. For

example, residual paralysis from poliomyelitis can be overcome by the use of callipers or other devices. Individuals with mild refractive errors can have these corrected with lenses, while the partially deaf can be rehabilitated with hearing aids. Rehabilitation is undertaken at four dimensions:

- Medical rehabilitation: This is done through medical / surgical procedures to restore the anatomy, anatomical functions and physiological functions to as near normal as possible.
- Vocational rehabilitation: This includes steps involving training and education so as to enable the person to earn a livelihood.
- Social rehabilitation: This involves steps for restoration of the family and social relationships.
- Emotional and Psychological rehabilitation: This involves steps to restore the confidence and personal dignity.

1) Explains state of health.

2) Explains state a accusnse of diaseas

3) Incubations period of Hapatitis A. list

4) Clinical manifestations of Hapatitis A.

Check Your Progress 3

1) Explain state of Health.

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2) Explain State of accusnse of Disease

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3) Incubations of Hapatitis A is .....

4) List Clinical manifestations of Hapatitis A.

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1.8 ROLES AND RESPONSIBILITIES OF MID LEVEL HEALTHCARE PROVIDERS (MLHP)

A mid level healthcare provider is defined as a health provider

a) Who is trained, authorised and regulated to work autonomously

b) Who receives pre-service training at higher education institution for atleast a total of 2–3 years and

c) Whose scope of practice includes (but is not restricted to) being able to diagnose, manage and treat illness, disease and impairments (including

perform surgery, where appropriately trained), as well as engage in preventive and promotive care.

Trained and competent human resources (CHR) are essential for an effective health care delivery system. There is a pressing need to strengthen health sub centres to provide Comprehensive Primary Care including for NCDs. Global evidence suggests that suitably trained (3–4 years duration) service providers can provide considerable primary care. As one of the measures to increase the availability of such appropriately qualified HR, especially in rural and remote areas, on 13th November 2013, the Cabinet approved the introduction of a 3&1/2 year Bachelor of Science in Community Health (BSc CH) Course in India. However, the uptake for this course has been slow and if some Universities were to start the course, the first batch of professionals will be available for recruitment only by the end of the fourth year. On the other hand, qualified Ayurveda doctors and B.Sc./GNM qualified nurses are available in the system, who could be trained in public health & primary care through suitably designed 'Bridge Programmes in Community Health'. Such qualified human resource may function as Mid Level Health Care Providers and called 'Community Health Officers (CHOs)' and posted at health Sub Centres; which could be developed as 'Health & Wellness Centres'.

The BSc (CH) Curriculum is the benchmark for developing this bridge course and these MLHPs will be primarily deployed at Health & Wellness Centres (or Sub Centres). You would possess the necessary knowledge and competencies to deliver comprehensive primary care services and implement public health programmes.

Job Responsibilities: The trained MLHPs would broadly be expected to carry out public health functions, ambulatory care, management and leadership at the Health & Wellness Centres (H&WCs). You would be expected to:

a) Implement National Programmes

b) Administration and management at Health and Wellness Centres (or Sub-centres)

c) Health education and encourage awareness about Family Planning, Maternal and Child Health, and Non-Communicable Diseases

d) Preventive, promotive and curative care

e) Identification of Danger Signs and Referral after pre-referral stabilisation

f) Implement Biomedical waste disposal guidelines and Infection Control policies

g) Supervision of health workers for Maternal and Child Health, Family Planning and Nutrition related services.

In other words, MLHP are those health cadres often, but not always, linked to traditional health professions, who have received less training and have a more restricted scope of practice than professionals. In India, MLHP have been regarded as "auxillaries" and have been bestowed with following worker's responsibilities:

1) Health Worker (Female):

   a) Maternal and child health: Register and provide care to pregnant women, ensure that each women comes for at least 4 antenatal visits, get basic

laboratory investigations done for her, refer women with 'high risk' pregnancy, make atleast 2 postnatal visits, assess the growth and development of infant and provide immunisation.

b) Family planning: Maintaining eligible couple register, motivate couples for family planning services, distribute conventional and oral contraceptives to the couples, motivate couples who have completed family for permanent methods of sterilisation, organise health education for the same.

c) Medical termination of pregnancy: Identify women requiring medical termination of pregnancy and refer them to approved institutions, educate women about harmful effects of septic abortion and acquaint them about safe abortion services in the community.

d) Nutrition: Identify cases of malnutrition and refer them to primary care facility, distribute iron folic acid to women and children, work in collaboration with anganwadi workers, provide vitamin A supplementation to all children below 6 years.

e) Immunisation: Immunise pregnant women with tetanus toxoid and children below 5 years with all vaccines under universal immunisation programme.

f) Implementation of communicable disease control programme in her area

g) Recording of vital events

h) Treatment of minor ailments: Treat minor ailments and provide first aid in case of emergencies and disasters.

i) Maintaining all records of her health facility pertaining to MCH services, immunisation and family planning.

j) Coordination with other team members like ASHA (Accredited Social Health Activist) and anganwadi workers, medical officer, etc.

2) Health Worker (Male):

a) Record keeping

b) National health programmes:

i) National vector borne disease control programme: Active surveillance, collect blood smears, assist in spraying operations, assist in administration of radical treatment, provide health education.

ii) National leprosy elimination programme: Identify cases and refer to health facility with doctor, maintain records of patients and ensure they are taking treatment, health education.

iii) Revised national tuberculosis control programme: : Identify cases and refer to health facility with doctor, maintain records of patients and ensure they are taking treatment, health education.

iv) Assisting health worker female (HW-F) in MCH, immunisation and family planning services.

v) Ensure environmental sanitation.

vi) Rest of the functions same as HW (F).

1.9 LET US SUM UP

In this unit we have discussed various aspects of health.

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

Health is not static. It ranges from complete well-being to uneasiness, disease, disability and death.

Pursuit of optimal health includes physical, emotional, intellectual, spiritual, occupational, financial, social, and environmental dimensions.

Health of an individual is a complex subject influenced by a variety of factors known as determinants of health.

Disease is the state where a body is not at ease, means it is not comfortable. Illness refers to the subjective sense of feeling unwell. Sickness refers to socially and culturally held conceptions of health conditions

Complex interactions among people, their characteristics and the environment influence health.

Complete course of a disease from the time a human host is exposed to the disease agent in an environment to its final outcome is termed the natural history of disease. Concept of interactions between agent, bost and environment is also death.

We also planned three major levels of prevention, depending on the phase of the natural history of the disease.

1.10 MODEL ANSWERS

Check Your Progress 1

1) World Health Organization (WHO) defines health as **"state of complete physical, mental and social well-being and not merely an absence of disease or infirmity".**

2) Refer Fig. 1.1 A, B

3) Three dimension of health are physical, emotional and intellectual.

Check Your Progress 2

i) Genetics, socio-cultural, environment, gender, nutrition

ii) World Health Organization (WHO) describes social determinants of health as the "the conditions in which people are born, grow, live, work and age".

iii) Literacy and education status of the people also have an indirect impact on health as these are interrelated with occupation, economic and hygiene standards. People with good educational background have an under standing to practice better ways and means of living improving their health standard.

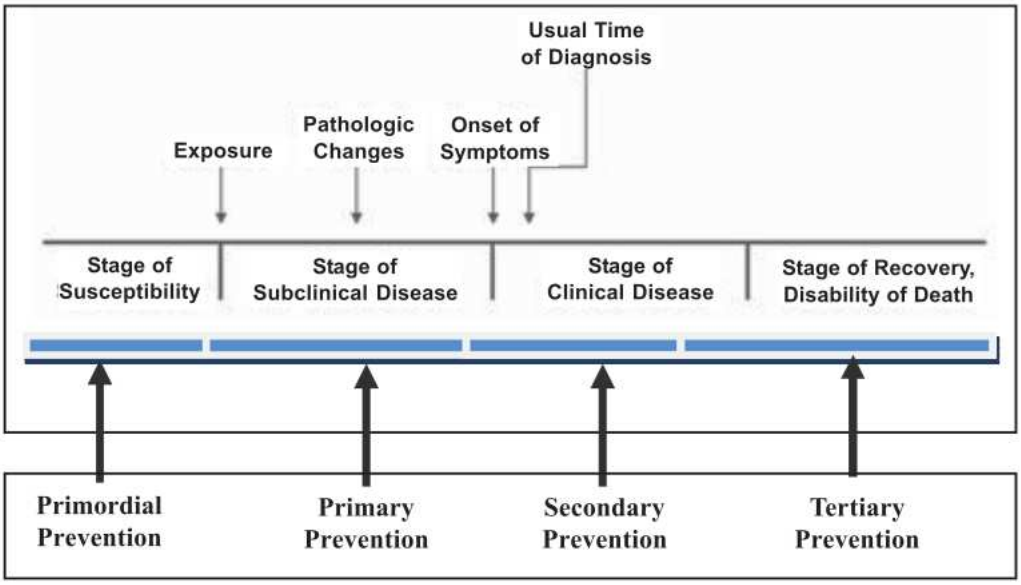
Check Your Progress 3

1) As long as Agent, host and environment are in a state of balance with each other the person stays in a state of health.

2) When agent, host and environment are not in fine balance or balance is disturbed due to change in any one or more of the agent, host and environment related factors disease occus.

3) Incubation period of Hapatits A is 28 days.

4) Fever, Malaise, anovexia, nausea, abdominal discomfort.



1.11 REFERENCES

1) C. E. A. Winslow, "The Untilled Fields of Public Health," Science, N.S. 51 (1920), p. 23.

2) Kishore J. The Dictionary of Public Health 3rd ed. Century Publications: New Delhi; 2014.

3) Park K. Park's Textbook of Preventive and Social Medicine. 23rd ed. Jabalpur; Bhanot Publishers; 2015.

4) Chapter 1. Public health system in India: An introduction and evolution [Internet] 2007 [Accessed on 2016, Sept 5]. Available from: http://shodhganga.inflibnet.ac.in/bitstream/10603/8917/7/07_chapter%201.pdf

5) Roy BN, Saha I. Mahajan & Gupta Textbook of Preventive and Social Medicine. 4th ed. New Delhi: Jaypee Brothers Medical Publishers; 2013.

6) WHO. The First Ten Years of the World Health Organization. Geneva: WHO, 1968.

7) AFMC Primer on Population Health. Part 1-Theory: Thinking about health. Chapter 1: Concepts of health and disease [Internet] 2014 [Accessed on 2016, Sept 5]. Available from: http://phprimer.afmc.ca/Part1-TheoryThinkingAboutHealth/Chapter1ConceptsOfHealthAndIllness/IllnessSickness and Disease.

8) AJPHNH. A Broadened Spectrum of Health and Illness. Am J Public Health Nations Health. 1961;51(5):762.

9) WHO. Ottawa Charter for Health Promotion: First International Conference on Health Promotion. Geneva: WHO;1986.

10) Dimensions of Health. [Internet] 2009 [Accessed on 2014, Mar 30]. Available from: http://www.buzzle.com/articles/5dimensions-of-health.html

11) Wellness WCSD. 8 Dimensions of Wellness. [Internet] 2012 [Accessed on 2014, Mar 30]. Available from: http://washoecountyschools.org/docs/wellness/March_2012_ Newsletter.pdf

12) Hettler B. Six Dimensions of Wellness Model. [Internet] 1976 [Accessed on 2014, Mar 30]. Available from: http://c.ymcdn.com/sites/www.nationalwellness.org/resource/resmgr/docs/sixdimensionsfactsheet.pdf

13) Five Dimensions of Health: Financial. [Internet] 2014 [Accessed on 2014, Mar 30]. Available from: http://www.gbophb.org/center-for-health/resources/five-dimensions-of-health-financial/

14) Wallace RB. Public Health and Preventive Medicine. 15th ed. USA: McGraw Hills Companies; 2008. p95

15) Detels R, McEven J, Beaglehole R, and Tanaka H. Oxford Textbook of Public Health. 4th ed. London; Oxford University Press: 2002.

16) Centers for Disease Control and Prevention (US). Addressing social determinants of health: accelerating the prevention and control of HIV/AIDS, viral hepatitis, STD and TB. External consultation meeting report. Atlanta: CDC; 2009.

17) AFMC, WHO. Text Book of Public Health and Community Medicine. 1st ed. Pune:AFMC;2009.

18) Besson GD. The Health-Illness Spectrum. Amer J Pub Health 1967;57(11):1901-05.

19) Kishore J. A text book for Health worker and Nurse midwife 2nd ed. New Delhi: Century Publications 2016.

20) Brown A, Cometto G, Cumbi A, Pinho H, Kamwendo F, Lehmann U, et al. Mid level health providers: a promising resource. Rev Peru Med Exp Salud Publica 2011; 28(2):308-15.

21) WHO. Mid-level health workers: The state of the evidence on programmes, activities, costs and impact on health outcomes A literature review. Geneva: WHO; 2008.

UNIT 2 HEALTH CARE PLANNING AND ORGANISATION OF HEALTH CARE AT VARIOUS LEVELS

Structure

2.0 Introduction

2.1 Objectives

2.2 Health Planning

2.3 Health Care Delivery System in India

- 2.3.1 Delivery of Health Services at Sub-Centre (SC)
- 2.3.2 Delivery of Health Services at Primary Health Centre (PHC)
- 2.3.3 Delivery of Health Services at Community Health Centre (CHC)
- 2.3.4 Delivery of Health Services at District Level
- 2.3.5 State Level
- 2.3.6 National Level

2.4 Let Us Sum Up

2.5 Model Answers

2.6 References

2.0 INTRODUCTION

In the previous unit, you have learnt concept of community health. While working in the community, it is important to carry out health planning at various levels of health care system.

Health care delivery system is defined as the organisation of people, institutions, and resources to deliver health care services to meet the health needs of target populations. Its primary intent is to promote, restore or maintain health. This includes efforts to influence determinants of health as well as more direct health-improving activities. India's health standards are still low compared to developed countries. And the greatest challenge that exists today is to reach to the whole population with adequate health services and to ensure their utilisation.

This unit deals with health planning. Health planning is necessary for the economic utilisation of material, man power and financial resources. The purpose of health planning is to improve the health services. National health planning has been defined as "the orderly process of defining community health problems, identifying unmet needs and surveying the resources to meet them, establishing priority goals that are realistic and feasible and projecting administrative action to accomplish the purpose of the proposed programme".

2.1 OBJECTIVES

After going through this unit, you should be able to:

- explain the steps of planning;

- state the delivery of health services at Sub-centre, PHC and CHC level;
- enumerate the functions of SC, PHC and CHC;
- describe the manpower of SC, PHC and CHC;
- discuss the organogram at national level; and
- describe the organisation at district level.

2.2 HEALTH PLANNING

Let us discuss the steps of health planning as given below:

1) Identify unmet needs
2) Assess resources required
   a) Manpower – number, skill, knowledge
   b) Money
   c) Material (including technology)
   d) Time
   e) Match resources with objectives
   f) Resources would be wasted if planning is inappropriate
3. Set goals – priorities, realistic, feasible
   a) List order of importance – Could depend on:
      i) magnitude of mortality/ morbidity
      ii) age group
      iii) financial constraints
      iv) ease of action
      v) community interest or pressure
      vi) political commitment etc
4) List of administrative actions needed
   a) Assess alternate plans and choose
   b) Documentation of plan
   c) Each stage – cost, timeline, action required, output expected, concurrent evaluation
   d) Procedure for modification of plan for resource allocation
   e) Implementation
   f) Requires organisational structure
   g) Roles and responsibilities – delegation and accountability
   h) Selection, training, motivation, and supervision of manpower
   i) Organisation and communication
   j) Efficiency of component institution

5) Monitoring and Evaluation
   a) Monitoring – day to day follow up of activities
   b) Continuous process, keeps on schedule
   c) Allows for corrective actions
   d) Evaluation – mostly concerned with final outcome
   e) Allows for re-allocation of priorities or resources if health needs change

2.3 HEALTH CARE DELIVERY SYSTEM IN INDIA

Health care services to be provided need to be comprehensive, accessible, acceptable, provide scope for community participation and should be available at an affordable cost. In India the health care system is represented by five major sectors:

1) Public Sector
2) Private Sector
3) Indigenous Systems of Medicine
4) Voluntary Health Agencies
5) National Health Programmes

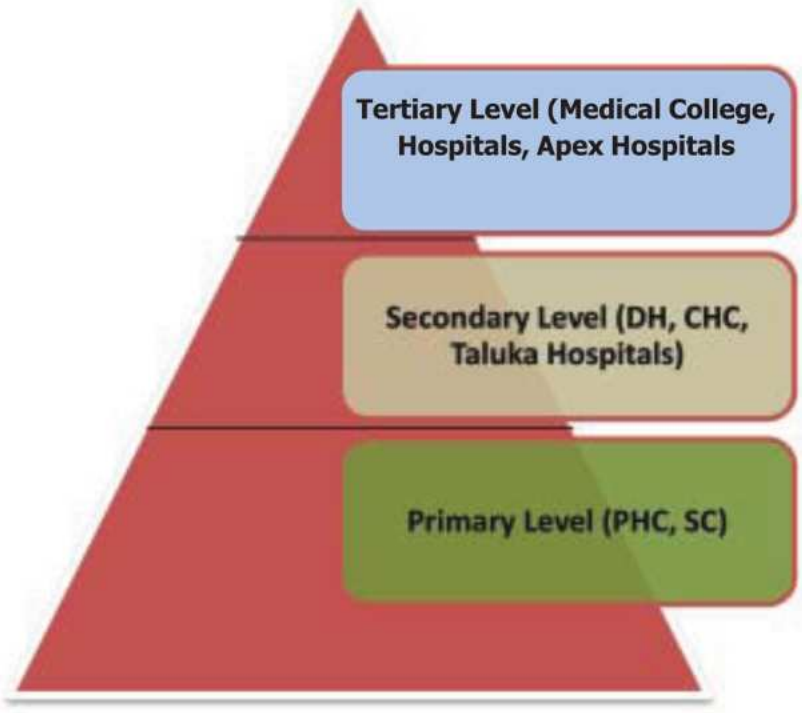


Fig. 2.1: NRHM Health Care Structure

2.3.1 Delivery of Health Services at Sub-Centre

The sub-centre is the peripheral outpost of the existing health delivery system in rural areas. They are being established on the basis of one sub-centre for every 5000 population in general and one for every 3000 population in hilly, tribal and backward areas.

Table 2.1: Manpower at Sub-centre according to IPHS Standards 2012

Type of Sub-centre	Sub-centre Type A		Sub-centre Type B	
Staff	**Essential**	**Desirable**	**Essential**	**Desirable**
ANM/Health Worker (F)	1	+1	2	
Health Worker (M)	1			
Staff Nurse (or ANM if Staff Nurse is not available)				1**
Voluntary worker*	1 (Part time)		1 (Full Time)	

*She is paid @ Rs. 100 by the ANM from her contingency fund; ** if number of deliveries are 20 or more in a month

List of services to be provided through two types of sub-centres are as follows:

1) Maternal health care which include:
   a) Antenatal care (ANC):
      i) Early registration of all pregnancies, minimum 4 Ante Natal Check ups.
      ii) Associated services like general examination (height, weight, B.P., anaemia, abdominal examination, breast examination), Iron and Folic Acid Supplementation from 12 weeks, and injection tetanus toxoid.
      iii) Minimum laboratory investigations and linkages with PHC for other required tests.
      iv) Counselling on diet, rest, and tobacco cessation if the antenatal mother is a smoker or tobacco user, advice on institutional deliveries, pre-birth preparedness and complication readiness, danger signs, clean and safe delivery at home if called for, postnatal care and hygiene, nutrition, care of newborn, registration of birth, initiation of breastfeeding, exclusive breastfeeding for 6 months, demand feeding, supplementary feeding (weaning and starting semi solid and solid food) from 6 months onwards, infant and young child feeding and contraception.
      v) Name based tracking of missed and left out cases.
      vi) Identification of high risk cases and management of danger signs of pregnancy.
   b) Intranatal care:
      i) Promotion of institutional deliveries
      ii) Skilled attendance at home deliveries when called for
      iii) Appropriate and Timely referral of high risk cases which are beyond her capacity of management.

      Essential for Type B Sub-centre

      iv) Managing labour using Partograph.
      v) Identification and management of danger signs during labour.

vi) Proficient in identification and basic first aid treatment for PPH, Eclampsia, Sepsis and prompt referral of such cases.

vii) Minimum 24 hours of stay of mother and baby after delivery at Sub-centre. The environment at the Sub-centre should be clean and safe for both mother and baby.

c) Postnatal care (PNC):

i) Initiation of early breastfeeding within one hour of birth.

ii) Ensure post-natal home visits on 0, 3, 7 and 42nd day for deliveries at home and Sub-centre (both for mother & baby).Ensure 3, 7 and 42nd day visit for institutional delivery (both for mother & baby) cases.

iii) In case of Low Birth weight Baby (less than 2500 gm), additional visits are to be made on 14, 21 and 28th days.

iv) Counselling on diet & rest, hygiene, contraception, essential newborn care, immunisation, infant and young child feeding, STI/RTI and HIV/AIDS.

v) Name based tracking of missed and left out PNC cases.

2) Child Health:

a) Newborn Care Corner In The Labour Room to provide Essential Newborn Care (For Type B sub-centre)

b) Counselling on exclusive breast-feeding for months and appropriate and adequate complementary feeding from 6 months of age while continuing breastfeeding.

c) Assess the growth and development of the infants and under 5 children and make timely referral.

d) Full Immunisation of all infants and children against vaccine preventable diseases as per guidelines of Government of India.

e) Vitamin A prophylaxis to the children.

f) Prevention and control of childhood diseases like malnutrition, infections, ARI, Diarrhoea, Fever, Anaemia etc. including IMNCI strategy.

g) Name based tracking of all infants and children to ensure full immunisation coverage.

h) Identification and follow up, referral and reporting of Adverse Events Following Immunisation (AEFI).

3) Family Planning and Contraception:

a) Education, Motivation and counselling to adopt appropriate Family planning methods.

b) Provision of contraceptives such as condoms, oral pills, emergency contraceptives, Intra Uterine Contraceptive Devices (IUCD) insertions (wherever the ANM is trained in IUCD insertion).

c) Follow up services to the eligible couples adopting any family planning methods (terminal/spacing).

4) Safe Abortion Services (MTP): Counselling and referral for safe abortion services.

5) Curative services: Provide treatment for minor ailments including fever, diarrhoea, ARI, worm infestation and First Aid including first aid to animal bite cases (wound care, tourniquet (in snake bite) assessment and referral). Appropriate and prompt referral.

6) Adolescent Health Care: Education, counselling and referral.

7) School health services:

   a) Screening, treatment of minor ailments, immunisation, de-worming, prevention and management of Vitamin A and nutritional deficiency anaemia and referral services through fixed day visit of school by existing ANM/MPW.

   b) Staff of Sub-centre shall provide assistance to school health services as a member of team.

8) Control of local endemic diseases.

9) Water and Sanitation: Disinfection of drinking water sources, promotion of sanitation.

10) Outreach/Field services:

   a) Village and Health Nutrition Day (VHND): VHND should be organised atleast once in a month in each village with the help of Medical Officer, Health Assistant Female (LHV) of PHC, HWM, HWF, ASHA, AWW and their supervisory staff, PRI, Self Help Groups etc.

   b) Home visits, house to house surveys, community level interactions.

   c) Coordinate services of anganwadi workers, ASHA, village health and sanitation committee (VHSC).

11) National Health Programmes:

   a) National AIDS Control Programme (NACP): Condom promotion and distribution of condoms to the high risk groups, Help and guide patients receiving ART on adherence, IEC activities to create awareness about preventive measures, Prevention of Parent to Child Transmission (PPTCT) services and HIV-TB coordination.

   b) National Vector Borne Disease Control Programme (NVBDCP):

      Collection of Blood slides of fever patients, Rapid Diagnostic Tests (RDT) for diagnosis of malaria Prevention of breeding places of vectors through IEC and community mobilisation.

      Where filaria is endemic, identification of cases of lymphoedema/ elephantiasis and hydrocele and their referrals to PHC/CHC for appropriate management. Annual mass drug administration with single dose of Diethyl carbamazine (DEC) to all eligible population at risk of lymphatic filariasis.

      Promotion of use of insecticidal treated nets, wherever supplied. Record keeping and reporting as per programme guidelines.

   c) National Leprosy Eradication Programme (NLEP):

      Health education to community regarding signs and symptoms of leprosy, its complications, curability and availability of free of cost treatment.

Referral of suspected cases of leprosy (person with skin lesion and/or nerve involvement) and its complications to PHC. Provision of subsequent doses of MDT and follow up of persons under treatment for leprosy, maintain records and monitor for regularity and completion of treatment.

d) National Tuberculosis Elimination Programme (NTEP) : Referral of suspected symptomatic cases to the PHC/Microscopy centre, provision of DOTS at Sub-centre, proper documentation and follow-up. Care should be taken to ensure compliance and completion of treatment in all cases. Adequate drinking water should be ensured at Sub-centre for taking the drugs.

e) National Programme for Control of Blindness (NPCB): Detection of cases of impaired vision in house to house surveys and their appropriate referral. The cases with decreased vision will be noted in the blindness register. Spreading awareness regarding eye problems, early detection of decreased vision, available treatment and health care facilities for referral of such cases. IEC is the major activity to help identify cases of blindness and refer suspected cataract cases.

f) National Programme for Prevention and Control of Deafness (NPPCD): Detection of cases of hearing impairment and deafness during House to house survey and their appropriate referral. Awareness regarding ear problems, early detection of deafness, available treatment and health care facilities for referral of such cases. Education of community especially the parents of young children regarding importance of right feeding practices, early detection of deafness in young children, common ear problems and available treatment for hearing impairment/ deafness.

g) National Mental Health Programme (NMHP): Identification and referral of common mental illnesses for treatment and follow them up in community. IEC activities for prevention and early detection of mental disorders and greater.

h) National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke: IEC Activities to promote healthy lifestyle sensitise the community about prevention of Cancers, Diabetes, CVD and Strokes, early detection through awareness regarding warning signs and appropriate and prompt referral of suspect cases.

i) National Iodine Deficiency Disease Control Programme (NIDDCP): IEC Activities to promote consumption of iodised salt by the community. Testing of salt for presence of Iodine through Salt Testing Kits by ASHAs.

j) National Tobacco Control Programme: Spread awareness and health education regarding ill effects of tobacco use especially in pregnant females and Non-Communicable diseases where tobacco is a risk factor e.g. Cardiovascular disease, Cancers, chronic lung diseases. Display of mandatory signage of "No Smoking" in the Sub-centre.

k) National Programme for Health care of Elderly. For details communicable and non communicable diseases please refer Course 1, Block 3 and Block 4.

12) Promotion of Medicinal herbs.

13) Recording of Vital Events.

Check Your Progress 1

1) Define National health planning

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2) Write five most important functions of Sub centre.

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2.3.2 Delivery of Health Services at Primary Health Centres

Primary Health Centres (PHCs) comprise the second tier in rural healthcare structure to provide integrated curative and preventive healthcare to the rural population with emphasis on preventive and promotive aspects. A PHC caters a population of 20,000 in hilly, tribal, or difficult areas and 30,000 populations in plain areas with 6 indoor/observation beds. It acts as a referral unit for 6 Sub-Centres and refer out cases to CHC (30 bedded hospital) and higher order public hospitals located at sub-district and District level.

PHCs have been classified as two types-depending upon delivery case load: Type A PHC with delivery load of less than 20 per month and Type B PHC with delivery load of 20 or more deliveries per month. Table 2.2 shows Manpower at Primary Health Centre according to IPHS Standards 2012.

Table 2.2: Manpower at Primary Health Centre according to IPHS Standards 2012

Type of Primary Health Centre	Type A		Type B	
Staff	**Essential**	**Desirable**	**Essential**	**Desirable**
Medical Officer	1		1	1#
Medical Officer-AYUSH		1		1
Accountant cum Data Entry Operator	1		1	
Pharmacist	1		1	
Pharmacist-AYUSH		1		1
Nurse (Midwife)	3	+1	4	+1
Health Worker (Female)	1*		1*	
Health Assistant (Male)	1		1	
Health Assistant (Female)/ Lady Health Visitor (LHV)	1		1	

Type of Primary Health Centre	Type A		Type B	
Staff	**Essential**	**Desirable**	**Essential**	**Desirable**
Health Educator		1		1
Laboratory Technician	1		1	
Cold Chain & Logistic Vaccine Assistant		1		1
Multi-skilled Group D Worker	2		2	
Sanitary Worker cum Watchman	1		1	+1
Total	13	18	14	21

*For sub-centre area of PHC; # If the delivery load is 30 or more per month;

Remember:

A PHC caters a population of 20,000 in hilly, tribal, or difficult areas and 30,000populations in plain area. It acts as a referral unit for 6 Sub-Centres and refer out cases to CHC.

List of services to be provided at PHCs are as follows:

1) **Medical Care:**
   a) OPD services: 6 hours OPD to be run for 6 days in a week. 4 hours in morning and 2 hours in afternoon with a minimum attendance of 40 patients per doctor/day.
   b) 24 hours emergency services: Appropriate management of injuries and accident, First Aid, stitching of wounds, incision and drainage of abscess, stabilisation of the condition of the patient before referral, Dog bite/ snake bite/scorpion bite cases, and other emergency conditions.
   c) Referral services.
   d) In-patient services (6 beds)

2) **Maternal and Child Health Care including Family Planning:**
   a) **Antenatal Care (ANC)**
      i) Early registration
      ii) Minimum 4 antenatal checkups and provision of iron and folic acid tablets, injection Tetanus Toxoid etc. Ensure, atleast 1 ANC preferably the 3rd visit, must be seen by a doctor. Minimum laboratory investigations like Haemoglobin, Urine albumin and sugar, RPR test for syphilis and Blood Grouping and Rh typing.
      iii) Nutrition and health counselling including tobacco cessation.
      iv) Identification and management of high risk pregnancy.
      v) Tracking of missed and left out ANC.
   b) **Intra-natal Care**
      i) Promotion of institutional deliveries.
      ii) Management of normal deliveries.

iii) Assisted vaginal deliveries including forceps/vacuum delivery whenever required.

iv) Manual removal of placenta.

v) Appropriate and prompt referral for cases needing specialist care.

vi) Management of pregnancy Induced hypertension including referral.

vii) Pre-referral management (Obstetric first-aid) in Obstetric emergencies that need expert assistance.

viii) Minimum 48 hours of stay after delivery.

ix) Managing labour using Partograph.

c) **Post-natal care (PNC)**

i) Ensure post-natal care for 0 & 3rd day at the health facility, ensure 7th & 42nd day post-natal home visits. 3 additional visits for a low birth weight baby (less than 2500 gm) on 14th day, 21st day and on 28th day.

ii) Initiation of early breastfeeding within one hour of birth.

iii) Counselling on nutrition, hygiene, contraception, essential new born care and immunisation.

iv) Others: Provision of facilities under Janani Suraksha Yojana (JSY).

v) Tracking of missed and left out PNC.

d) **Newborn care**

i) Facilities for Essential Newborn Care (ENBC) and Resuscitation.

ii) Management of neonatal hypothermia (provision of warmth/ Kangaroo Mother Care (KMC), infection protection, cord care and identification of sick newborn and prompt referral.

e) **Care of the child**

i) Routine and Emergency care of sick children including Integrated Management of Neonatal and Childhood Illnesses (IMNCI) strategy and inpatient care.

ii) Counselling on exclusive breastfeeding for 6 months and appropriate and adequate complementary feeding from 6 months of age while continuing breastfeeding.

iii) Assess the growth and development of the infants and under 5 children.

iv) Full Immunisation of all infants and children.

v) Management of severe acute malnutrition cases and referral of serious cases after initiation of treatment as per facility based guidelines.

f) **Family Welfare**

i) Education, Motivation and counselling to adopt appropriate Family Planning methods.

ii) Provision of contraceptives such as condoms, oral pills, emergency contraceptives, IUCD insertions.

iii) Referral and Follow up services to the eligible couples adopting permanent methods (Tubectomy/Vasectomy).

iv) Counselling and appropriate referral for couples having infertility.

3) Medical termination of Pregnancies: Counselling and appropriate referral for safe abortion services. Permanent methods like Tubal ligation and vasectomy/NSV, where trained personnel and facility exist.

4) Management of Reproductive Tract Infections/Sexually Transmitted Infections.

5) Nutrition services in coordination with ICDS.

6) School Health: Teachers screen students on a continuous basis and ANMs/ HWMs (a team of 2 workers) visit the schools (one school every week) for screening, treatment of minor ailments and referral. Doctor from CHC/PHC will also visit one school per week based on the screening reports submitted by the teams.

7) Adolescent Health Care: To be provided preferably through adolescent friendly clinic for 2 hours once a week on a fixed day. Services should be comprehensive i.e. a judicious mix of promotive, preventive, curative and referral services.

8) Promotion of Safe drinking water and Basic sanitation.

9) Prevention and control of locally endemic diseases such as malaria, Kala Azar, Japanese encephalitis.

10) Collection and reporting of vital events.

11) Health Education and Behaviour Change communication.

12) National Tuberculosis Elimination Programme (NTEP) :

    a) Revised National Tuberculosis Control Programme: DOTS Centres to deliver treatment through DOTS providers, treatment of common complications of TB and side effects of drugs, record and report on (NTEP) activities. Facility for Collection and transport of sputum samples.

    b) National Leprosy Elimination Programme: Health education, diagnosis and management of Leprosy and its complications including reactions. Counselling for adherence and prevention of disability.

    c) Integrated Disease Surveillance Project: Weekly reporting of epidemic prone diseases and SOS reporting of any cluster of cases. PHC will collect and analyse data from Sub-centre and will report information to district surveillance. Laboratory services for diagnosis of Malaria, Tuberculosis, and tests for detection of faecal contamination of water (Rapid test kit) and chlorination level.

    d) National Programme for Control of Blindness: Early detection of visual impairment and their referral, detection of cataract cases and referral for cataract surgery, provision of basic treatment of common eye diseases, awareness through IEC activities.

    e) National Vector Borne Disease Control Programme: Diagnosis and treatment of Malaria cases, complete treatment to Kala-azar cases in Kala azar endemic areas, complete treatment of microfilaria positive cases with DEC and participation in and arrangement for Mass Drug Administration (MDA) along with management of side reactions, if any and morbidity management of Lymphoedema cases.

f) National AIDS Control Programme: IEC activities to enhance awareness and preventive measures about STIs and HIV/AIDS, Prevention of Parents to Child Transmission (PPTCT) services, Promotion & distribution of condoms to the high risk groups and Help and guide patients with HIV/AIDS receiving ART with focus on adherence.

g) National Programme for Prevention and Control of Deafness: Early detection of hearing impairment and deafness and referral, basic diagnosis and treatment for common ear diseases. IEC for prevention, early detection of hearing impairment/deafness.

h) National Mental Health Programme: Early identification (diagnosis) and treatment of common mental disorders such as psychosis, depression, anxiety disorders and epilepsy and referral. IEC activities for prevention, stigma removal, early detection of mental disorders etc.

i) National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke:

   i) Cancer: IEC services for prevention of cancer and early symptoms. Early detection of cancer with warning signals. Referral for confirmation of the diagnosis.

   ii) Other NCDs: Early detection, management and referral of Diabetes Mellitus, Hypertension and other Cardiovascular diseases and Stroke. Health Promotion Services to modify individual, group and community behaviour.

j) National Iodine Deficiency Disease Control Programme (NIDDCP): Promote consumption of iodised salt. Testing of salt for presence of Iodine through Salt Testing Kits.

k) National Tobacco Control Programme: Health education and IEC activities regarding harmful effects of tobacco use and second hand smoke. Promoting quitting of tobacco in the community.

l) National Programme for Care of Elderly.

m) Physical Medicine and Rehabilitation Services.

13) Training: Undergraduate medical students and intern doctors in basic health care. Orientation training of male and female health workers in various National Health Programmes including RCH, Adolescent health services and immunisation. Skill based training to ASHAs. Initial and periodic Training of paramedics in treatment of minor ailments.

14) Basic Laboratory and Diagnostic services.

15) Functional Linkages with sub-centres.

16) Monitoring and supervision.

17) Recording of vital events.

18) Maternal Death Reviews.

19) Mainstreaming of AYUSH.

20) Selected surgical procedures: The vasectomy, tubectomy (including laparoscopic tubectomy), MTP, hydrocelectomy as a fixed day approach have to be carried out in a PHC having facilities of O.T.

Check Your Progress 2

1) List the type of manpower available in the PHC.

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2) PHC caters to how much population.

.....

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2.3.3 Delivery of Health Services at Community Health Centres

For a successful primary health care programme, effective referral support is to be provided. For this purpose one Community Health Centre (CHC) has been established for every 80, 000 to 1,20,000 population, and this centre provides the basic specialty services in general medicine, paediatrics, surgery, obstetrics and gynaecology. CHCs are being established and maintained by the State Government. It is manned by four medical specialists supported by 21 paramedical and other staff. It has 30 in-door beds with one OT, X ray, Labour Room and Laboratory facilities. (Table 2.3). It serves as a referral centre for 4 PHCs and also provides facilities for obstetric care and specialist consultations. Community Health Centres (CHC) forming the uppermost tier are established and maintained by the State Government under the Minimum Needs Programme/Basic Medical Services programme.

Table 2.3: Manpower at Community Health Centre according to IPHS Standards 2012

Staff	Essential	Desirable	Qualifications	Remarks
Block Public Health Unit				
Block Medical Officer/ Medical Superintendent	1		Senior most specialist/GDMO preferably with experience in Public Health/ Trained in Professional Development Course(PDC)	Will be responsible for coordination of NHPs, management of ASHAs Training and other responsibilities under NRHM apart from overall administration/ Management of CHC etc. He will be responsible for quality & protocols

Staff	Essential	Desirable	Qualifications	Remarks
				of service delivery being delivered in CHC.
Public Health Specialist	1		MD (PSM)/MD (CHA)/ MD Community Medicine or Post Graduation Degree with MBA/DPH/ MPH	
Public Health Nurse	1	+1	Graduate/Diploma in nursing	
Speciality services				
General Surgeon	1		MS/DNB (General Surgery)	
Physician	1		MD/DNB (General Medicine)	
Obstetrician & Gynaecologist	1		DGO/MS/DNB (Obs & Gynae)	
Paediatrician	1		DCH/MD/DNB (Paediatrics)	
Anaesthetist	1		DA/MD/DNB (Anaesthesia)	Essential for utilisa-tionof the surgical specialities.
General Duty Officers				
Dental Surgeon	1		BDS	
General Duty Medical Officers	2		MBBS	
Medical Officer-AYUSH	1		Graduate	
Nurses and para-medical				
Staff Nurse	10			
Pharmacist	1	+1		
Pharmacist-AYUSH	1			
Lab Technician	2			
Radiographer	1			
Dietician		1		
Ophthalmic Assistant	1			
Dental Assistant	1			
Cold chain & Vaccine Logistic Assistant	1			

Staff	Essential	Desirable	Qualifications	Remarks
OT Technician	1			
Multi-rehabilitation/ Community based rehabilitation worker	1	+1		
Counsellor	1			
Administrative Staff				
Registration Clerk	2			
Statistical Assistant/ Data Entry Operator	2			
Account Assistant	1			
Administrative Assistant	1			
Group D Staff				
Dresser	1			
Ward Boy	5			
Driver	1*	3		
Total	46	52		

*May be outsourced; Note: One lab technician/Staff nurse may be trained in ECG

Following is the consolidated list of services to be provided at CHCs:

1) Outpatient and Inpatient Department services: General Medicine, Surgery, Obstetrics & Gynaecology, Paediatrics, Dental and AYUSH services. Eye specialist services (One eye specialist at every 5 CHCs).
   a) Care of routine and emergency cases in Surgery
   b) Care of routine and emergency cases in medicine
2) Maternal health: In addition to services at PHC, 24-hour delivery services including normal and assisted deliveries. Managing labour using Partograph. All referred cases of complications in pregnancy, labour and post-natal period must be adequately treated. Minimum 48 hours of stay after delivery, 3-7 days stay post delivery for managing complications. Proficiency in identification and Management of all complications including PPH, Eclampsia, Sepsis etc. during PNC, Essential and Emergency Obstetric Care including surgical interventions like Caesarean Sections and other medical interventions and provisions of Janani Suraksha Yojana (JSY) and Janani Shishu Suraksha Karyakram (JSSK).
3) Newborn and Child health: In addition to the services provided at PHC, Newborn Stabilisation Unit is provided, Routine and emergency care of sick children including Facility based IMNCI strategy.
4) Family Planning: Full range of family planning services including IEC, counseling, provision of Contraceptives, Non Scalpel Vasectomy (NSV),

Laparoscopic Sterilisation Services and their follow up. Safe Abortion Services as per MTP act and Abortion care guidelines of MOHFW.

5) National Health Programmes: All NHPs should be delivered through the CHCs. Integration with the existing programmes is vital to provide comprehensive services.

   a) NTEP : Same as PHC

   b) NACP: Integrated Counselling and Testing Centre, Blood storage units and STD Clinic.

   c) NVBDCP: same as PHC

   d) NLEP: same as PHC

   e) NPCB: same as PHC

   f) IDSP: CHC will function as peripheral surveillance unit and collate, analyse and report information to District Surveillance Unit on selected epidemic prone diseases.

   g) NPPCD: same as PHC

   h) NMHP: same as PHC

   i) NPCDCS: Screening for Cervical cancer (pap Smear)

   j) NPHCE: Geriatric clinic twice a week.

6) School Health Services

7) Adolescent Health care

8) Blood storage facility

9) Diagnostic services: In addition to the lab facilities and X-ray, ECG should be made available in the CHC with appropriate training to a nursing staff/ Lab Technician.

10) Maternal Death Reviews

Check Your Progress 3

4) How much population is served by a CHC?

   .....

   .....

5) Write five important functions of a CHC.

   .....

   .....

2.3.4 Delivery of Health Services at District Level

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

1) Sub divisions

2) Tehsils (taluks)

3) Community Development Blocks
4) Municipalities and Corporations
5) Villages
6) Panchayats

Sub divisions: Districts in India are divided into two or more sub-divisions, in charge of each is an Assistant Collector or Sub Collector.

Tehsils (Taluks): Each division is again divided into tehsils (taluks) headed by Tehsildar. It comprises 200 to 600 villages.

AT THE DISTRICT LEVEL

Headed by Collector

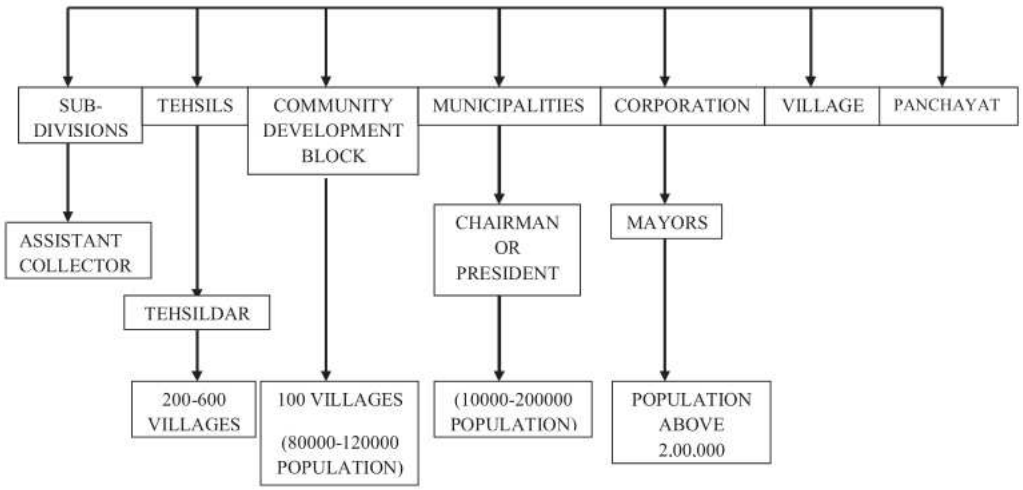


Fig. 2.3: Administration at District level

Community Development Blocks: The Block is a unit of rural planning and development, and comprises about 100 villages and about 80,000 to 20,000 population.

The Urban areas of the district are organised into following institutions of local Self Government:

Town area committee's: In areas with population ranging between 5000 and 10,000.

Municipal Boards: In areas with population ranging from 10,000 to 2 lakhs, headed by Chairman or the President.

Corporations: With population above 2 lakhs headed by Mayors.

Panchayati Raj: This is a three tier system of rural local self government, linking the village to the district. These are given below see Fig. 2.4:

- Panchayat (at the village level)
- Panchayat Samiti (at the block level)
- Zila Parishad (at the district level)

Tier	Phanchayati Raj System	System Organisational Head	Health Functionary
1st -District Level	Zila Parishad	Chief Executive Officers	DHO
2nd Taluka Level/ Block Level	Samiti Panchayat	BDO	MO
3rd Village Level	Gram Panchayat	VDO/ Gram Sevak	AWW MPW ANM TBA VHC

Fig. 2.4: District organisation under Panchayati Raj

2.3.5 State Level

In all the states, management structure sector comprises of:

1) State Ministry of Health
2) State Health Directorate

State Ministry of Health: It is headed by Minister of Health and Family Welfare and Deputy Minister of Health and Family Welfare. The Health Secretariat (Official Organ of State Ministry of Health) is headed by Secretary and assisted by Deputy Secretariat, under Secretaries and large administrative staff.

State Health Directorate: The Director of Health services (known in some states as Director of Medical and Health Services) is the chief technical adviser to the state government on all matters relating to medicine and public health. He is also responsible for the organisation and direction of all health activities.

Organisation of State Health Directorate:

1) The Director of Health and Family Welfare
2) Assisted by the Deputy and Assistant Directors of Health.

- Regional Directors: Inspect all branches of public health within their jurisdiction, irrespective of their specialty.
- The Functional Directors are specialists in a particular branch of public health such as mother and child health, family planning, nutrition, tuberculosis, leprosy, health education etc.

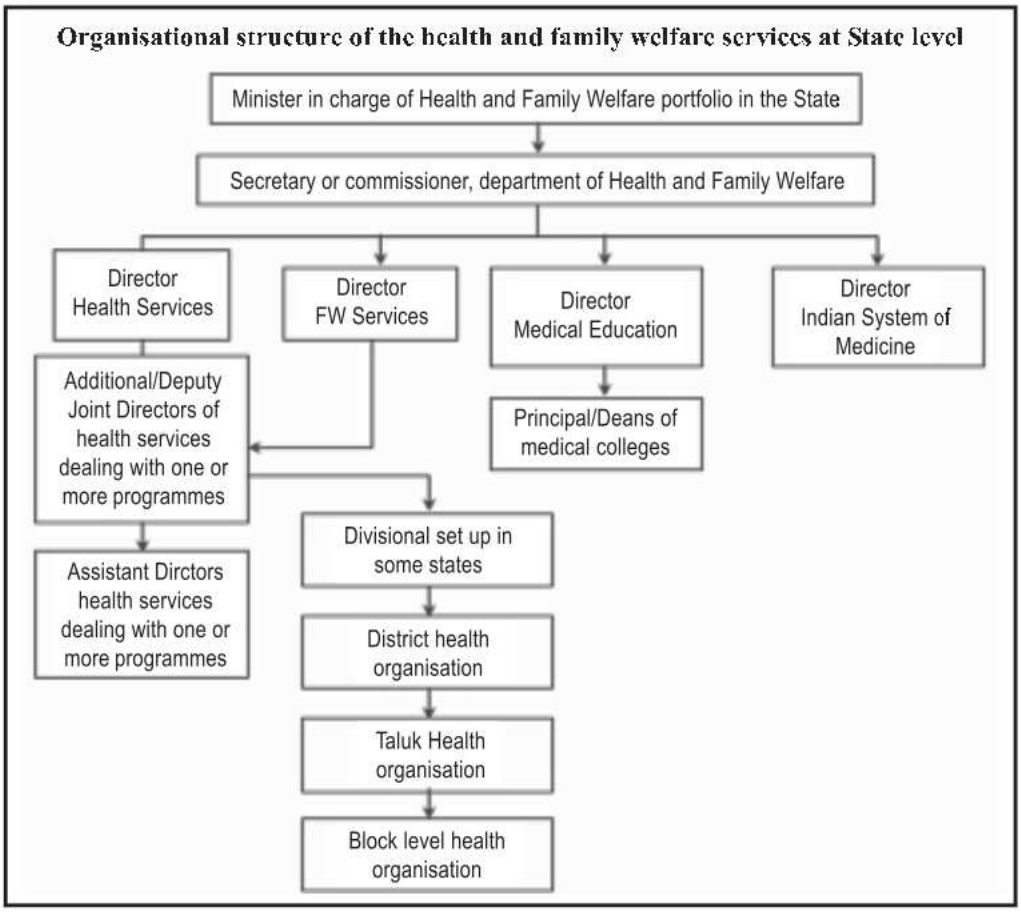


Fig. 2.5: Organisational structure of health and family welfare services at the State Level

2.3.6 National Level

The official organs of health system at the national level consist of:

1) The Ministry of Health and Family Welfare
2) The Directorate General of Health Services
3) The Central Council of Health and Family Welfare

Fig. 2.6 shows the Organisational structure of health and family welfare services at the National level.

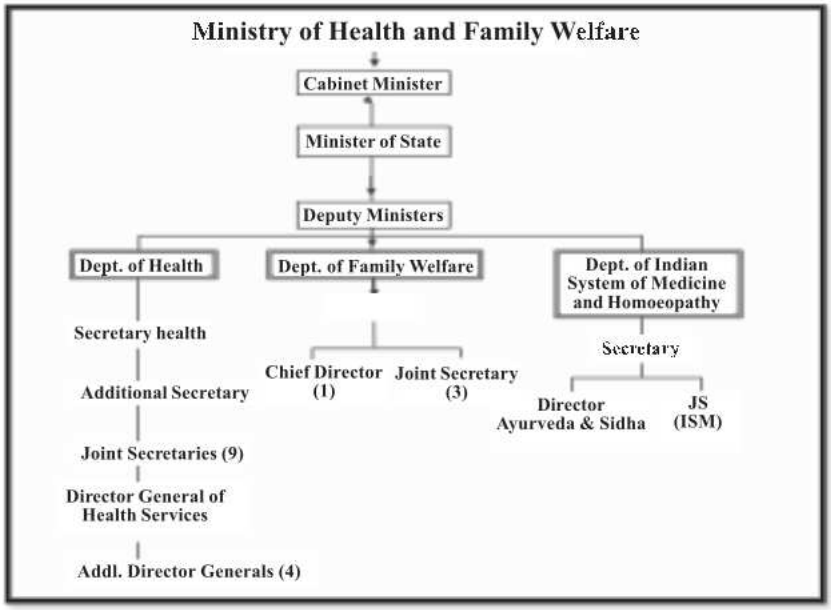


Fig. 2.6: Organisational structure of health and family welfare services at the National level

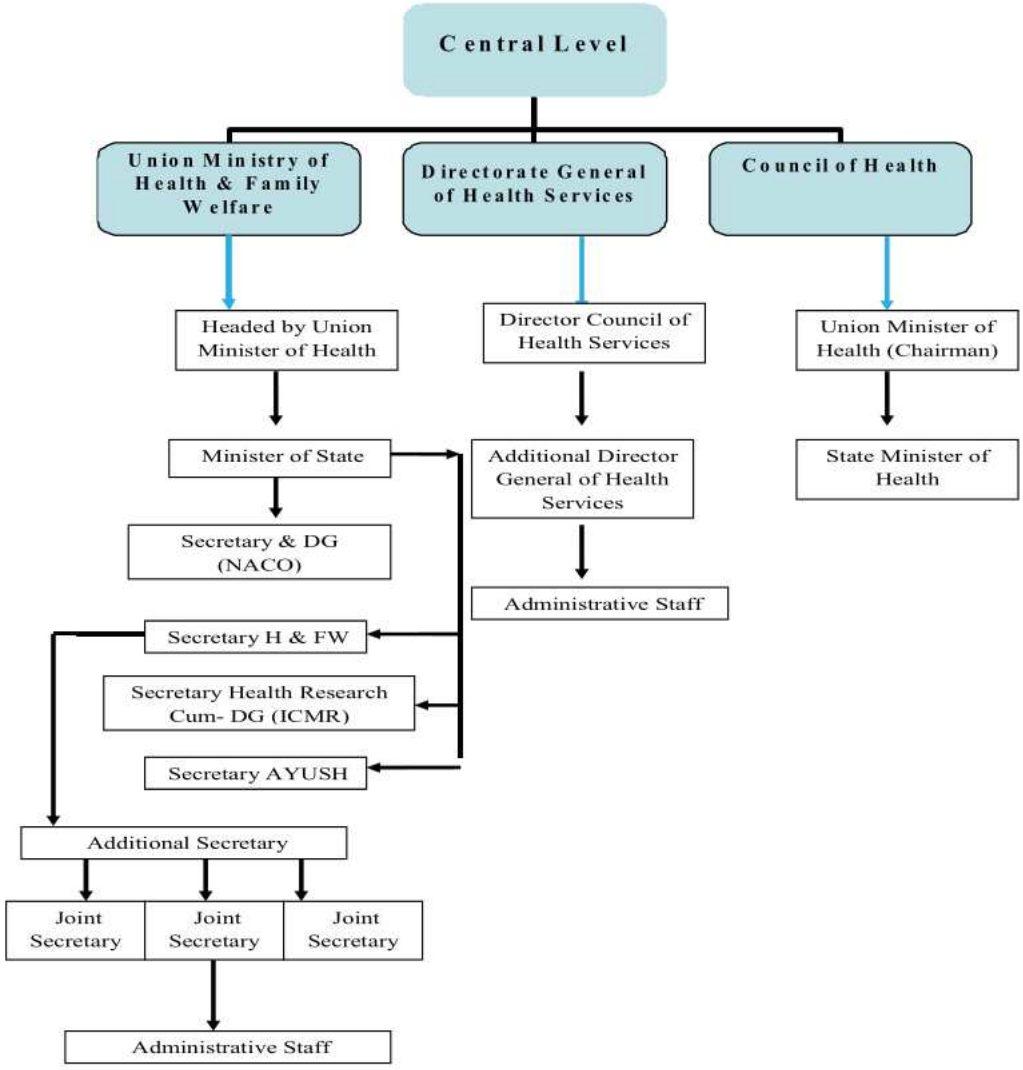


Fig. 2. 7 : Organogram at the National Level

2.4 LET US SUM UP

We have discussed health care delivery system in public and private sector, NRHM health care structure, services provided through sub-centres with respect to maternal care, child health, national health programme activities are also discussed. The organisational structures of CHC,PHC, District level, State level and National levels are also been covered.

2.5 MODEL ANSWERS

Check Your Progress 1

1) National health planning has been defined as "the orderly process of defining community health problems, identifying unmet needs and surveying the resources to meet them, establishing priority goals that are realistic and feasible and projecting administrative action to accomplish the purpose of the proposed programme".

2) Five most important functions of Sub-centre

- Maternal health care

- Child Health
- Family Planning and Contraception
- Safe Abortion Services (MTP)
- Curative services

Check Your Progress 2

1) Refer Table 2.2 from the text

2) 20,000 population in hilly and 39,000 in plain area.

Check Your Progress 3

1) One Community Health Centre (CHC) has been established for every 80, 000 to 1,20,000 population.

2) Five important functions of a CHC
   - Outpatient and Inpatient Department services
   - Maternal health
   - Newborn and Child health
   - Family Planning
   - Implementation of National Health Programmes

2.6 REFRENCES

1) AFMC, WHO. Text Book of Public Health and Community Medicine. 1st ed. Pune:AFMC; 2009.

2) DGHS, MoHFW. Indian Public Health Standards (IPHS): Guidelines for Community Health Centres Revised 2012. New Delhi: MoHFW; 2012.

3) DGHS, MoHFW. Indian Public Health Standards (IPHS): Guidelines for Primary Health Centres Revised 2012. New Delhi: MoHFW; 2012

4) Health care in India. [Internet] 2012 [Accessed on 2103, May 14]. Available from: http://ce.columbia.edu/files/ce/pdf/actu/actu-india.pdf

5) K. Park. Textbook of Preventive and Social Medicine. 23rd ed. Jabalpur: Banarasidas Bhanot Publishers; 2015.

UNIT 3 ENVIRONMENTAL HEALTH AND SANITATION

Structure

3.0 Introduction

3.1 Objectives

3.2 Concept of Environmental Health and Sanitation

3.3 Concept of Pollution Prevention

3.4 Concepts of Safe Water Sources, Waterborne Disease and Water Purification

- 3.4.1 Safe Water
- 3.4.2 Sources of Water
- 3.4.3 Waterborne Diseases
- 3.3.4 Water Purification Processes
- 3.4.5 Household Purification of Water

3.5 Physical and Chemical Standards of Drinking Water Quality and Tests for Assessing Bacteriological Quality of Water

- 3.5.1 Physical Standards of Drinking Water Quality
- 3.5.2 Chemical Standards of Drinking Water Quality
- 3.5.3 Tests for Assessing Bacteriological Quality of Water

3.6 Concepts of Water Conservation

3.7 Air and Noise Pollution

- 3.7.1 Air Pollution
- 3.7.2 Noise Pollution

3.8 Solid Waste, Human Excreta and Sewage Disposal

- 3.8.1 Solid Waste Management
- 3.8.2 Human Excreta Disposal and Management
- 3.8.3 Sewage Disposal and Management

3.9 Commonly used Insecticides and Pesticides

3.10 Let Us Sum Up

3.11 Model Answers

3.12 References

3.0 INTRODUCTION

This unit is important in context of the 'SWACHHTA ABHIYAN' declared by our Hon'ble Prime Minister. We have learnt about definition, concept and determinants of health. That included 'what is health?', 'whom do we call as healthy?', 'why is health important to ensure a good quality of life?' We have also learnt 'what factors enhance or compromise our health?' This was explained in terms of disease agents (bacteria, chemicals, injury), host factors (our age, education, occupation, income, habits, lifestyle, genes, diet, immunity etc.) and environment (physical – water/ air etc; social– family relations, culture etc; biological– vectors like flies/ mosquitoes, animals like rats/dogs; psychosocial – stress, pace of life).

Any health worker may think that her job is to take care of people, mainly the health of women and children. So why should she/he be worried about (or even working for) improvement in Environmental Health and Sanitation (EHS)? Bulks of diseases we suffer from are due to some problem with our environment, yet it is usually a neglected area. Whether it is a doctor or a health worker, we are all working for improving the health status of people in our assigned areas. The success of a hygiene programme is not determined only by the number of latrines or the number of wells constructed. Successful programms are created by what people do, that is, by their behaviours and practices. So, if we are serious about helping people to remain healthy, we need to change our approach. In this unit you will learn issues related to management of physical environment and sanitation in a sub-centre area, e.g. safe water, waterborne diseases, air / noise pollution waste. Before proceeding further it will be worthwhile for you to understand that all the related activities will have to be done by you within mechanism and the settings available to you.

3.1 OBJECTIVES

After completing this unit, you should be able to:

- explain the characteristic of a village;
- define the concept of safe water;
- list waterborne diseases;
- enumerate the physical and chemical standards of drinking water quality;
- list the steps in water purification processes;
- describe the concept of water conservation;
- discuss the management of solid waste, human excreta and sewage disposal; and
- list the commonly used insecticides and pesticides; symptomology of poisoning related to these.

3.2 CONCEPT OF ENVIRONMENTAL HEALTH AND SANITATION

WHO defined environment sanitation as the control of all those factors in man's physical environment which exert a deleterious effect on physical development, health and survival.

Poor environmental sanitation leads to: Contamination of water, pollution of air, soil unhygienic disposal of sewage, refuse and waste, infestation of insects, rodents etc. Therefore it is important to learn about environmental sanitation and improvement of environmental sanitation so that many communicable diseases can be prevented and controlled in our country.

Let us read one by one, physical environment first i.e. water which constitute the most important component of physical environment. Water is prime natural resource, a basic human need and a precious national asset and therefore, WHO refers to **"Control of water supplies to ensure that they are pure and wholesome"** as one of the primary objectives of environmental sanitation. Equilibrium between man and environment leads toward health and imbalance heads to ill-health Fig. 3.11

Fig. 3.2 depicts components of environment such as Physical, Biological, Social and Cultural. In Fig. 3.3 we brief about seasons of environment polutions. Fig. 3.4 concept of sanitation.

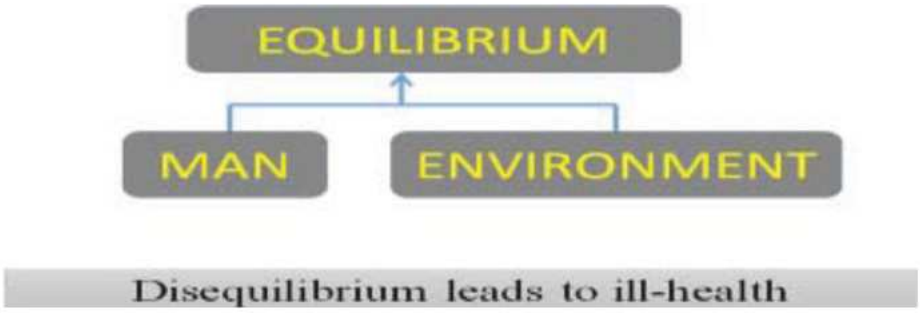


Fig. 3.1: Concept of Environment and Health

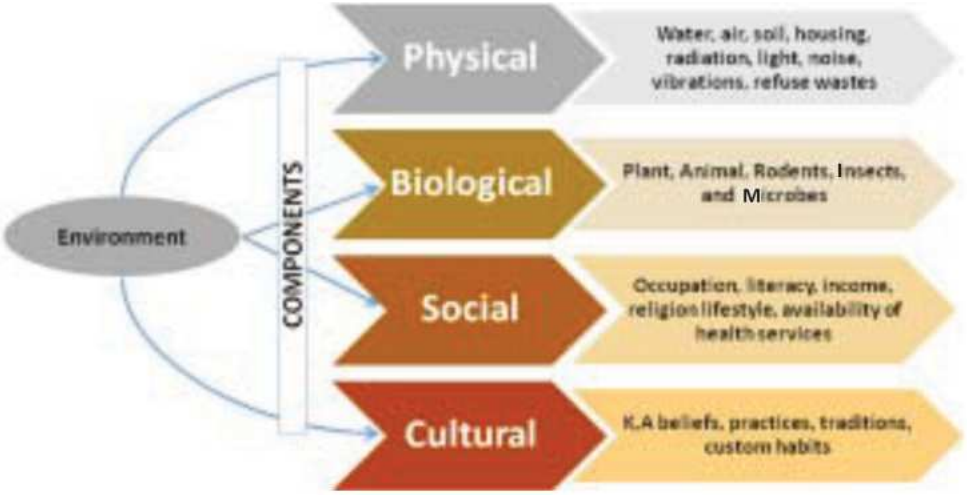


Fig. 3.2: Components of Environment



Fig. 3.3: Causes of Environmental Pollution



Fig. 3.4: Concept of Sanitation

3.3 CONCEPT OF POLLUTION PREVENTION

There are a number of principles of pollution prevention.

Principle of waste optimisation: Reduce, Reuse and Recover. Reduction refers to changing the process so that waste is not produced in the first place. Reuse involves using an item more than once (for example, you can reuse plastic bottles

for collecting water). Recovery involves recovery of materials or energy through recycling, composting and incineration. An example of recycling is taking used aluminium cans (tin cans) and recycle the metal to make it into something else. In composting we can take waste organic matter and make it into useful compost for fertilizer. Through incineration (burning) we can recover the energy contained in waste materials.

Polluter pays principle: This principle identifies the people or organisations who generate or produce waste or pollution. They are responsible for paying the costs of any damage.

Principle of 'Cradle to Grave': Production of any object or to any activity by an individual or institution and all the pollution that object or activity might cause throughout its lifecycle; for example, if you make a plastic bottle, pollution might be caused in the manufacturing process; or by the lorries that transport the bottles around the country; and when the bottle is thrown away.

Principle of discharge/emission permit: A waste generator has an obligation to obtain permission from the regulatory authority in order to discharge waste to surface water and to the atmosphere.

Infrastructure and Basic Life Amenities: Housing: Good-quality housing is a key element for ensuring a healthy village. Poor housing is related to indoor air pollution, poor lighting, ventilation and over crowding. Poor housing can lead to many health problems e.g. infectious diseases, stress and depression. (Fig. 3.5).



Fig. 3.5: *Kuchcha* house and a *Pucca* house in a village

Overcrowding causes ill-health because it makes disease transmission easier and because the lack of private space causes stress. Overcrowding is related to socioeconomic level, and the poor villagers in India often have little choice but to live in cramped conditions. In India, often, many people share the same room. Privacy is lacking which causes mental disorders. Overcrowded house causes respiratory and skin disease.

3.4 CONCEPT OF SAFE WATER, SOURCES, WATER BORNE DISEASE AND WATER PURIFICATION

Let us now read in details about safe water, Sources, waterborne diseases and purifications of water as discussed below:

3.4.1 Safe (potable) Water

An adequate, safe and accessible water supply must be available to all people. Improving access to safe drinking water can result in tangible benefits to health.

Safe water is

- Free from harmful chemicals
- Pleasant to taste
- Usable for domestic purpose

3.4.2 Sources of Water

Surface water

Surface water supplies taken from rivers, lakes or ponds can provide a consistent and manageable source of water. However, it is subject to greater risk of contamination than groundwater and therefore usually requires treatment. Contamination is most likely to be with microbiological pathogens from human and animal excreta. There is also the possibility of accidental or deliberate pollution by industries or farming.

Groundwater

Groundwater can be obtained from springs, boreholes or wells i.e. deep sources, may provide water of good microbiological quality. Ground water sources are therefore preferable to surface water sources. However, groundwater can contain chemical contaminants, such as arsenic, fluorides and nitrates. A spring may vary in volume and contamination levels according to the amount of rainfall. Springs are likely to be polluted by direct contamination unless the surrounding land area is protected. A spring can produce both a consistent volume and a better quality supply. Springs should be protected from flooding and surface water pollution by constructing a deep diversion ditch above and around the spring. The ditch should be constructed so it collects surface water running towards the spring and carries, or diverts, it away. It needs to be deep enough to carry all surface water away, even in a heavy rainstorm. The surrounding area should be fenced to protect it from animals.

Well water is still an important source of supply in many Indian villages. During heavy rain, dug wells are susceptible to contamination by pathogens which may be deposited on the surface or naturally present in the soil and are washed in to the well, particularly if it is improperly constructed. Hand pumps placed over the well need to be built so the surrounding surface is covered and protected.

Bored wells have small yields, may be easily polluted and are affected by droughts.

For protection of well water from pollution and contamination it should be located on a higher level than possible sources of contaminants such as latrines and cesspits. This is because the liquid from the pit may seep into the surrounding ground and into the groundwater. If the latrine is higher up a slope than the well then the contaminated groundwater is likely to flow downwards and into the well. The natural flow of the groundwater should be away from the well and towards the sources of contaminants, and not the other way round. In normal soils, the minimum distance between the well and the source of contaminants should never be less than 15 meters.

A concrete cover should be fitted over the casing to prevent dust, insects, small animals and any other contaminants from falling in.

A pump should be installed, but if a pump is not available then a sanitary bucket and rope system may be used. The immediate area of the well should preferably

be fenced to keep animals away. The area surrounding the well should be graded off (i.e. should slope away from the well) in order to prevent the flow of storm water into the well.

Organisms causing diseases such as **typhoid fever, gastroenteritis** will contaminate surface water sources.

The government has provided water containers with taps under *Indira Gandhi Pey Jal Yojna* to people in villages. Still, even the houses having water supply from their own taps have irregular supply of water. Wells have been closed in most villages. Ponds are used for bathing cattle and not fit for human consumptions. Fig. 3.6 shows some of sources of water supply is village.



Water Tank



Handpump

Fig. 3.6: Sources of water supply in village- tap at house level, motorissed hand pump, village pond and well



Village pond



Well

Many villages in India have now piped water systems. These piped water systems are often small and rely on community management, and many use untreated groundwater sources. Small piped water systems are usually fed by gravity, either from protected springs or from surface water above the village, although some may be supplied from boreholes fitted with motorised pumps. Piped systems require regular maintenance. Leakage in need to be repaired rapidly to prevent water loss, and to prevent surface water from entering the pipes and contaminating the supply. One way of dealing with these issues is to give someone in the community responsibility for checking communal taps and making repairs. To prevent the accumulation of stagnant water around community taps, which could become mosquito breeding sites, community members could build a concrete platform at the base of the taps and an outlet

Water is so called contaminated "When it contains pathogens and said to be called polluted when it contains impurities".

3.4.3 Waterborne Diseases

Let us learn disease caused by unsafe water.

These include cholera, typhoid and bacillary dysentery etc. These are caused by ingestion of water contaminated by human or animal excrement.

- **Water-washed diseases** are caused by poor personal hygiene due to water shortage, e.g., scabies, trachoma, typhus, flea, lice and tick-borne diseases.
- **Water-related diseases** are caused by insect vectors, especially mosquitoes, that breed or feed near water, e.g., dengue fever, filariasis, malaria.

Chemical contamination of water is another potential cause of health problems. In some places, water may contain naturally occurring toxic chemicals such as arsenic and fluoride. Other chemicals may get into the water supply because of pollution. Lead poisoning, for example, can result from water contaminated with lead. Examples of chronic health effects of chemical contamination of water are liver / kidney damage. Sample checklist for well water sanitary inspection is given below as Table 3.1. You as MLHP should know about well water to be monitered for safety of community.

Table 3.1: Sample checklist for well water sanitary inspection

Sample checklist for well water sanitary inspection

Name of Health Facility……Village name and location of well/ handpump……		
Questions to be asked during survey	**YES**	**NO**
Is there a latrine within 15 m of the well and handpump?		
1. Is the nearest latrine on higher ground than the handpump?		
2. Are there any animal excreta or rubbish within 15 m of the handpump?		
3. Does the drainage channel contain stagnant water within 2 m of the handpump?		
4. Is the drainage channel broken allowing a pool of water to form?		
5. Does the wall or fencing around the handpump have any breaks that would allow animals in?		
6. Is the concrete floor less than 1 m wide all around the handpump?		
7. Are there any pools of water on the concrete floor around the handpump?		
8. Does the concrete floor around the handpump have any cracks that could let water in?		
9. Is the handpump loose at the point of attachment to the base which could let water enter the casing?		
10. Is the cover of the well unhygienic (unclean)?		
11. Are the walls of the well poorly sealed at any point for 3 m below ?		

Name of Interviewer——————— **Signature** ———————
Date ————

The finding of survey should be discussed with village panchayat for corrective measures.

3.3.4 Water Purification Processes

The control of pollution should ideally take place at the point of generation i.e. at source. Water is unlikely to be completely free of contaminants at the original source. The types of water treatment processes depend on the Characteristics of the raw water (untreated water direct from its source) and required water quality standards. Suspended solids, bacteria, algae, viruses, fungi, minerals such as iron and manganese, and fertilizers are among the substances that are removed during water treatment. Effective treatment should ensure the removal of all disease-causing agents and so reduce the possibility of the outbreak of waterborne disease.

The options for improving water quality in the home are to treat water, by boiling, filtering, chlorinating or leaving the water to settle.

Boiling is a simple way of killing any ova (eggs), cysts, bacteria and viruses present in contaminated water. Water should be heated until large bubbles are continuously coming to the surface of the water. Boiled water can become re-contaminated once it has cooled.

Solar disinfection (SODIS) relies on energy from the sun to kill bacteria. For this, collect several bottles (0.3 to 2.0 liter) made of clear plastic, remove all labels and wash them thoroughly. Fill the bottles with water of low turbidity and shake for about 20 seconds to aerate the water. Expose the bottles to the sun by placing them on a roof or rack for at least six hours (if sunny) or two days (if cloudy). The water is now ready to drink.

Chlorine solution (bleach) is the most affordable, easiest to produce, and most widely available chemical for household water treatment. Add a capful of chlorine solution to a 25 liter container (bucket). Shake and wait for 30 minutes chlorine contact time before drinking. Double dosing is advisable if the water is visibly dirty. Chlorine tablets, supplied by health department treats 20 liters of clear water. For visibly turbid water, two tablets per 20 liters are needed. It is very important to mix well and leave for 30 minutes contact time before consumption. Whatever type of treatment method is used, it is essential that water is stored safely and hygienically. Even if water has come from an improved source, this will not guarantee that it is safe because contamination can occur in the household due to poor storage and handling practices. The principal health risk associated with household water storage is the ease of recontamination, particularly where the members of a family or community do not follow good hygiene practice. Safe storage is especially designed to eliminate sources of recontamination by keeping objects, including hands, out of the system.

3.4.5 Household Purification of Water

Three methods are used for purifying at home.

- **Boiling:** Water must be brought to 'ROLLING BOIL' for 5 to 10 min.

  Advantages: Cheap and best method.

  Along with microorganism, spores, ova, cyst, viruses etc are also destroyed and water get sterilised.

Points to Remember

Boil water is the same container in which it is to be stored to avoid contamination during storage.

- **Chemical method :** There are various chemical substance which purifies water such as Chlorine, Iodine and Potassium Permagnate.

  Let us discuss important features of these chemical substances: Chlorine is used as gas, powder and Solutions as gives belows:

  a) Chlorine in gas form used for purification of water on large scale.

  b) Powder form–bleaching powder 2.5 gm per 1000 liter of water

  c) Solution form– prepared from bleaching powder.

Iodine:

This method is used in emergency conditions. Not used as a routine because iodine interferes with thyroid activity. It is high cost also. It is costlier than bleaching powder.

Potassium Permagnate:

It is used for disinfestations of fruits and vegetables. It destroys Vibrio Cholera organism. It alters (change) the colour, smell and taste of water.

Water resource should be protected and there is need to reserve water. Protection of water resource by avoiding wastage of water. Hence, extensive education to be public is required about economical use of water and consumption of minimum requirement for daily use.

Sanitary analysis of water

This means to collect information of water source and its laboratory examination of water sample.

Field Survey - To collect data on the nature and source of water supply, likely source of water pollution, mode of filtration, mode of distribution etc.

Laboratory examination of water - Sample collection for routine. 2 liter sample should be collected in a clean glass bottle (Winchester Overt bottle).

For Bacteriological analysis - Collect 200 cc of water in sterile bottle, sterilised in an autoclave.

For radiological analysis, polythene bottle is preferred.

3.5 PHYSICAL AND CHEMICAL STANDARDS OF DRINKING WATER QUALITY AND TESTS FOR ASSESSING BACTERIOLOGICAL QUALITY OF WATER

You are not expected to carry out microbiological and chemical tests of drinking water. But it will help you if you understand the principles. The source of the

pathogens is usually human faeces; therefore, tests have been devised that detect faecal contamination. This indicates that pathogenic organisms such as E.Coli may be present. The most widely used tests are total coliforms count. These are a group of bacteria found in human and animal faeces and also in soils and some other natural environments.

Water can also be contaminated if water containers are not properly washed. Water could also be contaminated during transportation. Open buckets are very often easy to contaminate and should be replaced by small neck covered containers. Water can also be contaminated at home when it is left open for animals to drink, children to dip their hands in. The safe way is to store it in a narrow necked container that can be covered with a screw cup.

Serving water from a container with a spout and a lid is ideal, but if there is no container with a spout and a lid available, the best alternative is to serve water by pouring it from a pitcher or to serve it with a clean, long-handled dipper and well washed hands. A bowl should never be used to dip water from a container because it can be contaminated very easily. What is most important when serving water is that nothing dirty – such as hands, a bowl, or a cup – comes into contact with the water.

The ideal situation for storing water is to use a container with a lid and a spout. It is important to have a lid that seals tightly on the container in which treated water is stored. Water should never be stored in a container with a lid that is not well sealed.

3.5.1 Physical Standards of Drinking Water Quality

Potable water is at a desirable temperature, completely transparent and free from turbidity, tastes, odours and colours, but is not necessarily free from disease-causing agents. Aesthetically also, drinking water should look clear and taste good.

3.5.2 Chemical Standards of Drinking Water Quality

Some analytical equipment is portable and can be taken to the site but other tests can only be done in a laboratory. The recommended tools for field use are a portable pH meter with digital readout, a hand-held colorimeter, portable spectrophotometer and residual chlorine test kit. The orthotolidine-arsenite test (OTA) is used to determine the amount of free chlorine residual. When the reagent is added to water containing chlorine, a greenish-yellow colour will appear. The amount of residual chlorine needs to be in the range of 0.2–0.5 mg/l if it is to prevent recontamination with bacteria. The OTA test requires a special test kit available from district health office.

3.5.3 Tests for Assessing Bacteriological Quality of Water

Water quality should be monitored on a regular basis.To know whether water is polluted with specific bacterial contaminants, samples should be taken and sent to a laboratory for analysis. E.coli is the standard indicator organism for faecal contamination of water and for the possible presence of faecal pathogens. For water intended for drinking, E.coli must not be detectable in any 100 ml sample.

Check Your Progress 1

1) List Water borne diseases.

.....

.....

2) What are the methods for purification of water at home?

.....

.....

3.6 CONCEPTS OF WATER CONSERVATION

Rainwater can be used for domestic purposes in areas where there are no alternative sources of safe water such as springs, rivers and lakes. Rainwater harvesting means collecting, or harvesting rainwater as it runs off from hard surfaces such as rooftops and storing it in a tank or cistern.This can alleviate water scarcity.

Most piped water supplies include storage tanks so that water is always available. Such tanks are usually necessary because the rate of water use at peak times of the day is greater than the average rate of use throughout the day. The tanks also provide emergency storage in the event of a breakdown.

3.7 AIR AND NOISE POLLUTION

Air is immediate constituent of physical environment. Without air life existence is not possible. It is not only necessary for breathing purposes, cooling of body, hearing and smelling but it also act as a vehicle of transmission of disease, resulting in even epidemics and pandemics.

In nature, the environment has an inherent capacity to clean itself through self-cleaning processes. Pollutants can come from natural sources of pollution (volcanoes; ash and dust; arsenic) or man-made pollutants (industrial, domestic), transport and agriculture.

3.7.1 Air Pollution

Let us go through the sources of air pollution:

Sources of Air Pollution

Domestic Source	Burning of fire wood, Kerosene oil, coal
Industrial Source	Factories of iron, steel, paper, cement, fertilizers, thermal power plant, petroleum refineries.
Vehicular Source	Motor vehicles, railways, ships, airplanes
Miscellaneous	Tobacco smoking, nuclear explosions, forest fire, burning of refuse, dust storms, ocean sprays.

Hazards or ill effects due to air pollution on health

Immediate and acute effects: Irritation of conjunctiva, nose, throat and

respiratory mucous membrane, allergic rhinitis, acute pharygits, bronchitis asthama. It may cause suffocation and death. E.g. **Bhopal Gas Tragedy.**

Delayed and Chronic Effects: Chronic bronchitis, bronchiectasis, emphysema, COPD, bronchial asthama, even lung cancer.

Global Effects: Acid rain causes acidification of soil and water, Tree gets killed by acid rain causes deforestation, erosion of soil.

Global warming: Increase dryness of climate, reduce food production, increased sea level resulting floods, smog formation, increased incidence of skin cancers, depletion of ozone layers.

Crowded living spaces, damp rooms, smoke and dust filled environment, all these give rise to respiratory problems and lead to diseases like TB. Cooking activities inside the house, where family members spend most of their time, generates smoke that is hazardous to health. Mothers, children and elders are the ones who are most exposed to the effects of smoke. The usual type of fuel that is used for cooking and heating in the rural areas is biomass, i.e. animal dung, crop residues and wood. Biomass fuel is inferior to kerosene, because it is not energy-rich when burned. Carbon monoxide and tiny carbon particles are dangerous if inhaled. Indoor air pollution occurs when the air inside is predominantly smoke instead of clean air. This can lead to acute respiratory infections, bronchitis and chronic lung diseases.

You can advise the family to use an efficient *chulha* that minimises fuel consumption and therefore smoke emission (equipped with a chimney). Promoting the separation of the kitchen from the main house. Promoting the separation of animal sheds from the main house (animal dung and urine produce bad odours). Advising mothers to cook without involving children in the kitchen. Recommending that a window be installed and left open until cooking is finished.This is important in rural areas where wood, charcoal and dung are used as fuel. These give off smoke containing harmful chemicals /dust. Where cooking is done indoors, it is essential that smoke and fumes be removed from the house quickly and efficiently. Smokeless *chulahs* should be popularised.



Fig. 3.8: Village belle kindling the fire in *chullah*

Other measures for prevention of air pollutions are:

- Enforcement of Act: Indian factory Act, Prevention and Control of Air Pollution Act, Smoke Nuisance Act etc.
- General Measure: Traffic control, maintenance of vehicles
- Create 'Green Belt' grooming plants and trees

- Health Education
- Population Stablisation

3.7.2 Noise Pollution

Nothing worthwhile is being done in this field. FHW may not have any responsibility in this regard. Yet she can co-ordinate with PRI for appropriate location of any nearby industry at its establishment stage. Also she/he can educate proper to produce less noise.

Check Your Progress 2

1) Explain sources of Air pollution.

.....

.....

2) What are the hazards or ill effects due to air pollution on health?

.....

.....

3.8 SOLID WASTE, HUMAN EXCRETA, SEWAGE DISPOSAL

Waste is introduced into the environment due to the day-to-day activities of humans. There are many methods and processes of dealing with waste at every stage from generation and collection through to final disposal. Main idea is to isolate waste from humans and the environment. This safeguards our health. In addition, the aesthetic value of a clean physical environment is important for our emotional well-being.

Solid waste is dry in form and is discarded by people as unwanted, e.g., domestic waste. Other varieties include industrial, commercial, institutional or agricultural waste, or street sweepings. The solid waste that is produced as a result of food preparation, or any foodstuff leftover after eating, is called kitchen waste or garbage.

Domestic waste is mostly non-hazardous. It may include rubbish, such as packaging materials, kitchen wastes, ash, etc. Agricultural wastes could include food residues, animal dung, crop residues, grass and leaves (mostly non-hazardous and biodegradable). However, containers for used or obsolete pesticides, herbicides and rodenticides could be a health hazard to families and sprayers. Therefore, these items should be safely removed in collaboration with the agricultural department. Commercial wastes are generated from business establishments, shops or market places. These may include packaging paper, cardboard, electronics, timber, wire, metals, plastic bags (festal), tin cans, garbage and other non-hazardous wastes. Industrial waste may vary depending on the raw material used. These may be hazardous or non-hazardous. It could contain chemicals, wood, metal, ceramic etc. Institutional solid waste is produced from public or government institutions, offices, schools, universities, religious

institutions, sporting fields, etc. It can be very mixed in its components. Healthcare waste is produced from Health Posts, health centres and hospitals. This has both hazardous (infectious) and non-hazardous wastes. The management of healthcare waste needs special attention, therefore dealt separately.

Rural waste is suitable for making compost (a mixture of decomposed organic matter, mostly of plant origin). It can be used to improve soil structure and to return nutrients to the land. The waste can be used to fill in a hole in the ground - Landfill sites. In landfill sites and some community waste disposal sites, the leachate will seep out from the bottom of the waste tip and can pollute surface and groundwater. It may contain toxic chemicals in addition to pathogenic microorganisms. This needs to be disposed of safely.

Improper disposal of wastes is one of the major risk factors that affect our health and comfort through environmental pollution, breeding of disease-vector insects, animal scavengers. This may result in a range of diseases through different routes of exposure such as feco-oral and soil transmitted mechanisms (fluids, fingers, fomites and flies by contaminating our food.

To break the transmission route of these disease agents, there needs to be total sanitation. This includes prevention of any human contact with waste, i.e. no open defecation and the proper handling of solid waste. There is a need to protect the food from contamination and to protect the people from contaminated food, fingers, drinking water etc.

3.8.1 Solid Waste Management

The common practice for household refuse disposal in rural areas is to dump solid wastes openly in backyard gardens or in an open space. Such indiscriminate disposal is an environmental hazard and can threaten human health and safety. It can create a breeding ground for pathogenic microorganisms and vectors of disease, and cause a public nuisance due to unsightliness and bad smell. It can cause contamination of surrounding soil, groundwater and surface water, and it can also create fire hazards, physical hazards and have poisoning effects (from pesticides and insecticides).

However, these problems can be avoided by using appropriate management techniques. For all waste management issues, FHW should engage community members and families in awareness of the solid waste problems in their area and try to change their behaviour.

The type of waste will determine the choice of possible disposal methods. Waste can also be described as combustible or non-combustible depending on whether it will burn or not. Putrescible wastes are generated by growing, handling, preparation, cooking and consumption of food. These kinds of wastes tend to be more abundant during the summer (rainy) seasons. Non-putrescible wastes do not decompose easily; they may or may not be combustible. Because they do not break down, they persist in the environment and are often the cause of nuisance and aesthetic problems.

Plastic bags are widely used to carry goods from market to home in all areas because they are convenient, cheap and easy to use. Plastic bags are usually non-biodegradable and persist in the environment for a very long time. Moreover, when discarded indiscriminately, they pollute the land surface of your community,

prevent rainwater from percolating into the soil, can easily be blown all over the place by wind, and create unsightly and nuisance conditions. The bags can also be easily swallowed by animals, which may block their digestive system and kill them.

Main components of waste management

In any waste management process, there is a stage when waste will be temporarily stored or contained on the place where the waste is produced. If storage is temporary, then subsequent stages will be the transfer or transport to a treatment facility or technology, followed by final disposal offsite away from village.

The most usual method of onsite liquid and human excreta waste containment in rural India is the pit latrine. Pit latrines are simple drop and store systems in which the liquid waste collects in a pit below. In places where water is more easily available, typical methods are pour-flush latrine.

Wastewater from water carriage systems may be piped into a septic tank or into a community treatment system. Onsite handling, storage and processing methods are undertaken at household level. Collection and transfer or transport activities are not common in rural areas because the waste is usually disposed of immediately onsite in a prepared waste disposal or composting pit.

Ideally, waste management should go beyond pollution prevention and disease prevention for humans and should benefit society by providing economic gain for families and communities. The preferred approach for dealing with solid waste is integrated solid waste management (ISWM). This considers not only the appropriate disposal of solid waste but also integrating this with other management options such as minimising waste production, recycling, composting and other waste recovery options. It considers all options and aims to manage waste in ways that are most effective in protecting human health and the environment. ISWM can also have many economic and social benefits for your community. For example, you could consider composting of human waste and animal manure to produce natural fertilizer for gardening and for cultivating vegetables and crops. Some solid wastes can be recycled or reused. You could also consider helping your community in the development of a biomass waste digestion plant that will produce biogas to be used for cooking and lighting energy.

Biomass is any biological material from living or recently living plants that is used to generate energy, usually in the form of biogas.

Hazardous and non-hazardous waste

Hazardous wastes are those with a potential to harm human health (corrosive substances that cause damage on contact, e.g. acids; ignitable (materials that can catch fire easily like benzene; toxic materials that can be poisonous to humans when inhaled or ingested, or come in contact with skin or mucous membranes; reactive (substances that can yield a harmful chemical if they react with other substances; infectious (substances that are capable of causing or communicating infection).

Potential sources of hazardous waste in rural households include obsolete pesticides, herbicides or rodenticides. Non-hazardous wastes include all other types of waste.

3.8.2 Human Excreta Disposal and Management (Liquid Waste)

Liquid waste includes human waste, runoff (rainwater that collects on the ground and runs off into channels, ditches and rivers), sullage, industrial wastewater and other forms of wastewater from different sources. Human waste is mainly composed of feces and urine, which together are known as excreta. All human body waste is classed as liquid waste. The mixture of human waste with wastewater is known as sewage. Sullage is water that has been used for washing in bathrooms and kitchens it does not include human waste.

Human waste is biodegradable and when contained in a waste containment facility (for example, a pit latrine or septic tank). It undergoes a biological digestion process by which bacteria decompose the organic matter. This does not require oxygen. This may take days to a few months, before it is completely decomposed or degraded. The digested waste is called sludge. Animal wastes, food waste, paper, and agricultural wastes are also biodegradable. This way these wastes do not accumulate in the environment. Many plastics are not biodegradable and these create environmental problems because they remain unchanged for many years .

Although human waste is a potential source of disease, the amount of human feces disposed of indiscriminately in open fields and under bushes, mostly in rural settings, is a major problem. In rural areas, a large proportion of households do not have pit latrines and although this situation is changing, open defecation continues to be widely practiced. This can spread disease, contaminate the soil and pollute drinking water sources. To avert these risks, everyone should work towards community goals to be 'open defecation free'. This can be achieved through the building, and consistent use of, onsite communal or household latrines.

Excreta Disposal: Plans for locating sanitation facilities, and for treating and removing waste, must consider cultural issues, particularly as sanitation is usually focused on the household. It may be a difficult subject for a community to discuss: a taboo. People may not like to discuss issues they regard as personal and unclean. In some cases, people may feel that children's faeces are not harmful. In others, separate facilities may be required for men and women, and it may be necessary to locate the facilities so that no one can be seen entering the toilet. If the disposal facilities smell and are a breeding ground for flies, people may not use them. As of now, open field defecation is still rampant in rural India. Various schemes launched by the government for sanitary latrine construction have not yielded desired success (even in village schools, latrines are not maintained properly).

Latrines have the added advantage of providing privacy when they have walls and a door or curtain. This has become an issue in rural Indian setting where prospective brides are known to reject marriage in a family that lacks a latrine. This has also been portrayed in some TV / radio advertisements.

Excreta can be made safe by burial in the ground. Even a cover or shallow covering of soil over the top of the excreta will prevent flies from walking and feeding off the excreta. Where no other type of excreta disposal system is available, burial is a clean and convenient way of disposal. Care needs to be taken to make sure that all excreta, is disposed of in a latrine or is buried. The possession of an improved latrine, on its own, will not halt the transmission of faeco-orally transmitted diseases among the people of your community. For this to have an impact on

health, the people have to use their latrines and hand washing facilities effectively. Both hands should always be washed using soap or ash after defecation or after going to a latrine. It is important that everyone always washes their hands after defecation and before handling food. However, most people do not wash their hands often enough. Latrines should be located atleast 6 meters away from kitchen.

3.8.3 Sewage Disposal and Management

Sullage management

Some people may think they can simply throw used cooking and washing water away but it should not be disposed of indiscriminately because of its negative health effects on families and community members. Proper collection and disposal of sullage is advised. Some of the disadvantages of improper disposal of sullage include the potential to contaminate the soil, pollute water sources and create favourable breeding conditions for disease vectors.

Sullage can be discharged to sewers or septic tanks in areas where they exist. However, in many rural areas there is no sewer system so it is necessary to construct a pit near the household to dispose of sullage properly. The pit should be filled with gravel or sand and the sullage can be allowed to percolate into the ground. A soak pit keeps the wastewater in one place and encourages it to soak quickly into the ground. It also avoids bad odor and unsightliness in the environment.

Septic tanks are used with water carriage sanitation systems. The human waste is washed into the tank, where it is stored and partially treated. It's a watertight chamber, usually made of concrete, and is mostly under the surface of the ground. They have inlet and outlet pipes. The retention time of the wastewater in septic tanks should be a minimum of 19 hours but can be a great deal longer. The purpose of septic tanks is for the solids to settle out of the wastewater and for anaerobic decomposition of organic solids to take place. However, the treatment in a septic tank is only partial. The solids will be broken down in the tank and diluted in the wastewater but this will still contain high levels of organic pollutants. Septic tanks should only be used in places where water is plentiful and where vacuum trucks are available to remove sludge periodically from the chamber (desludging).

Septic tanks are a storage and treatment unit to complement such facilities as WCs (cistern flush toilets), pour-flush toilets and aqua privies. The effluent from septic tanks is usually piped into a soak pit. It is lined with open-jointed or porous material such as bricks or stone without mortar, which allows the wastewater to seep out slowly into the soil. Alternatively the wastewater may be spread across a drainage field using an array of pipes buried below the surface.

A septic tank has the following advantages:

- can be built and repaired with locally-available materials
- has a long service life
- presents no problem of flies and odour, if properly used
- has a relatively low capital cost (though it may not be affordable by rural households), and moderate operating costs
- does not require electrical energy because it uses gravity flow.

However, the constraints of a septic tank include the following:

- only applicable for water carriage sanitation systems
- treatment is only partial and the effluent may still contain pathogens
- sludge must be removed periodically.

An anaerobic biogas reactor, also known as an anaerobic digester, uses anaerobic digestion to convert liquid wastes and other organic matter into sludge and biogas. The sludge can be used as a soil fertilizer and the biogas can be used for energy to produce heat (for use in cooking) or electricity. This affordable technology can easily be adapted by rural families and communities if appropriate training is given to local artisans and masons in the design and construction of the reactor.

Pit latrines

In general, pit latrines with a slab are effective sanitation systems because they isolate human excreta from the surrounding environment and prevent the transmission of faeco-orally transmitted diseases. They also have other advantages:

- They do not require water so are appropriate in areas where there is no adequate water supply.
- Squatting is normal to many people and thus is acceptable to users.
- Alternating double pits will allow the excreta to drain, degrade and transform into a nutrient-rich, safe humic material that can be used to improve soils.
- They avoid contamination of surface water and top soil if properly installed and maintained.
- They can be constructed with minimum cost using local material and local skills.
- The presence of properly constructed slabs will allow easy cleaning and avoid flies and unsightliness.

However, pit latrines are not without limitations. There may be a foul odour from the pit and they can be a favourable place for the breeding of flies and mosquitoes. With single pits, a new pit needs to be dug every time one gets full. They can be susceptible to failure/overflowing during floods. Other disadvantages can be overcome by proper design, construction and usage. For example, if the superstructure is not properly constructed, it may discourage use of the latrine by family members. Children may be discouraged from using the latrine if the slab is not designed with them in mind and is too big for them. Use of excess water or less compostable materials for anal cleansing should be avoided because it may affect the decomposition rate of human excreta.

Pit latrines must be properly maintained to function properly. You should advise families to keep the squatting or standing surface clean and dry. This will help to prevent pathogen/disease transmission and limit odours. If the pit has been dug to an appropriate size for the number of users, then it may never become full. The liquid will drain into the soil and the solid waste will slowly decompose so the volume remains stable.Villages in India do not have sewerage system since it is a costly proposition.

Hazardous waste: Health effects and management

Health effect of hazardous waste range from bad smells and simple irritation of eyes, skin, throat and breathing (lungs), to serious health conditions that affect

the nervous system and could cause paralysis of the functional body parts, birth defects and cancer. Not all stages of solid waste management are relevant in rural areas. Onsite handling is the very first step in waste management. It involves individual family members, households and communities, all of whom need to know how to handle waste properly at this level. Benefits of appropriate onsite handling include reducing the volume of waste for final disposal and recovering usable materials.

It is important that waste is stored in proper containers, e.g., baskets, plastic buckets or metal containers, dustbins that are leak proof, have tight lids and be long-lasting. In rural areas, waste is not normally collected house to house. Disposal is limited to onsite processing. Even after recycling and resource recovery there will almost certainly be some residual waste that needs final disposal. Methods of disposal can be sanitary or unsanitary. Open field dumping is the most unsanitary method of refuse disposal and is most likely to cause a health hazard. Sanitary methods include controlled tipping or controlled burial, incineration and sanitary land fill.

Final disposal: Landfill, controlled tipping and burning

This means the controlled filling of compacted layers of solid waste and soil into pre-prepared land. Large-scale landfill sites for municipal waste need to be designed to protect surface and ground water from contamination by leachate, the liquid waste that may seep out into the ground underneath the layers of waste. Sanitary landfill sites are not just rubbish dumps for open field dumping. The site must be managed to minimise any negative environmental impact. Controlled tipping or controlled burial is similar in principle to sanitary landfill but at a smaller scale that is appropriate in rural areas. Here, solid waste is disposed of into a dug pit and is regularly covered with soil to avoid attracting disease vectors such as flies and rodents. Sites for controlled tipping should be 10 m away from the house (preferably at the back of the house), atleast 15 m and preferably 30–50 m away from water wells and at a lower ground level. The site should be easily accessible, with adequate space, and should be fenced so that it is not accessible to children and domestic animals.

Latrine Utilisation : Changing Attitudes and Behaviour

There is poor utilisation of latrines among individuals and families in India. Involving model families to share their experiences and participate in regular inspections will help households to properly use their latrines, to seek technical advice when they need it and to solve any problems they encounter. The purpose of this study session is to teach you about approaches that are currently being used to achieve behavioural changes of people towards good practice of hygiene and sanitation. Promotion of hygiene and proper sanitation is the single most important way to improve the health of your community. However, the right approaches need to be used to change behaviour and get people to take better care of themselves, their family's health and their environment.

For example, elderly or uneducated people in rural areas may find it difficult to get used to new technologies and may resist the adoption of new behaviours. In some local cultures, people may not want to share latrines with others; for example, women may not want to share the same facility as their father-in-law and there are some cultural practices that inhibit the use of one latrine by both the husband and wife. Household members may be discouraged from using the latrine at night

because of the fear that 'evil' or 'devils' inhabit the latrine during that time. There are other more practical reasons such as the use of inappropriate materials for latrine construction, the collapse of latrines due to termites, flooding problems or loose soil conditions, and the need for frequent maintenance.

Motivating people to change their behaviour

Community mobilization and household visits are essential for TOTAL BEHAVIOUR CHANGE. The Regional Behaviour Change Strategy identifies the critical role of COMMUNITY MOBILISATION AND HOME VISITS in achieving the ambitious goals of hygiene and Sanitation Improvement. Health education is frequently delivered by someone lecturing about hygiene and sanitation in health facilities and community gatherings. However, such an approach is not recommended as the sole means to achieve individual behavior change. Because human behaviour is influenced by the surrounding environment and social context, specific messages instead of universal messages of hygiene and sanitation are more important. Hygiene messages must be contextually and culturally suitable, and comfortable, for your community.

If you are trying to change behaviour by targeting individuals, you need to consider not only their prior experience but also their learned behaviours. These are the habits gained by social learning channels, i.e. from parents, friends and opinion leaders in their community. Each individual has their own beliefs, values and knowledge about health practices. People may ask themselves, before adopting a new behaviour, if the new practices are going to fit with their ideas and way of life. They need to be convinced that there will be important benefits from changing their behaviour.

Healthcare Waste Management

Improper handling and disposal of healthcare wastes puts the health worker, the patient and the community at large at risk through transmission of pathogens via blood or body fluids, contaminated medical equipment, or sharp instruments. Recognising the health risks involved in poor healthcare waste management and practicing proper medical waste disposal will help protect everyone from the hazards of healthcare waste.

Between 75% and 90% of the waste produced in healthcare establishments is general waste. This includes papers, packaging materials, dust and the like. This can be disposed of in the same way as other non-hazardous wastes, but only if is not contaminated by contact with hazardous wastes. The remaining10–25% of waste is hazardous and could be composed of sharps (needles, lancets, etc.), syringes, blood or body fluid, contaminated surgical instruments, delivery bowls, used gauzes and gloves, plasters, etc. It may also contain expired drugs, lab reagents and other chemicals.

There is a need to take precautions to avoid environmental damage by such waste. Usually, in rural areas there is little or no segregation of non-hazardous and hazardous waste, it is inevitable that the general waste component will become contaminated and must then be regarded as hazardous. Everyone in the community is potentially at risk from exposure to health care waste, including people within the health care establishment and those who may be exposed to it as a result of poor management of the waste. The details of Biomedical waste or health care waste is given seperatly.

3.9 COMMONLY USED INSECTICIDES AND PESTICIDES

Pesticides include insecticides, herbicides and fungicides. There are several thousand different types in use and almost all of them are possible causes of water pollution. For example, DDT, malathion, parathion, delthametrine and others have been sprayed in the environment for long periods of time for the control of disease vectors such as mosquitoes, and to control the growth of weeds and other pests. The extensive use of fertilizers and pesticides in agricultural regions means that both surface and groundwater are affected by these pollutants. The pollution by chemicals such as pesticides may have long-term consequences, such as groundwater pollution.

Presence of pesticides in cold drinks/soft drinks and drinking water (whether packaging or municipal drinking water) has been found in India also. Most of the water supplies in India are found contaminated due to the pesticide discharge. In case of bottled water, pesticide residues were found in 5 top brands and other less popular brands. According to a study conducted in India by ICMR, 85% of milk samples found to have pesticides level above the acceptable limits. The most common pesticides found were organochlorines and organophosphorus. Among the organochlorines, HCH and DDT were frequently detected and among organophosphorus, Endosulfan. Malathion and Chlorpyrifos pesticides were also most frequently detected.

The indiscriminate use of pesticides and unchecked effluent flow from industries into the rivers and drains contaminates underground water. When a pesticide is applied to a target pest either plant or animal, the whole site is affected which includes crop plants, soil organisms, wildlife and potentially humans and children in the immediate area. In addition, part of it evaporates into the air or drain into surface waters due to emission or drift. From the air it may deposit on humans, wildlife, plants or on the soil. It can also enter into groundwater through leaching. Pesticides in surface water may go into aquatic organisms, and by sedimentation into other organisms that remain in the sediment.

Once the pesticide is released in the environment, they have different distribution and persistence patterns in air, water and soil. The persistence of the pesticide depends on its physical and chemical properties and the characteristics of the soil, air and water. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their place of application. For example, many pesticides which are used in homes have been found in house dust for many days to weeks after the application. Climatic characteristics also play a role in persistence. Studies in the Arctic have shown that insecticides and herbicides persist 3 to 8 times longer in cold climates than in temperate zones.

The most persistent pesticides are termed "persistent organic pollutants" (POPs) and may represent long-term dangers. They have a capacity to bio-magnify up the food-chain. Humans, and particularly breastfed babies, are at the top of the food-chain. In India due to more use of persistent pesticide, their residues remain in food products. The examples of pesticides which are considered as most persistent organic pollutants (POPs) are organochlorine pesticides, namely, aldrin, endrin, clordane, DDT, heptachlor, mirex, toxaphene and hexachlorobenzene. There are various processes through which the pesticides when sprayed on the

target pests also enters into other media of environment which includes air, water and soil.

Food residue

As per Ministry of Agriculture, in India, pesticides mainly enter into food products due to following reasons:

- Indiscriminate use of chemical pesticides
- Non-observance of prescribed waiting periods
- Use of sub-standard pesticides
- Wrong advice and supply of pesticides to the farmers by pesticide dealers
- Continuance of DDT and other uses of pesticides in Public Health Programmes
- Effluents from pesticides manufacturing units
- Wrong disposal of left over pesticides and cleaning of plant protection equipments
- Pre-marketing pesticides
- Treatment of fruits and vegetables

Effect on non-target organisms by both pesticides and pesticide residues.

"It is not my contention that chemicals never be used. I do contend that we have put poisonous and biologically potent chemicals in the hands of persons largely or wholly ignorant of their potential harm." (Rachel Carson, Silent Spring, 1964)

Accidental oral exposure occurs most frequently when pesticides have been taken from the original labelled container and put into an unlabelled bottle or food container. Unfortunately, children are the most common victims. For example, children under age 10 are the victims of accidental pesticide deaths. Breast milk may be contaminated and represents the very top of the food-chain: Residues of organochlorine pesticides and POPs have been detected in breast milk (including DDT, HCB and HCH isomers) in contaminated areas. Pesticide powders, dusts, gases, vapours and especially very small spray droplets can be inhaled during mixing, loading or application or when pesticides are applied in confined areas. Once breathed into the lungs, pesticides can enter the bloodstream rapidly and damage can damage nose, throat and lung tissue.

Pesticides can cross the epithelium of the skin and mucous membranes that exchange gases (alveoli) or nutrients (gastrointestinal mucosa).

Pesticides have been detected in the amniotic fluid and body tissues of human foetuses even during early stages of prenatal life.

Effects on human health and children: The signs and symptoms of pesticide poisoning

- dermal and ocular irritation (or allergic response)
- upper and lower respiratory tract irritation
- allergic responses and asthma
- gastrointestinal symptoms: usually vomiting, diarrhoea and abdominal pain

- neurological symptoms: excitatory signs in the case of exposure to organochlorines, lethargy and coma; also polyneuritis

Remedial measures

Many strategies can be adopted to mitigate the hazards due to pesticides. The most important is Personal protective equipment (PPE) because it can prevent 90% of the pesticides related injuries.

Personal Protective Equipment (PPE)

Personal protective equipment (PPE) is clothing and devices that are worn to protect the human body from contact with pesticides or pesticide residues. Personal protective equipment includes such items as coveralls or protective suits, footwear, gloves, aprons, respirators, eye-wear and head gear. According to a study, 90% of the pesticides injuries can be prevented by the use of PPE. This protective equipment are made up of woven fabric or a water repellent material, for example, Neoprene, nitrile, polyvinyl chloride (PVC) and butyl rubber. Besides clothing, other devices like face shields, goggles, boots are also required for the protection. For the proper maintenance of pesticides contaminated clothing, it should store and wash separately from the family laundry. Discard clothing that has become saturated with a concentrate. Washing in hot water removes more pesticide from the clothing than washing in cooler water.

Pesticides regulations in India

Many efforts have been done by the Government of India to tackle the problem of adverse health effects of pesticide use. Pesticides regulations are governed in India under various Acts/Rules.The monitoring of pesticides residue levels in food comes under the purview of Union Ministry of Health and Family Welfare. Ministry of Agriculture is taking some steps to minimise pesticides residues. These are -

- Educating farmers about ill effects of pesticides, need-based use of chemical pesticides
- Use of recommended dosage
- Correct application techniques
- Observance of prescribed waiting period
- Practices of Integrated Pest Management (IPM)
- Benefits of organic farming

Action taken to prevent pesticide exposure for health and environment welfare

Many steps can be taken at the local/practice level, national/government level and international treaty/trade levels to decrease exposure to pesticides and related illnesses.

Prevention at Local level

- Pesticides should be used only when the non-chemical pest control procedures have failed.
- Integrated pest management (IPM) procedures which include hygiene, sealing of cracks and crevices, screening of doors and windows and other measures should be the first line of defence for pest management.

- Users should always follow the safety precautions specified by the manufacturer and should also were Personal protective equipment (PPE).
- Pregnant women should not apply pesticides and it should be kept away from the infants and small children.
- If chemicals are required, the least hazardous chemical (when there is scientific evidence of less toxicity) should be used.

Prevention at Community Level

- Many organisations like Food and Agriculture Organisation (FAO) and World Health Organization (WHO), promote alternative non-chemical forms of pest-control and there is increasing engagement in non-pesticide dependent agriculture and integrated pest management (IPM).
- A variety of local initiatives involving the community can help to create an environment that promotes decreased dependence on pesticides in homes, schools, public areas, health facilities and parks.
- Other examples of community activities include:
  i) community campaigns and school activities
  ii) local awards or contests
  iii) pesticide-free "zones"
- Education is a key component of safe pesticide use and prevention of toxic exposures. Farmer, pesticide applicators and their families need to be informed and educated on how to recognise and prevent pesticide poisonings. Trained or licensed pesticide applicators can maximise preventive measures.

Check Your Progress 3

i) List the Signs and Symptoms of pesticide poisoning.

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ii) Write advantages and disadvantages of pit latrines.

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3.10 LET US SUM UP

The Centrally Sponsored Rural Sanitation Programme (CRSP) was launched in 1986 in India with the overall objective of improving the quality of life of the rural people and to provide privacy and dignity to the women. Total Sanitation Campaign (TSC) was introduced in 2002. It was people centered and community led programme. It involved construction of sanitary latrines for households below poverty line, construction of village sanitary complexes for women, setting up of sanitary marts and intensive campaign for creating awareness and health education. However, despite these programmmes the scenario of sanitation system in Indian villages is quite dismal.

Low-cost sanitation facilities and hygiene promotion campaigns have never been prestigious; politicians and movie stars don't demonstrate latrines. Among professionals, the best and the brightest avoid low-cost sanitation as a low-status, low-paying career, particularly as it is more difficult and demanding than the high-status, high-tech engineering or medical fields. Among consumers, low cost sanitation has no prestige in comparison with "conventional" water borne sanitation that the industrialised world and the economic elite of developing countries use. Still due the importance involved FHW should actively participate in TSC and Swachchhta Abhiyaan.

3.11 MODEL ANSWERS

Check Your Progress 1

1) These include cholera, typhoid and bacillary dysentery etc. These are caused by ingestion of water contaminated by human or animal excrement.

- **Water-washed diseases** are caused by poor personal hygiene due to water shortage, e.g., scabies, trachoma, typhus, flea, lice and tick-borne diseases.
- **Water-related diseases** are caused by insect vectors, especially mosquitoes, that breed or feed near water, e.g., dengue fever, filariasis, malaria.
- **Chemical contamination** of water is another potential cause of health problems. In some places, water may contain naturally occurring toxic chemicals such as arsenic and fluoride. Other chemicals may get into the water supply because of pollution. Lead poisoning, for example, can result from water contaminated with lead. Examples of chronic health effects of chemical contamination of water are liver / kidney damage.

2) Three methods are used for purifying at home

Boiling: Water must be brought to 'ROLLING BOIL' for 5 to 10 min.

Advantages: Cheap and best method.

Along with microorganism, spores, ova, cyst, viruses etc are also destroyed.

Water get sterilised.

Check Your Progress 2

1)

Domestic Source	Burning of fire wood, Kerosene oil, coal
Industrial Source	Factories of iron, steel, paper, cement, fertilizers, thermal power plant, petroleum refineries.
Vehicular Source	Motor vehicles, railways, ships, airplanes
Miscellaneous	Tobacco smoking, nuclear explosions, forest fire, burning of refuse, dust storms, ocean sprays.

2) Ill effects of air pollution

- **Immediate and acute effects:** Irritation of conjunctiva, nose, throat and respiratory mucous membrane, allergic rhinitis, acute pharygits,

bronchitis asthama. It may cause suffocation and death. E.g. **Bhopal Gas Tragedy.**

- **Delayed and Chronic Effects:** Chronic bronchitis, bronchiectasis, emphysema, COPD, bronchial asthama, even lung cancer.
- **Global Effects:** Acid rain causes acidification of soli and water, Tree gets killed by acid rain causes deforestation, erosion of soil.

Check Your Progress 3

1) **The signs and symptoms of pesticide poisoning**

- dermal and ocular irritation (or allergic response)
- upper and lower respiratory tract irritation
- allergic responses and asthma
- gastrointestinal symptoms: usually vomiting, diarrhoea and abdominal pain
- neurological symptoms: excitatory signs in the case of exposure to organochlorines, lethargy and coma; also polyneuritis

2) **Advantages and disadvantages of pit latrines**

In general, pit latrines with a slab are effective sanitation systems because they isolate human excreta from the surrounding environment and prevent the transmission of faeco-orally transmitted diseases. They also have other advantages:

- They do not require water so are appropriate in areas where there is no adequate water supply.
- Squatting is normal to many people and thus is acceptable to users.
- Alternating double pits will allow the excreta to drain, degrade and transform into a nutrient-rich, safe humic material that can be used to improve soils.
- They avoid contamination of surface water and top soil if properly installed and maintained.
- They can be constructed with minimum cost using local material and local skills.
- The presence of properly constructed slabs will allow easy cleaning and avoid flies and unsightliness.

3.12 REFERNCES

1) NRHM: Handbook for members of Village Health Sanitation and Nutrition Committee.

2) Bassett W.H. (ed.).Hygiene and Environmental Health. Part 1 &2.Blended Learning Modules for the Ethiopian Health Extension Programme. 19th ed, London, Spon Press, 2004.

3) Trainers Participatory Hygiene and Sanitation Promotion Manual. UNICEF Nigeria, 2008.

4) Training Manual on Hygiene and Sanitation Promotion and Community Mobilization for Volunteer Community Health Promoters (VCHP).

TOTAL BEHAVIOUR CHANGE IN HYGIENE & SANITATION VCHP GUIDE.

5) UNICEF. Water, Environment and Sanitation Technical Guidelines Series - No. 3.In. Towards Better Programming A Sanitation Handbook. First Edition: May 1997.

6) Singh N, Madhanraj K and Singh AJ. Health Promotion in Rural Areas: The Healthy Village Concept.In. "Health Promotion: Need for Public Health Activism Vol I, Singh AJ, Goel S and Kathiresan J.(editors) Germany LAP LAMBERT Academic Publishing, 2013: 197-223.

7) Madhanraj K, Singh A, and Singh N. How 'Healthy' are Villages in District Ambala, Haryana: A Pilot Study?Journal of Postgraduate Medicine Education and Research, 2014;48 :19-23.

UNIT 4 INTRODUCTION TO EPIDEMIOLOGY-EPIDEMIOLOGICAL APPROACHES AND PROCESSES

Structure

4.0 Introduction

4.1 Objectives

4.2 Epidemiology - Concept, Definition, Distribution and Frequency of Disease

- 4.2.1 Concept and Definition
- 4.2.2 Distribution and Frequency of Disease
- 4.2.3 Aims and Uses of Epidemiology
- 4.2.4 Epidemiological Models of Causation of Disease
- 4.2.5 Concepts of Disease Transmission

4.3 Modes of Disease Transmission

- 4.3.1 Direct Transmission
- 4.3.2 Indirect Transmission
- 4.3.3 The Chain of Infection

4.4 Time Trends or Fluctuations in Disease Occurrence

- 4.4.1 Definitions used in Disease Epidemiology
- 4.4.2 Types of Fluctuations in Disease Occurrence

4.5 Epidemiological Approaches

- 4.5.1 Descriptive Epidemiology
- 4.5.2 Analytical Epidemiology
- 4.5.3 Experimental Epidemiology

4.6 Principal of Control Measures/Levels of Prevention of Disease

4.7 Let Us Sum Up

4.8 Model Answers

4.9 Key Words

4.10 References

4.0 INTRODUCTION

In the previous units of this block, you must have read about community health, health care planning and organisation of health care at various levels, also environmental health and sanitation in details. Epidemiology not only helps in understanding the health concepts, and disease causation, it also helps in planning, implementing and evaluating health care services.

The present unit gives an overview of epidemiology in terms of its concept, aims, uses, modes of disease transmission and fluctuations in disease occurrence. Let us learn these aspects of epidemiology.

4.1 OBJECTIVES

After completing this unit, you should be able to:

- define the term epidemiology and explain its aims and uses;
- describe the concept of epidemiology and comprehend the various modes of disease transmission;
- discuss epidemiological approaches and methods;
- explain the levels of prevention of diseases;
- describe epidemic, endemic and pandemic; and
- familiar the time trends or the fluctuations of disease occurrence;

4.2 EPIDEMIOLOGY-CONCEPT, DEFINITION, DISTRIBUTION AND FREQUENCY OF DISEASE

We shall focus on various aspects of epidemiology as given below.

4.2.1 Concept and Definition

The science of epidemiology deals with the study of occurrence of health related states and events in a population – who gets the disease where and why?

You might be wondering why oral cancer is more common among males as compared to females, Japanese encephalitis keeps on occurring in eastern Uttar Pradesh, trachoma is found more commonly in western parts of India such as Punjab, Rajasthan as compared to other parts of India. If you try to analyse carefully you will find that there are certain factors responsible for the variations in the occurrence of diseases by person, by place and according to the time of the year. Sometimes there is a large scale occurrence of a particular disease in a specific area affecting specific population. Why this happens? How can this be controlled? It is necessary to understand the characteristics of disease occurrence and find out the responsible factors for disease prevention and control. There is a scientific approach to study the disease in the context of its occurrence, its distribution across geographical regions, populations, and factors responsible for its occurrence. The approach generally comes under epidemiology.

The term epidemiology is derived from the Greek 'epi' means 'on, upon, befall', 'demo' means 'people, population', and 'logos' means 'the study of'.

Definition

There are several definitions of epidemiology.

According to Greenwood (1934) "Epidemiology is the study of disease as a mass phenomenon." This concept is merely concerned with the occurrence of disease in a large population. This definition has the limitation of being having a narrow outlook. If epidemiology deals with disease outbreaks in the population, what about the distribution, and factors responsible for disease occurrence?

The epidemiology is define as "The study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems".

Hence, Lilienfeld (1957) came with another definition which states "Epidemiology may be defined as the study of the distribution of a disease or condition in a

population and of the factors that influence this distribution". On similar concept, MacMahon (1960) also gave the definition of epidemiology as "The study of the distribution and determinants of disease frequency in man".

This definition widens the scope of epidemiology. It gives an idea about the distribution of a disease in the population. Let us look at the following example. A low lying village near the river Brahmaputra gets inundated by floods every year during monsoon season. During monsoon season, a large number people suffer from diarrhoea in the village, much more than the usual frequency of diarrhoea occurring among the people during other seasons of the year.

In this example, diarrhoea is affecting a large number of people in a village near the river during a particular season. Hence, the disease occurrence has been distributed in the particular village (place of occurrence). Diarrhoea has occurred out of proportion during monsoon season (time of occurrence). The factor responsible for the diarrhoea occurrence during monsoon season can be related to consumption of contaminated water by the people in the village due to floods. Thus, factor responsible for diarrhoea has also been determined. All these aspects are covered under the definition given by Lilienfeld.

Let us go beyond these aspects of epidemiology. Think about 'what is the use of describing a disease in terms of distribution by place, person and time?' Is it merely for discussion by the health care providers? Or is it related for actions to control and prevent the disease? The ultimate aim of studying a disease lies in the control and prevention of the disease so as that people are healthy. Hence, a broader definition which includes aspects of disease control and prevention is more comprehensive and acceptable. Such a definition was given by John M. Last in 1988.

This definition goes beyond disease and includes health related states or events such as accidents, mental health, quality of health services etc. Hence, this is the most acceptable definition of epidemiology. Let us try to understand some of the terms used in this definition.

4.2.2 Distribution and Frequency of Disease

You can look around and try to find out whether everyone is healthy. It may not be so, some one may be suffering from infectious disease such as typhoid fever, malaria, tuberculosis etc. whereas some person may be suffering from chronic diseases such as diabetes, hypertension, asthma, heart attack, so on. Thus, a variety of diseases may be prevalent in the population. Epidemiology helps in mapping out such diseases or health related events in various subgroups of the population by time, place and person.

Not only mapping, we also need to know the magnitude of the health problems to identify the most frequent diseases or health related events. This is measured in form of rates or proportion (e.g. prevalence rate, attack rate, proportion of cataract among causes of blindness etc.) Such measurements help in comparison of the health problems between different populations or subgroups of the population such as between males and females, between rural and urban areas etc. Measuring frequency of health problems in the same population over a period of time can give us a picture about the changing trend of the occurrence of the health problem. This is important from the point of assessing the effectiveness of efforts in trying to control or prevent the health problems by the Government or local health agencies.

Determinants of disease: You might have heard that smoking causes lung cancer, alcohol consumption leads to liver failure, consumption of high salt intake is a risk

factor for hypertension (high blood pressure) and so on. You might be wondering how these factors are related to the occurrence of the diseases. Epidemiological studies are helpful in identifying such risk factors related to diseases.

4.2.3 Aims and Uses of Epidemiology

Let us now read about aims of Epidemiology and followed by uses in details.

According to the International Epidemiological Association, aims of epidemiology are:

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

Descriptive epidemiology involving cross sectional studies help us in describing distribution and magnitude of disease or health problems in the population.

Hence, epidemiology aims at reduction of human suffering from diseases or health problems by helping in understanding the risk factors, aetiological agent, and also the natural history of diseases.

Uses of epidemiology

By now, you might have learnt about the concept of epidemiology and the aims. You might have got some idea about its uses as well. Now, let us discuss the uses in detail. Epidemiology is the basis for improving public health status globally and it has got many uses. According to J M Morris, the uses of epidemiology are summarised as below.

1) **To study the natural history of disease, disability, injury and death**

You have gone through natural history of disease in Unit 1 of this block.

It helps to study the rise and fall of diseases and changes in their character. Remember that the occurrence of disease in the community is never static. It keeps on changing over a period of time affecting new susceptible population. Sometimes, the disease may fade gradually and may disappear until favourable conditions help it to appear in the population. As an example, small pox has been eradicated from the globe, but newer diseases such as HIV, Lassa fever etc. have been identified. Epidemiology has played a major role in the understanding of the occurrence of such newer diseases and in the control of other diseases.

2) **To make a community diagnosis**

Community diagnosis refers to the identification of health problems, related factors and their quantification in the population. The health problems could be in terms of understanding the diseases, conditions, injuries, disorders, disabilities, defects causing illness, or death in a community or region. This is done by measuring the present dimensions and distribution of ill health in terms of incidence, prevalence, and mortality. Epidemiological method such as survey is employed in understanding the magnitude of the health problems in the community. In addition to profiling diseases, epidemiology also helps in understanding the factors such as social, cultural and environmental conditions contributing to the distribution and occurrence of health problems. This information is useful in designing intervention programmes for controlling the diseases in the population.

3) **To assess risk factors of diseases in the population**

You may recall that agents are responsible for causation of infectious diseases. In addition to the causal agents, there are several contributing factors for occurrence of diseases. Sometimes, it may be difficult to identify the causal agent and we may only come across factors associated with the diseases in the community. Such factors are considered to be risk factors. As an example, the risk factors for hypertension are obesity, family history of hypertension, sedentary life style, smoking, alcoholism, high salt intake, high intake of saturated fat etc.

Risk factors are assessed in the population groups for various diseases, health conditions, injury, disabilities, defect etc. Epidemiological approaches such as health risk appraisal, health screening, medical examination, disease assessments by rapid surveys etc. are used for this.

4) **To assess, evaluate and conduct research on the health programmes**

You may know that there are several health programmes launched by the Government with the aim of controlling, preventing or giving treatment to the affected persons in the population. It is necessary to understand the progress and effectiveness of these health programmes for further modifications in the programme, if needed, and also to understand how well do public health and health services meet the problems and needs of the population. Epidemiological methods are applied in assessing and evaluating the outcome, effectiveness of health programmes in the population. Studies using epidemiological approaches are also used for converting research on the health problems and bringing out appropriate solutions to tackle the problems.

5) **To complete a clinical picture**

Understanding of the clinical spectrum of diseases is often the result of reports of diseases which are presented in the hospitals or clinics. While it is easier for the physician to study details of the disease in hospital set up, it is limited by a large number of diseases which go unreported to the doctor in the hospital. Many of them might have died even without reaching the hospital. Under such circumstances, we are unable to study clinical details of those who have not visited a doctor in the hospital. Thus, the reports based on hospital cases do not represent the whole clinical spectrum of diseases occurring in the community level. Epidemiological approaches in the community help in overcoming this gap to get a complete clinical picture of the disease.

Let us look at this example. Usually minor or atypical ischaemic heart disease does not report to the physician in the health centre or hospital. And many of such atypical ischaemic heart disease cases die suddenly, unattended by a physician. Missing information on such sudden death cases leads to incomplete clinical picture about ischaemic heart diseases. However, epidemiological methods can help in understanding the clinical picture, prognosis and thus, help in modifying treatment. In short, the natural history of disease will be more complete if the information is obtained from all cases using standardised criteria for diagnosis in the community.

6) **To identify syndromes**

Syndromes are a group of clinical features, characteristically related to a particular disease.

Syndrome identification is done by describing the distribution, association, and dissociation of clinical phenomena in the population using appropriate epidemiologic methods. A common observation in clinical practice is the clubbing

of cases of coronary heart disease and cerebrovascular lesions as "Atherosclerosis" cases. This is not justified since the two conditions may not behave similarly in terms of clinical presentation and prognosis. Similarly, in earlier times until 1920, little was known about two main groups of peptic ulcers i.e. gastric and duodenal ulcers. Better understanding of differentiation of these cases came with observational studies leading to refining syndromes. Thus, epidemiology contributes in defining and redefining clinical syndromes.

7) **To search for causes of health and disease by studying the incidence in different population groups, in terms of inheritance, behaviour and environment**

You might wonder how causes or aetiological agents of diseases could have been identified. Initial observation of the physicians, correlation of factors, comparison of the observations across different geographical areas as reported by various researchers, and supplemented by positive laboratory investigations leads to identify the causal factors. These are components of epidemiological approaches. Several examples can be cited in this regard, viz. use of thalidomide drug during pregnancy for pain relief and teratogenic outcomes in the newborns, cigarette smoking in British doctors and occurrence of lung cancer, rubella infection during early pregnancy and observation of congenital malformations in the newborn child etc. Our understanding of the causal factors in various chronic non communicable diseases such as cataract, cancers, cardiovascular diseases etc. is limited. Every day we find some newer factors or refuting older factors even in the chronic diseases based on epidemiological studies. Thus, the search for "risk factors" will remain elusive and it will continue in future as well.

In brief, to accomplish all the above mentioned uses, various epidemiologic methods are employed viz. (1) investigation of disease outbreaks or epidemics, (2) studies based on surveys to obtain occurrence of new cases of disease (incidence) and the prevailing disease at the time of survey or within a specified period of time (prevalence), assess risks, etc. (3) clinical trials to determine effectiveness of drugs, vaccines, or therapeutic regimes etc., (4) maintaining registries of diseases such as cancer registry, blindness registry, birth defect registry etc., (5) early detection or screening for diseases, (6) surveillance of a community for disease occurrence, (7) monitoring and evaluating the impact of health care systems.

4.2.4 Epidemiological Models of Causation of Disease

When we talk about the occurrence of a disease, we need to understand that it involves certain causative factors, affected person and the circumstances under which the disease occurs. In an outbreak of disease, several factors often play a role. As an example, when cholera outbreak occurs, there is a causative factor i.e. a type of microorganism (bacteria) called as Vibrio cholerae; transmitting medium which is usually contaminated water or food items, and an occasion where a large number of people gather together, take foods or drinks from a common source which may be contaminated by the microorganism (bacteria), the quantum of bacteria ingested, and the condition of immune system of the persons affected. These factors can be interrelated to each other and absence of one or more factors may not lead to the occurrence of cholera. When we talk about these factors, we try to categorise these factors into three broad groups viz. agent, host and environment. In this example, agent is Vibrio cholerae, host is human being and environment factors are water supply, sanitation etc.

Let us try to understand the interrelationship of agent, host and environment in a more elaborate manner.

Agent

Agent is usually considered to be the causal factor. A single factor must be present for an infectious disease to occur. It may be the microbes which may be bacteria, fungi, rickettsiae, virus. As an example, the spirochete is the agent of syphilis, a bacterium is the agent of cholera, a virus is the agent of measles. In occupation related diseases, lead is the agent for lead poisoning, asbestos for asbestosis etc. In other disease conditions, disability, injury, or death situations, the agent may be a chemical such as a poison, physical factor such as cold, heat, radiation, nutritional deficiency, animal poison such as that of a snake etc.

In epidemiology, we try to understand the interaction of various elements and factors in the environment in the context of disease outcome. The relationship between the organisms with the environment is closely observed and studied. However, all disease conditions cannot be attributed to a single causal agent, such as myocardial infarction (heart attack), which has several factors i.e. family history, sedentary lifestyle, smoking, alcohol consumption, obesity, high blood pressure, and high fatty diet consisting of saturated fats. When more than a single cause is present for occurrence of a disease, this is called multiple causation. Even in infectious disease also, a bacterium cannot solely cause the disease outbreak. We need to consider other factors such as the environment in which the organism grows, mode of transmission, the level of sanitation within the community, medium conducive to propagation, communicability of the organism, level of immunity in the population, population density and proximity of the cases to one another.

Host

By now you might have noticed that presence of an agent alone does not lead to disease condition. The agent should enter the body of another living being such as a human or an animal to cause the disease or harbour the agent. Thus, a host harbours the disease. The host may or may not get the disease. It again depends upon several factors such as immunity level, genetic make up, exposure level, and the state of health. Other factors such as gender susceptibility, social class, economic status, age, educational level also contribute to the etiology and distribution of disease. Illness caused by environmental factors such as heat, cold, radiations, noise, pollution etc are amenable to preventive and control.

Environment

The external conditions or surroundings of the human or animal favouring transmission of the disease agent are considered to be environmental factors. In the case of cholera, it may include a poor sanitation leading to contamination of the water supply with disease causing microbes, in case of dengue fever-stagnant clear water for mosquito breeding and so on. The environment includes three components: biological environment consisting of animals, plants, and living organisms external to the host and also within the host; social environment consisting of the economic, political, social and cultural practices prevalent in the society; the physical environment consisting of water, air, soil, radiations, sound, radiations, altitude, chemicals to which the host is exposed.

Historically, in 1500s, when small pox was introduced in Jamaica, the entire native population of the country lost their lives. The attributing factors included lack of exposure, immunity against small pox in the people, lack of sanitation, lack of knowledge about prevention and environmental conditions.

The relationship between the agent, host and environment is shown in the form of a triangle (Fig. 4.1).

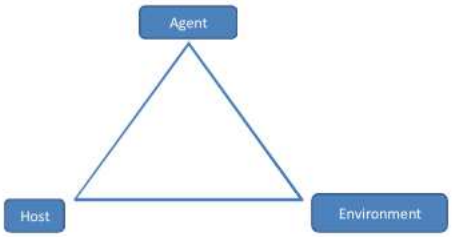


Fig. 4.1: Epidemiology Triangle

4.2.5 Concepts of Disease Transmission

Before discussing the modes of disease transmission we need to know some concepts related to disease transmission viz. fomite, vector, reservoir and carrier. Let us try to understand some of these one by one.

Fomites

Fomites (in singular, fomes) are inanimate objects which play a role in disease transmission. These could be towel, drinking glasses, pen, pencil, door handles, clothing's, or any other inanimate object which can help in transmission of infection by being contaminated with infectious agents and then touched or came in close contact with another person.

Vector

A vector is an arthropod such as mosquito, fly, flea, or rodents such as rat, mouse which is living non human carrier of disease that transports or serves the process of disease transmission. The vector carries the agent from an infected person or animals through bite, body fluids, waste products, or by contaminating foods and spreads to another person.

Reservoir

A reservoir is human, animal, plant, soil or inanimate organic matter (food or faeces) in which the infectious organisms live and multiply. Human being can serve both as a reservoir or a host.

Carrier

A carrier harbours, contains or spreads an infectious organism. A person or animal may appear to be normal despite harbouring the infectious organism but he or it can transmit the infectious agent to another person or animal through contact, or a transmission media such as water, food etc. and cause disease. The transmission of the infectious agent can occur during illness or even during or after recovery of the illness. Depending on the stage of disease state, carriers can be classified as: (a) incubatory carrier, (b) convalescent carrier, (c) healthy carrier.

a) **Incubatory carrier:** A person who sheds the infectious agent during early phase of the disease when the infectious agent has entered the body and the body has not started showing symptoms and signs of the disease (also called as incubation period). Such a person can transmit the infectious agent to another person and cause infection. Some examples of diseases having this type of carrier state are measles, mumps, polio, pertussis, diphtheria, and hepatitis B.

b) **Convalescent carrier:** An individual who has been exposed to and harbours a disease causing organism during the recovery phase of the course of the illness, but is still infectious is considered to be convalescent carrier. One of the best examples in this type of carrier is that of Typhoid Mary, who carried the salmonella typhi (causative organism for typhoid fever) for a long time and infected a large number of persons. It is known that typhoid fever patient can excrete the bacilli for 6 to 8 weeks. Such a carrier can pose a serious threat to the unprotected contacts and household members. Examples of some other diseases showing this type of carrier state are cholera, diphtheria, pertussis.

c) **Healthy carrier:** An individual who has been exposed to and harbours a disease causing organism, but has not become ill or has not shown any symptoms and signs of the illness at any point of time is called as a healthy carrier. Such type of carrier is also considered to be having a subclinical state of the disease. They are also called as "Passive carriers". Some examples of diseases showing this type of carrier state are cholera, meningococcal meningitis, polio, diphtheria and salmonellosis.

Based on the duration, carriers can be categorised as (a) temporary carrier, and (b) chronic carrier.

a) **Temporary carrier:** In this type, an individual harbouring the infectious organism excretes the organism for a short period of time. This category can include incubatory, convalescent and healthy carriers.

b) **Chronic carrier:** Here, an individual harbouring the infectious organism excretes the organisms for an infectious disease over a prolonged period of time. Some examples of diseases showing chronic carrier state are typhoid fever, dysentery, malaria, hepatitis B etc. Chronic carriers are a major source of transmission of infectious disease in the community. Some of them can excrete the organisms intermittently while some excrete the organisms continuously. Such carriers are the source of introducing an infectious disease in a virgin area or otherwise free of infection.

Check Your Progress 1

1) What is the definition of epidemiology to be used in the course?

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2) Enumerate the uses of epidemiology.

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3) What are the components of an epidemiology triangle?

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4) What is the role of vector in disease transmission?

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4.3 MODES OF DISEASE TRANSMISSION

After understanding some of the above mentioned concepts of disease transmission, let us now discuss details of modes of disease transmission. There are several methods of transmission of the agent to the host, from one host to the next host or exit from the host to infect another susceptible host which may be an animal or human being. It is dependent upon the infectious agent, portal of entry or the local prevailing environmental conditions. Broadly, the modes of disease transmission can be either direct or indirect.

4.3.1 Direct Transmission

It is also referred to as person-to-Person transmission. In this, there is direct and immediate transfer of the microorganism or the agent from a host or reservoir to a susceptible host. Direct transfer can happen through (a) direct contact, (b) droplets, (c) contact with soil, (d) inoculation through skin or mucosa, and (e) transplacental (through placenta from the mother to the foetus).

a) **Direct contact:** Here, transmission of the infectious agent occurs through skin to skin contact as in the case of scabies, or mucosa to mucosa, or mucosa to skin of the same or another person. There is no involvement of any intermediate agency for the transmission of the agent. Skin to skin contact may be through touching by the contaminated hand or close continuous contact, kissing, or sexual intercourse. Examples of some diseases transmitted by this mode are leprosy, HIV/AIDS, skin infections etc.

b) **Droplets:** The nasal or nasopharyngeal secretions or saliva are released into a spray of droplets during coughing, sneezing, talking or spitting. Such droplets from an infected person, usually of the respiratory tract can be expelled to the surrounding environment. The droplets containing infectious agent can be transmitted upto a distance of about 30–60 cms from the source. On inhalation by other persons, small droplets (5 mm or less) can go deeply and reach the alveoli and can spread the disease. Examples of diseases which can spread through droplets are tuberculosis, respiratory infections, whooping cough, meningococcal meningitis etc.

c) **Contact with soil:** Soil including compost or decaying organic matter is the source of infectious agents for diseases such as tetanus, hookworm, mycosis etc. Direct exposure to soil can lead to transmission of these infectious agents.

d) **Inoculation into skin or mucosa:** Infectious agents such as hepatitis B, HIV, can be transmitted directly by inoculation into the skin by injection or through dog bite for rabies virus.

e) **Transplacental:** Also called as vertical transmission, some infectious disease agents such as HIV, hepatitis C, syphilis etc. can be transmitted from the mother to the foetus through placenta.

4.3.2 Indirect Transmission

This is a condition when the disease causing agents are transferred or carried by some intermediate items, means, processes, or organisms to the susceptible host resulting in disease. Indirect transmission can occur through several means: (a) airborne, (b) waterborne, (c) vehicle-borne, (d) foodborne, and (e) vectorborne.

a) **Airborne transmission:** As discussed above, airborne transmission can occur through droplets or dust particle infected with organisms or disease agents. It can remain floated in air for a long time and are carried by wind stream to long distances away from the source.

b) **Waterborne transmission:** This is one of the common ways of transmission of infectious disease agents. Drinking water sources include river, lakes, ponds, wells etc. which may be contaminated by sewage, effluents from industrial waste, and other toxins. Contaminated swimming pool can also lead to transmission of skin and eye infections. There are a large number of waterborne diseases some of which are cholera, shigellosis, typhoid, amoebiasis, giardiasis etc.

c) **Vehicle borne transmission:** In this mode of disease transmission, there are intermediate items such as fomites, eating utensils, comb, clothings, shared drinking bottles etc. transmit the agents. For example, sharing of common kajal applicator can lead to transmission of microbial agent causing trachoma from one person to another.

d) **Food borne transmission:** Food items can act as a medium for transmission of disease agents such as contaminated and improperly washed vegetables used for salad can transmit microbial agent, salmonella which can cause typhoid fever, canned seafood can lead to food poisoning and so on.

e) **Vector borne:** As mentioned earlier, vectors are arthropods or living carrier other than human being which transports infectious agents to susceptible individuals. Vectors could be invertebrates such as flies, mosquitoes, fleas, cockroaches, lice, bugs, ticks, mites and svertebrates such as mice, rat, bat. There are broadly two ways in which vectors transmit infectious agents viz. (1) mechanical and (2) biologic transmission.

   1) **Mechanical transmission:** The mode of transmission can be by a simple mechanical process, when the vector carries or transports the infectious agent such as a fly carrying bacilli causing diarrhoeal disease. This is known as mechanical transmission.

   2) **Biologic transmission:** On the other hand, some infectious agent multiplies or develops inside the host/vector a part of its lifecycle, than it is termed as

biologic transmission. For example, the malarial parasite Plasmodium develops inside the female Anopheles mosquitoes a part of its sexual development.

4.3.3 Chain of Infection

You might be wondering why we have been discussing the issues related to epidemiology triangle, concepts is epidemiology and modes of disease transmission. Understanding these concepts is essential before we proceed for knowing the dynamics of disease transmission. Communicable disease transmission follows a medical model shown in Fig. 4.2. This is termed as chain of infection. Transmission of disease occurs when the infectious disease agent leaves the reservoir through a portal of exit, and is spread by one or more modes of transmission to the susceptible host. The infectious agent enters the host through a portal of entry.

The etiological agent/ infectious agent can be microbes such as bacteria, virus, worms, or chemicals, other plant or animal related substances having the potential to cause disease, disability, or death. The source is the person, animal, object or substance from which an infectious agent passes or is disseminated to the host. The reservoirs are mostly human, animal, or non-living things such as soil, food, faeces, decaying organic matter or substance wherein the infectious agent lives, multiplies, or reproduce. In hookworm infestation, the source of infection is the soil, contaminated with infective larvae and man is the reservoir of infection.

Human reservoirs could be differentiated into three groups: (1) clinical cases – those who are ill and exhibit signs and symptoms of the disease, (2) subclinical case – those who are infected with the infectious agent which multiplies in the host but does not exhibit signs and symptoms of the disease, and (3) latent infection – in which the infectious agent lies dormant within the host without signs and symptoms, and without demonstrable presence in body fluids, blood, tissues, secretions of the host. Subclinical cases play an important role in the transmission of infection from one person to another. Subclinical case may be detected by laboratory tests e.g. by estimating antibody response, biochemical tests etc. Many subclinical cases may be seen in rubella, polio, mumps, influenza etc. Some infections such as herpes simplex, slow viruses, etc. show latent infection.

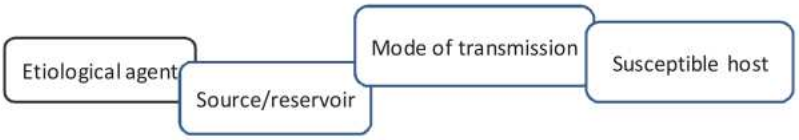


Fig. 4.2: Chain of infection

Once the etiological agent leaves the reservoir, it is passed on to the host by mode of transmission either by direct (person to person) or indirect transmission (airborne, droplets, fomites, food, vectors etc.). The final link in the chain of infection is the susceptible host (human or animal). Several factors play a role in the host before the disease sets in the host. The host has defensive mechanism against infectious agent in the form of protection by intact skin, mucous membrane, ciliary action of the respiratory tract, cough, acidity of the stomach, body's immune response. If the infectious agent overcomes these protective mechanisms and enters the body of the host, it is likely that the host will fall ill.

Check Your Progress 2

1) What are the direct modes of transmission of diseases?

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2) Enumerate the indirect modes of disease transmission.

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3) What constitutes the chain of infection?

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4.4 TIME TRENDS OR FLUCTUATIONS IN DISEASE OCCURRENCE

Before discussing the time trends or fluctuations in disease occurrence, let us try to understand some definitions used in disease epidemiology. Some of these are as follows:

4.4.1 Definitions used in Disease Epidemiology

Endemic: (en = in, demos = people). The constant presence of a disease or infection within a specified geographical area or population group is considered to be endemic for that particular area. Endemic can also be referred to as "usual" or expected frequency of the disease within a specified area or population. When the amount of diseases present in the population remains stable for long periods of time, it is considered to be endemic in that particular population. For example, upper respiratory infection, diarrhoeal diseases are endemic in India.

Epidemic: (epi= upon, demos= people). When a large number of persons are affected out of proportions to the routine occurrence of diseases in a specified population, then it is termed as epidemic. In other words, epidemic is "occurrence of an unusual frequency of disease above the endemic or expected frequency of occurrence" in a specified population, place and time. Some use the term "outbreak" for a small localised epidemic. For example, epidemics of infections such as measles, hepatitis, chicken pox, cholera etc. keeps on occurring off and on in specified populations in India.

There is ambiguity in what constitutes 'excess of expected frequency' for labelling epidemic. In places where the disease is eradicated or eliminated, occurrence of a single case would constitute as epidemic. For example, once polio is eradicated, even a single of polio would be considered as epidemic. For other commonly endemic diseases, when the frequency is more than two standard errors of the usual presence of the disease, usually calculated for a period of at least previous three years is considered to be epidemic.

Sporadic: When the disease occurs in scattered populations, irregularly, haphazardly from time to time and generally infrequently, then it is considered to be sporadic. There is no specific pattern of the occurrence of the disease in the

population with respect to time and place. The cases are usually few in number, not amounting to large epidemic proportions. In addition, there is no common source of outbreak that can be identified. As an example, some zoonotic diseases are seen to be sporadic in man.

Pandemic: (pan=all, demos=people) An epidemic affecting large population groups, extending to a wide geographical areas such as a nation, continent or the world is considered to be pandemic, e.g H1N1 influenza pandemic in 2009.

4.4.2 Types of Fluctuations in Disease Occurrence

Short-term, periodic, long-term

By now you might have come to know that disease occurrence keeps on changing over a period of time in different geographical areas. There are fluctuations in the disease occurrence and these can be (1) short term, (2) periodic, and (3) long term or secular.

1) **Short-term Fluctuations: Epidemics, Types**

Short-term fluctuations in the occurrence of disease can lead to an epidemic. As discussed earlier, you may recall that epidemic is considered when the disease occurs clearly in excess of expected normal distribution in a specified population and time. There are broadly three different types of short term fluctuation of diseases or epidemics.

A) Common source epidemics

B) Propagated epidemics

C) Mixed epidemics

A) **Common source epidemics**

When a large number of cases occur following exposure to a particular source, it is considered to be common source epidemic. It can be subdivided into (a) a single or point source exposure, (b) intermittent and (c) continuous/ repeated exposure.

a) **Common source, single exposure epidemic**

As an example, let us suppose that drinking of contaminated water supplied by a water plant led to the occurrence of large number of cholera cases (300) in East Delhi area supplied by the water plant over a period from July to September in 2013. Available data shows that only few cases ranging from 9 in 2012 to 10 in 2010 and 2011 occurred during the same months (Table 4.1). This shows clearly a great number of cases during 2013 as compared to the previous years in the same months. The occurrence of cholera in 2013 is considered to be an epidemic.

Table 4.1: Year and month wise distribution of Cholera cases in East Delhi from 2010 to 2013

Year	July	August	September	Total
2010	4	5	1	10
2011	3	5	2	10
2012	5	3	1	9
2013	50	240	10	300

If the cholera cases in 2013are shown in the form of a bar diagram, it shows a peak in August 2013 as shown in Fig. 4.3.

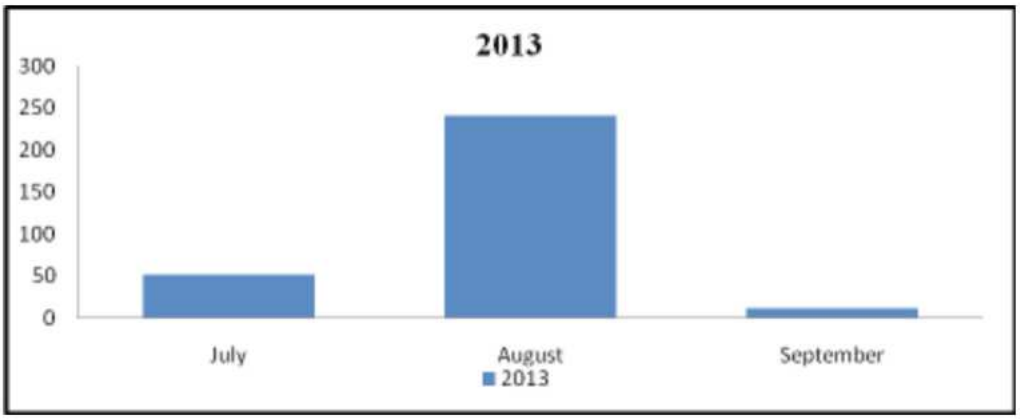
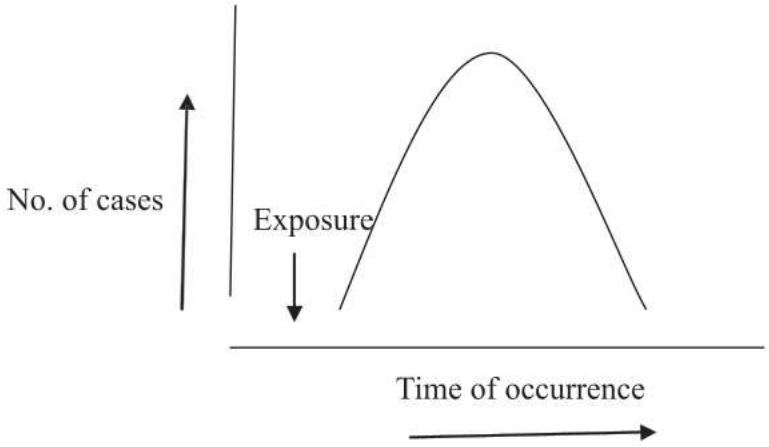


Fig. 4.3: Bar diagram showing number of cholera cases during July to September 2013.

Thus, when the occurrence of disease is shown as a curve it shows a peak with downward slope on both sides indicating an increasing and decreasing number of cases after the peak as shown in Fig. 4.4. This is known as epidemic curve.



The characteristics of a point source epidemic are (a) the curve rises and falls rapidly, (b) the peak shows maximum clustering of cases and within a short time interval, and (c) the cases develop during one incubation period (period from entry of the organism in the host to showing signs and symptoms of the disease).

b) **Common source, intermittent exposure epidemic**

In some disease outbreaks, persons are exposed to the disease off and on over a period of time i.e. days, weeks or even months together. In tuberculosis, the infected person coughs and transmits the disease through air droplets to close contacts. The infected person moves around and transmits to other people who come in close contact with him. Thus, there is no constant transmission of tuberculosis, but intermittently depending upon the movement and closeness of the infected person with other susceptible persons. This is clearly a case of intermittent exposure from a common infected person.

c) **Common source, continuous or repeated exposure epidemic**

Sometimes after the onset of an epidemic, the number of infected persons does not decrease over a long period of time. It keeps on sustaining at that level until it gradually comes down after affecting majority of the susceptible people in the particular or specific population. Such a situation emerges because of the spread of infection to the population through the untreated common source. As an

example, contaminated well water serves as a source of gastroenteritis in a particular village. Persons using this well water for drinking will keep on having the disease until it is chlorinated. Thus, there will be sustenance of the number of gastroenteritis casesin the village until well water is treated with chlorination. In common source, continuous exposure epidemic the occurrence of the disease outbreak continues beyond the range of one incubation period.

B) **Propagated epidemic**

In some disease outbreaks it may be difficult to identify the single common source. However, once the outbreak has been initiated, the disease transmission continues because of person to person transmission depending upon the contacts. Thus, the new infected person transmits another person, who in turn will transmit to another person and so on. This will lead to a situation in which the cases will continue until the immunity of the affected population is built up and or no more susceptible persons remain to be infected. Propagated epidemic usually exhibits an exponential growth pattern of the disease and fall off gradually. As in the case of common source continuous epidemic, the cases keep on appearing beyond one incubation period. The epidemic curve shows a series of successive peaks, indicating fresh number of cases cropping up in a large number, transmitted from newly infected persons. An example of this type of epidemic is the spread of HIV or hepatitis B infection through sharing of needles by intravenous drug users infected with HIV and or hepatitis B. New drug users using the infected shared needle keep on getting the infection and the epidemic can continue till no more new drug users are available to be infected. The epidemic declines once the affected population is treated, or immunised against the infection (if vaccine is available) or there is death of the affected persons. Propagated epidemics can be through direct contact, person to person, fomite borne, vehicle borne and or vector borne transmission. Mosquitoes spreading malaria is an example of vector borne transmission.

C) **Mixed epidemic**

The disease outbreaks can be a combination of common source epidemic which has started the epidemic and propagated epidemic maintained by person to person transmission. Both the situations may exist at the same time. This is called as mixed epidemic.

In addition to the abovementioned epidemics, another variant of epidemics commonly termed as "slow epidemic" or modern epidemic is also in vogue. This denotes the ever increasing number of cases of non-communicable disease such as diabetes, coronary heart diseases, depression etc. leading to public health alert. Such an epidemic may not be considered as a short-term fluctuation of disease since slow epidemics appear over a long period of time, years to decades. Steps of investigation of an epidemic outbreak is discussed in details in Practical Course 3 Block 1, Unit 3 management is also discussed in Course 1 Block 3.

2) **Periodic Fluctuations: Seasonal Trend, Cyclic Trend**

Occurrence of diseases may show fluctuations throughout the year and even year after year also. Such fluctuations may show (a) seasonal and (b) cyclic trend.

a) **Seasonal trend**

Many communicable diseases show a seasonal trend of disease occurrence. During winter season, cases of rota virus diarrhoea cases in children shoots up; whereas at the arrival of spring season the number of measles cases increases and during rainy season gastroenteritis cases increases while after the rains, dengue fever

cases come up in large numbers. Such observations are considered to be linked with the seasons and hence, epidemics may show a seasonal trend. The seasonal variation in the disease occurrence is related to the environmental conditions favouring disease transmission. It may be humidity, temperature, rainfall, overcrowding, or conducive conditions leading to breeding of the vectors which transmits the infections.

b) **Cyclic trend**

There are some communicable diseases which appear in the form of epidemics in a cyclical or periodic manner. It may be spread over days, weeks, months or even years. One of the examples is measles. During pre-vaccination times, it occurred cyclically after every two to three years when the number of susceptible individuals gradually built up and led to epidemics. Similarly, in rubella, epidemics can occur at every 6–9 years intervals of time. Cyclical nature of epidemics in infectious diseases is related to the immune status of the community, occurring more when there are a large number of people without immunity to the disease.

3) **Long-term or Secular Trends**

Some diseases tend to occur in large numbers over a long period of time, more than a year or so. It may be even in decades. Chronic diseases such as lung cancer, coronary artery disease, diabetes etc. tend to show this type of time trend. In all these conditions, the disease rates are tracked over time and secular trends emerge after years and decades. This information is useful for identifying diseases of public health importance, to formulate policy, programmes and the effectiveness of any intervention programme done to reduce morbidity and mortality from the disease in the population.

Check Your Progress 3

1) Define the terms endemic, epidemic.

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2) What is propagated epidemic?

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3) What is cyclic trend of diseases?

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4) List three levels of prevention of disease.

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4.5 EPIDEMIOLOGICAL APPROACHES

Epidemiological study requires systematic collection of health data, its analysis, description of health needs and health problems, identification of factors associated with the problems and stating the hypothesis which are: (i) Descriptive method, (ii) Analytical method, (iii) Experimental method. Descriptive and analytical methods or studies are also known as observational studies because the investigator does not intervene; he or she makes an observation of the frequency and distribution of the disease by person, place and time.

4.5.1 Descriptive Epidemiology

Descriptive epidemiology is concerned with the study of frequency and distribution of disease and health related events in population in terms of person, place and time. Its purpose is to provide and overview of the extent of health problems and to give a clue to possible etiological factors involved. This method gives information about who all are affected by a particular disease or health related problems, where the cases occur and when they occur. The data is collected about:

1) Personal characteristics such as age, sex, marital status, occupation, education, income, social class, dietary pattern habits.
2) Place distribution of cases i.e., areas of high concentration, low concentration and spotting of cases in the map.
3) Time distribution/trends such as year, season, month, weak, day and hour of onest of the disease.

Such information gives clues to possible associated factors such as age with specific disease e.g., measles, diphtheria, pertussis, in early childhood, cancer, dietary pattern with obesity; seasonal variation, periodic fluctuation, etc.

The data collected are analysed and presented in terms of percentage, rates and ratios. This refers to statistical information of a problem and are given in the table for you to learn to compute.

Thus, descriptive epidemiology provides information for:

1) Making community diagnosis i.e., describing the nature of diseases or problems and measuring their extent in terms of incidence/prevalence rate, ratios, mortality rates, etc., by age, sex, occupation, social class, etc.
2) Providing clues to etiology of disease for further rigorous investigation and confrontation of the causes.
3) Planning, organising and implementation of health care services to deal with these problems.

4.5.2 Analytical Epidemiology

You have learnt that descriptive studies yield etiological clues for various disease which helps in making a guess or formulation of hypothesis for further vigorous study or testing e.g. "cigarette smoking (10 to 20) in a day causes lung cancer in 10 to 15 per cent of smokers after 20 years of exposure". These type of hypothesis are further studied and tested by analytical studies to determine the association of cause with the effect.

Thus, analytical epidemiology goes beyond the descriptive epidemiology. It consists of two type of observational studies: (i) Case Control Study, and (ii) Cohort Study.

1) **Case Control Study:** In this method a group of people who have been diagnosed as having a particular problem (cases) are compared with a group of people who are similar in characteristics to that of cases but they are free from the problem under study (controls). Here the approach used is retrospective i.e., the disease has already occurred and the epidemiologist goes back in time. He reviews the records, interviews the cases and their family members. The data thus collected about the suspected factor/factors is analysed statistically to determine the extent of its association with the disease. This method, therefore, is called as retrospective method. This approach has helped in identification of causative factors of many diseases/problems, etc. e.g. Rubella in mothers during early pregnancy in the cause of congenital deformities in children, smoking associated with lung cancer, iodine deficiency associated with hyperthyroidism. These conclusions are based on repeated case control studies. Case control studies are easy to organise and are less expensive.

2) **Cohort Study:** A cohort is a specific group of people, at a certain time, sharing common characteristics or experience e.g., people born on the same day or the same year (birth cohort), couple married in the same year (marriage cohort), a class of nursing students (experience cohort), people with same occupations (occupational cohort) etc.

Cohort study is prospective in nature because the group under study is free from the disease but exposed to risk factor. In this method of study the epidemiology selects a cohort i.e., a group of people say in the same age group and who are exposed to a certain risk factor say cigarette smoking (study group) and who are not exposed to the risk factors (control group). Both the groups are followed up for several years and observations are made with reference to frequency and distribution of the suspected disease (in this example lung cancer) over a period of time. The data is statistically analysed and comparisons are done between the incidence among smokers and non-smokers to determine the association of risk factors to the disease.

The prospective study is expensive and time consuming but it has its advantages over retrospective method. This method can help in studying the natural history of disease, estimating incidence rates, risk factor under study to other diseases or problems e.g., cigarette smoking and high blood pressure, cardiovascular problems etc.

4.5.3 Experimental Epidemiology

Experimental studies are similar in approach to cohort studies expect that conditions are under the careful control of the investigator. Experimental studies are done to confirm the cause and effect association of the efficacy of preventive or therapeutic agent or procedure. In these studies, the investigator administers and does investigation/gives treatment to the experimental group which is either exposure to causative agent or preventive/therapeutic agent, but not to the control group which is similar to the experimental in all its aspects. He then observes and analyse the outcomes using statistical methods and confirm the cause of diseases, and establishes the efficacy or preventive measures and drugs under study. Usually these experiments are done in the laboratory animals. But clinical and community trials are done to determine efficacy of preventive or therapeutic laboratory animals. These trials do involve medical, ethical and moral issues.

4.6 PRINCIPAL OF CONTROL MEASURES/ LEVELS OF PREVENTION OF DISEASE

We are all familiar with a very popular phrase "Prevention is better than cure". It is because of the fact that prevention helps to promote and preserve health and minimises

the sufferings and distress. It is also economical because preventive measures can be followed and practiced by all at the village and home level. It does not require sophisticated infrastructure, equipment and material. Above all it is a positive approach to healthful living. Epidemiologically, the concept of prevention is broad based. According to natural history of disease, three levels of prevention have been identified. They are : (i) Primary Prevention, (ii) Secondary Prevention, (iii) Tertiary Prevention.

1) **Primary Level of Prevention:** It refers to preventive measures taken before the occurrence of a disease i.e., during the prepathogenesis phase of disease. Preventive measures during this period of a disease process prevent the occurrence of disease and promote health. These measures are classified as:

   - **Health Promotion:** Health promotive factors include wholesome nutritious food, safe environment to live, healthful life-style and adequate resources. All these aspects are directly related to social-economic and cultural status of the family which must be improved. Much of the morbidity and mortality due to communicable diseases such as typhoid, cholera, dysentery, tuberculosis. Plague, leprosy etc., have been reduced due to these preventive measures. Health promotive measures are equally applicable to the prevention of chronic and non-communicable diseases such as cardiovascular, diabetes, accidents, etc.
   - **Specific Protection:** It refers to actions to protect from a particular disease or group of disease, like B.C.G immunisation for tuberculosis, D.P.T for diphtheria, pertussis and tetanus, increase or decrease of specific nutrient in diet and or supplementing it e.g., iron rich diet and supplementing with iron tablets in case of prevention of anaemia.

     Primary prevention is given major emphasis in health care and it is identified with health education because it is considered as the responsibility of the individual, family and community.

2) **Secondary Level of Prevention:** Secondary level of prevention refers to measures taken during pathogenesis period to control the progress of disease in man to stop or control the spread of disease in the community. Secondary preventive measures prevent disability or defects, and restore health. It includes early identification of cases an their contacts and giving them timely treatment and follow-up e.g., early diagnosis and treatment of all cases of tuberculosis and their contacts. These actions help in early recovery prevent cavitation and consolidation of the affected part of the lungs and also prevent further spread of the tuberculosis in community. Similarly, early diagnosis and treatment of high blood pressure will help in the prevention of possible cardiovascular emergencies. Thus secondary level of prevention reduces prevalence rate of disease i.e., prevents the occurrence of new cases and controls old cases.

3) **Tertiary Level of Prevention:** The purpose of tertiary level prevention is to limit the disability and help the individual adjust to permanent impairment and disabilities so as to lead a useful life. The measures included are physical, vocational and psychosocial rehabilitation e.g., deep breathing exercise, meditation, etc., for efficient lung expansion; guidance and training to learn new vocation and guidance and counselling for restoration of family and social relations, etc., in case of patients with pulmonary tuberculosis.

4.7 LET US SUM UP

In this unit you have learnt that epidemiology is the science of community health. Epidemiology deals with the study of distribution and determinants of health

related events and it is used for understanding rise and fall of diseases, community diagnosis, syndrome identification, completing clinical spectrum of diseases, searching of risks and causes, planning, evaluation and control of health problems. Diseases occur by interaction of agent, host and environmental factors (epidemiology triangle). Diseases can be transmitted by direct and indirect modes of transmission. The chain of infection includes eiological agent, source or reservoir of infection, mode of transmission and host. When disease occurs in outbreaks more than the expected frequency of disease in a population, it is also called as epidemic. Epidemics can occur through common source, it can be intermittent, continuous, propagated and mixed epidemic. Some diseases can occur seasonally, cyclically, and follows a secular trend. There are three levels of prevention of disease, primary which includes health promotion and specific protection, measures taken during pathogenic phase to stop or control the spread of disease by early detection and treatment in secondary level and in tertiary to limit viability and help individual to adjust the permanent impairment by physical, vocational and psychological rehabilitation.

4.8 MODEL ANSWERS

Check Your Progress 1

1) The most comprehensive definition of epidemiology was given by John M. Last in 1988 that states "The study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems".

2) The uses of epidemiology are:
   a) To study the natural history of disease,
   b) To make a community diagnosis,
   c) To assess risk factors of diseases in the population,
   d) To assess, evaluate and conduct research on the health programmes,
   e) To complete a clinical picture,
   f) To identify syndromes,
   g) To search for causes of health and disease by studying the incidence in different population groups, in terms of inheritance, behaviour and environment

3) The components of epidemiology triangle are agent, host and environment.

4) A vector is an arthropod such as mosquito, fly, flea, or rodents such as rat, mouse which is living non human carrier of disease. It plays an important role in disease transmission. The vector carries the agent from an infected person or animals through bite, body fluids, waste products, or by contaminating foods and spreads to another person.

Check Your Progress 2

1) The direct modes of transmission of diseases are (a) direct contact, (b) droplets, (c) contact with soil, (d) inoculation through skin or mucosa, and (e) transplacental (through placenta from the mother to the foetus).

2) Enumerate the indirect modes of disease transmission?

   Indirect transmission can occur through several means: (a) air-borne, (b) water-borne, (c) vehicle-borne, (d) food-borne, and (e) vector-borne.

3) What constitutes the chain of infection?

The chain if infection includes etiological agent, source/ reservoir, modes of transmission and host.

Check Your Progress 3

1) Endemic: The constant presence of a disease or infection within a specified geographical area or population group is considered to be endemic for that particular area. Endemic can also be referred to as "usual" or expected frequency of the disease within a specified area or population.

2) Epidemic: Epidemic is "occurrence of an unusual frequency of disease above the endemic or expected frequency of occurrence" in a specified population, place and time.

3) Propagated epidemic:

Once the outbreak has been initiated from a source, the disease transmission continues because of person-to-person transmission depending upon the contacts. This type of sustained epidemic is termed as propagated epidemic.

4) What is cyclic trend of diseases?

Some communicable diseases appear in the form of epidemics in a cyclical or periodic manner. It may be spread over days, weeks, months or even years. For example, measles epidemic occurs at every 2–3 yearly intervals.

5) Three levels of prevention of disease are:

a) Primary which includes health promotion and specific protection,

b) Secondary level includes measures taken during pathogenic phase to stop or control the spread of disease by early detection and treatment,

c) Tertiary to limit viability and help individual to adjust the permanent impairment by physical, vocational and psychological rehabilitation.

4.9 KEY WORDS

Agent : Causative factor invading a susceptible host through a favourable environment to produce disease, which may be biological, chemical or physical in nature.

Clustering : Grouping or /colony of/ crowding of.

Communicable : Able to be transmitted from one host to another.

Ecology : A branch of biological science concerned with the study of interrelationship of organism and their environment.

Endemic : Habitual or usual presence of disease or infectious agent within a defined geographical area.

Environment : The aggregated of all external conditions that may enhance or inhibit the interaction between host and agent; they may be physical, biological, social, cultural and economical.

Epidemic : The occurrence in a community or region of an illness or a group of illness of similar nature clearly in excess or normal expectation.

Etiology	:	Cause of disease condition.
Host	:	A vertebrate or invertebrate species (human, animals, etc.) capable of being infected or affected by an agent.
Hypothesis	:	Statement showing relationship of one factor with the other.
Immunity	:	Insusceptibility to disease or condition, may be natural or acquired.
Incidence	:	A measurement of the number of new cases of a disease or other event occurring in a population during a given period.
Infection	:	The entry and development or multiplication of an infectious agents in the body of host; not synonymous to disease.
Morbidity	:	Illness or some other conditions, not including death.
Mortality	:	Death
Pandemic	:	An epidemic over a wide geographical area, or even worldwide.
Prevalence	:	Measurement of all cases (old or new) of disease or other conditions present in a population at a given time.
Scrutiny	:	Close or detailed examination, critical gaze.
Susceptible Host	:	Sensitive host i.e., the host who does not have immunity.

4.10 REFERENCES

1) Timmreck TC. An introduction to epidemiology. Jones and Bartlett Publishers, Sudbury, Massachusetts, 2002.

2) Park K. Park's textbook of preventive and social medicine. BanarasidasBhanot Publishers, Jabalpur, 23rd edition, 2015.

UNIT 5 DEMOGRAPHY, SURVEILLANCE AND INTERPRETATION OF DATA

Structure

5.0 Introduction

5.1 Objectives

5.2 Demography and Vital Statistics

- 5.2.1 Demographic Cycle
- 5.2.2 World Population Trends
- 5.2.3 Vital Statistics

5.3 Sex Ratio and its Social Implications

- 5.3.1 Sex Ratio and Child Sex Ratio
- 5.3.2 Trends of Sex Ratio in India
- 5.3.3 The Causes and Social Implications of Declining Sex Ratio

5.4 Sources of Vital Statistics

- 5.4.1 Census
- 5.4.2 Registration of Vital Events
- 5.4.3 Sample Registration System
- 5.4.4 Others

5.5. Integrated Disease Surveillance Project (IDSP) and Mother and Child Tracking Systoms (MCTS) in India

- 5.5.1 Surveillance
- 5.5.2 Integrated Diesease Surveillance Project (IDSP)
- 5.5.3 Organisation of IDSP
- 5.5.4 Flow of Information
- 5.5.5 Mother and Child Tracking Systems (MCTS)

5.6 Collection, Analysis, Interpretation and Use of Data

- 5.5.1 Collection of Data
- 5.5.2 Analysis and Interpretation of Data
- 5.5.3 Use of Data

5.7 Common Sampling Techniques, Frequency Distribution

- 5.6.1 Random Sampling Techniques
- 5.6.2 Non-Random Sampling Techniques

5.8 Disaggregation of Data

5.9 Let Us Sum Up

5.10 Model Answers

5.11 References

5.0 INTRODUCTION

In the previous unit, you have learnt about epidemiology, epidemiological approach, burden of disease, cause of risk factors. You also learnt epidemic / outbreak related terms, steps to control epidemics etc. In this unit you will learn the populations' trends, sex ratio, causes and the impact of declining sex ration on society. It is also important for you to know sources of vital statistics, data collection and its uses, at the same time interpretation of data.

5.1 OBJECTIVES

After learning this units you should be able to:

- define demography, phenomena of demography;
- explain demography cycle;
- explain cause and social implication of declining sex ratio;
- comprehend data collection, analysis, use of data;
- discuss sampling techniques;
- understand surveillance, type of surveillance; and
- understand IDSP.

5.2 DEMOGRAPHY AND VITAL STATISTICS

Demography is derived from Greek. The word 'demos' means the people and 'graphy' implies writing, description and measurement.

Demography is defined as the scientific study of human population and focuses on three observable phenomena as shown in Fig. 5.1.

The population growth is observed by three parameters as shown in Fig. 5.1.

1) Size
2) Space
3) Composition

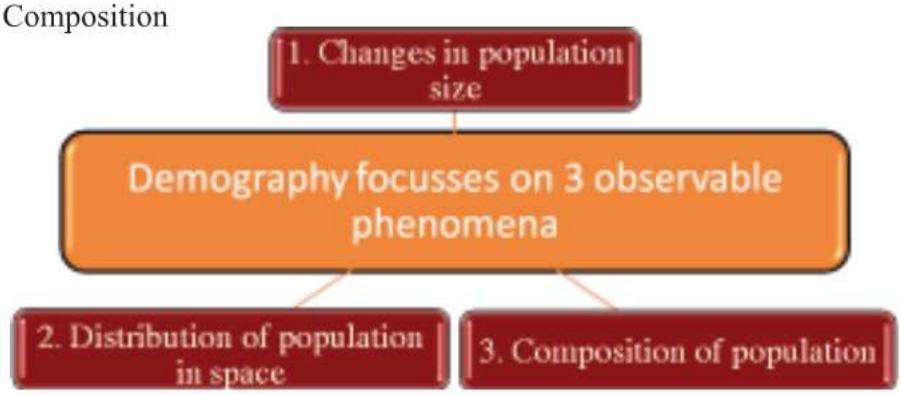


Fig. 5.1: The three observable phenomena of Demography

5.2.1 Demographic Cycle

The demographic cycleare the stages through which the trend of demography has been observed in the world since the industrial revolution.

This trend is useful to understand the effects on Birth Rate (BR), Death Rate (DR) and population growth in the different stages of development of a country.

The demographic cycle is explained in the Table below.

Table 5.1: The demographic cycle

Stage	Name	BR	DR	Population Growth	Example
I.	High Stationary	High	High	Increasing	India before 1920
II.	Early Expanding	High	Declining	Increasing	Afghanistan
III.	Late Expanding	Declining	Declining	Increasing	India, Nepal, China
IV.	Low Stationary	Low	Low	Neutral	US, Denmark, Sweden
V.	Declining	Low	Declining	Decreasing	Germany & Hungary

5.2.2 World Population Trends

Let us learn the world population trends in brief.

- Global human population was <1 billion in 1800, it increased to 2 billion in 1927 (127 years). The population increased to 3 billion in 1959 (32 years), to 4 billion in 1974 (15 years), to 5 billion in 1987 (13 years), to 6 billion in 1998 (11 years) and 7 billion in 2011 (13 years).
- The population of the world has doubled since 1963.
- Currently, we add 2.5 people every second (79 million/year).
- The world's population is projected to be 10 billion by 2015.

5.2.3 Vital Statistics

- A vital statistics system is defined as, 'the total process of:
  a) collecting information by civil registration or enumeration on the frequency of occurrence of specified and defined vital events, as well as relevant characteristics of the events themselves and of the person or persons concerned, and
  b) Compiling, processing, analysing, evaluating, presenting and disseminating these data in statistical form.'

  The vital events of interest are: live births, adoptions, legitimations, recognitions; deaths and foetal deaths; and marriages, divorces, separations and annulments of marriage.

- The important sources of vital statistics in India are:
  1) Population Census
  2) Civil Registration System (CRS)
  3) Demographic Sample Surveys such as those conducted by the National Sample Surveys Organisation (NSSO)
  4) Sample Registration System (SRS)
  5) Health Surveys, such as National Family Health Surveys, (NFHS) and District Level Household Surveys (DLHS-RCH) conducted for assessing progress under the Reproductive and Child Health programme.

Check Your Progress 1

1) In the Demographic cycle, at which stage does India stand?
   A) High Stationary B) Low Stationary
   C) Late Expanding D) Early Expanding
2) Answer whether True (T) or False (F):
   i) The current world population is 9 billion. (T/F)
   ii) Data on Divorce is a part of vital statistics. (T/F)
   iii) Population Census is a major part of vital statistics. (T/F)
3) List important source of vital statistics.

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5.3 SEX RATIO AND ITS SOCIAL IMPLICATIONS

After learning population, demographic cycle and vital statistic, let us now go through importance of knowing sex ratio, implications of society.

5.3.1 Sex Ratio and Child Sex Ratio

- Sex ratio is used to describe the number of females per 1000 of males.
- Sex ratio is a valuable source for finding the population of women in India and what is the ratio of women to that of men in India.
- In India, the child sex ratio is also measured.
- Child sex ratio is defined as the number of females per thousand males in the age group 0–6 years in a population.

5.3.2 Trends of Sex Ratio in India

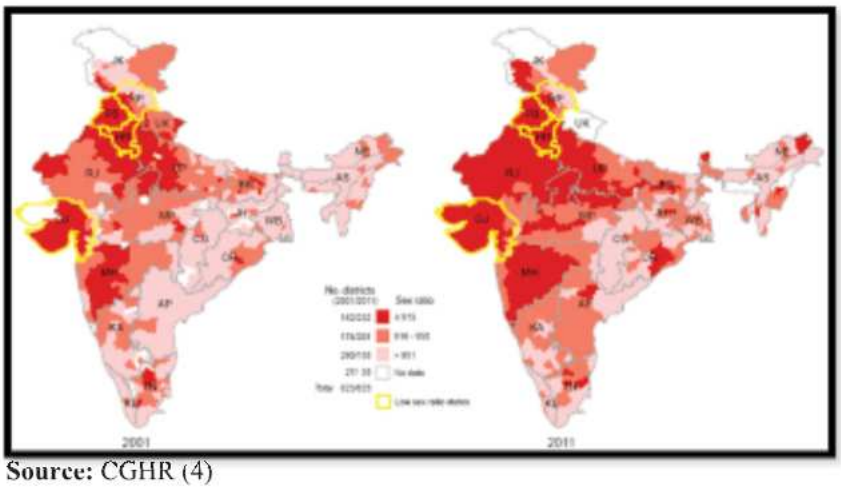
You should also briefly know trends of sex ratio in India as discuss below:

- The overall sex ratio of India has improved but that does not depict the true status of the problem, as the life expectancy of women are more than men.
- The sex ratio in 2011 census was reported as 943 women per 1000 men; 929 in urban and 949 in rural areas. In 2001 the sex ratio was 933 women per 1000 men; 900 in urban and 946 in rural areas.
- The child sex ratio of India has decreased over the last 3 decades, as seen in the Table below:

Table 5.2: The trends of child sex ratio in India

Census Year	Total	Urban	Rural
1981	962	963	931
1991	945	948	935
2001	927	933	906
2011	919	923	905

- Another disturbing trend is that the poorest child sex ratio is found in the richer states of India, and in the urban areas, which depicts that the problem is not directly related to lack of financial or educational status but the opposite of it.



Source: CGHR (4)

Fig. 5.2: Map of India showing child sex ratio in 2001 and 2011

5.3.3 The Causes and Social Implications of Declining Sex Ratio

- The declining child sex ratio depicts an unfortunate trend of selective abortion of females.
- According to CGHR estimates, about 4–12 million girls have been aborted in the last 3 decades, despite the fact that prenatal sex diagnosis is banned in the country.
- The skewed sex ratio depicts a socio-cultural bias that exists in our country representing a feudal mindset that considers women as objects and not similar to men.
- The social implications of the poor child sex ratio means that less women of marriageable age group will be available and a significant proportion of men will have to delay their marriage.
- The poorest males will be most severely affected due to the skewed child sex ratio by the marriage trends.

Check Your Progress 2

i) The poorest child sex ratio among these states is found in:

A) Gujarat B) Kerala C) Bihar D) West Bengal

ii) Answer whether True (T) or False (F):

i) The main reason of poor child sex ratio is female foeticide (T/F)

ii) Urban areas have a better sex ratio, because they are more educated. (T/F)

iii) Though the child sex ratio has decreased, the sex ratio has increased in the last decade. (T/F)

iii) Explain the social implication of declining sex ratio.

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5.4 SOURCES OF VITAL STATISTICS

Let us now read the sources of vital statistics as given below:

5.4.1 Census

- Census which taken in most countries at regular interval; usually 10 years, is one of most important source of health information.
- The census is defined as "total process of collecting, compiling and publishing the demographic, economic and social data pertaining at specified time or times, to all persons in a particular country or delimited territory".
- Census provides not only demographic but also social and economic characteristics of the people, the conditions under which they live, how they work, their income and other basic information.
- First Indian census was taken in 1881, and then at 10 years intervals. The last census was held in March 2011.

5.4.2 Registration of Vital Events

- It keeps a check on demographic changes.
- Defined by the United Nations as "legal registration, statistical recording and reporting of the occurrences of, and the collection, compilation, presentation, analysis and distribution of statistics pertaining to vital events i.e., live birth, death, foetal death, marriages, deaths, adoptions, legitimations, recognitions, annulments and legal separations".
- **"The central birth and death registration act 1969"**, provides for the compulsory registration of births and death in the entire country.

Both birth and death are to be registered within 21 days.

5.4.3 Sample Registration System

- Due to deficiency of civil registration system, a sample registration system was started in India in 1960 to provide reliable estimates of birth and deaths in the country.
- It is a dual record system consisting of continuous enumeration of births and deaths by an enumerator and independent survey every 6 months by an investigator-supervisor.
- It provides more reliable information on birth rate, death rate, age specific fertility and mortality rate, infant mortality, under five mortality and adult mortality rates.

5.4.4 Others

Notification of diseases, hospital records, disease register, record linkages, epidemiological surveillances, population surveys etc. are also available for data collections.

Check Your Progress 3

i) The first census of India was conducted in:

A) 1911 B) 1901 C) 1891 D) 1881

ii) Answer whether True (T) or False (F):

a. Sample registration System enumeration is done annually. (T/F)

b. Census of India is conducted every 10 years. (T/F)

c. Central Birth and Death registration act was passed in 1969. (T/F)

iii) Explain registration of Vital Events.

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5.5 INTEGRATED DISEASE SURVEILLANCE PROJECT (IDSP) AND MOTHER AND CHILD TRACKING SYSTEM (MCTS) IN INDIA

Let us now go through surveillance, IDSP and MCTS in details.

5.5.1 Surveillance

Surveillance is the process of systematic collection, orderly consolidation and evaluation of pertinent data with prompt dissemination of the results to those who need to know, particularly those who are in a position to take action. Surveillance is "the ongoing systematic collection, analysis, and interpretation of health data essential for planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those who need to know". The data collection should lead to prevention and control of diseases.

Health worker play a significant role in surveillance as he/she is the only who collect the data from the community. When disease data is presented properly then disease trends in time, place, and persons, can be observed or anticipated and appropriate action, including investigative or control measures, can be taken. Sources of data may relate directly to disease or to factors influencing disease. Thus they may include (1) mortality and morbidity reports based on death certificates, hospital records, general practice sentinels, or notifications; (2) laboratory diagnoses; (3) outbreak reports; (4) vaccine utilisation–uptake and side effects; (5) sickness absence records; (6) disease determinants such as biological changes in agent, vectors or reservoirs; (7) susceptibility to disease, as by skin testing or serological surveillance (e.g., serum banks).

Surveillance is different from monitoring. In monitoring data is collected on day to day basis as planned. Data collected inn monitoring become the part of surveillance.

Surveillance is mainly of two types:

Active Surveillance is surveillance where health worker go to house to house to collect the data as it is done in malaria surveillance.

Passive Surveillance is the surveillance where reports are awaited and no attempts are made to seek reports actively from the participants in the system. In this the patients come to the health centre to get treatment when health worker collect the information from patient or collect the sample for investigation. For example in tuberculosis control the sputum sample is collected at the health centre by the health worker or DOTs worker.

There is another surveillance type which is used in certain situation. For example, **sentinel surveillance** which is based on the collection of data from a sample (random or non-random) of collecting sites as indicator data for the rest of the population, in order to identify cases of a disease early or to obtain indicative data about trends of a disease or health event. Examples are the use of a few hospitals to monitor the composition of influenza virus and check that the vaccine includes the right components, or the use of a network of general practitioners to

monitor diseases or health events (e.g., attempt suicide, requests for HIV testing). One instance of sentinel surveillance is the use of a particular populations group (e.g., monitoring the serology of syphilis among pregnant women as an indicator of syphilis trends in the general population). Sentinel surveillance is inappropriate for those situations where every case require public health action, e.g., poliomyelitis.

Surveillance is essential for the early detection of emerging (new) or re-emerging (resurgent) infectious diseases. In the absence of surveillance, individual health care workers may not recognise the new disease, but may apply a near-fit diagnosis of a locally prevalent disease, which the disease in question may resemble.

Because of the importance of surveillance in disease detection and control, the Government of India has started a national programme.

5.5.2 Integrated Disease Surveillance Project (IDSP)

IDSP was established to strengthen the disease surveillance in the country through a decentralised State based surveillance system for epidemic prone diseases for timely and effective public health actions towards health challenges in the country at the Districts, State and National level.

5.5.3 Organisation of IDSP

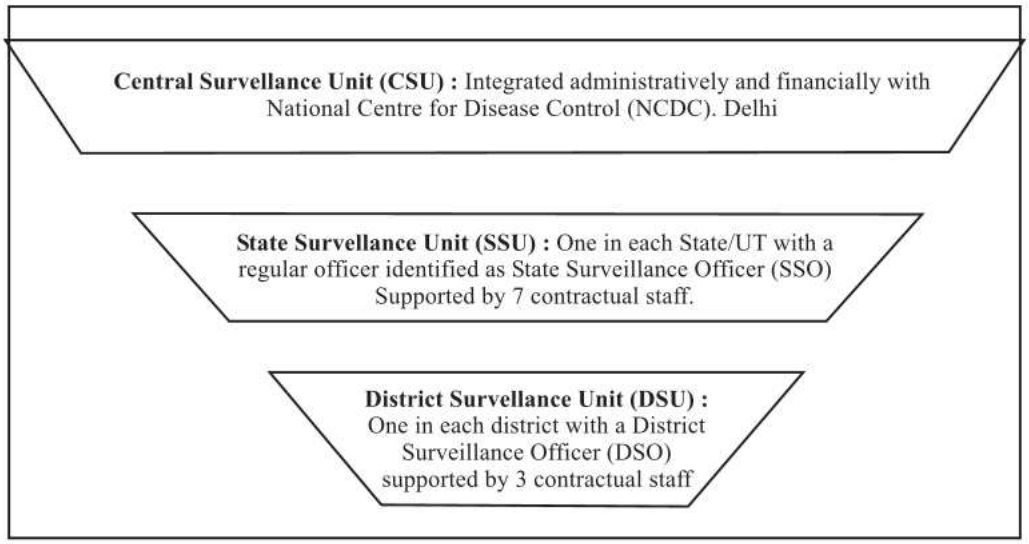


Fig. 5.1: Organisation of IDSP

5.5.4 Flow of Information

- Under the IDSP the, information is collected on three specified reporting formats namely "S" (suspected cases), "P" (presumptive cases) and "L" (laboratory confirmed cases).
- 'S' form is filled by the health workers to report data on suspected cases/syndromes. 'P' form is filled up by Medical Officers to report data on probable/clinically suspected cases. 'L' form is designed to collect data on lab confirmed cases.
- Weekly (Monday–Sunday) disease surveillance data on epidemic prone disease are collected from reporting units such as sub-centres, primary health centres, and community health centres, hospitals including government and private sector hospitals and medical colleges.

- The weekly data gives information on the disease trends and seasonality of diseases.
- Whenever there is a rising trend of an illness in any area, it is investigated by the Rapid Response Teams (RRT) to diagnose and control the outbreak.
- Data analysis and actions are being undertaken by respective State/District Surveillance Units.
- Under this project, presently, more than 90% districts report such weekly data through e-mail/portal (www.idsp.nic.in).
- A 24×7 call centre was established in February 2008 to receive disease alerts on a Toll Free telephone number.

5.5.5 Mother and Child Tracking System (MCTS)

- Mother and Child Tracking System (MCTS) is an initiative of Ministry of Health and Family Welfare to leverage information technology for ensuring delivery of full spectrum of healthcare and immunisation services to pregnant women and children up to 5 years of age.
- It is an innovative, web-based application, developed by NIC, to facilitate and monitor service delivery as well as to establish a two-way communication between the service providers and beneficiaries.
- Generation of work plans of ANMs, sending regular alerts to the service providers as well as beneficiaries about the services due and a user-friendly dash board for health managers at various levels to monitor delivery of services will go a long way in ensuring quality service delivery, micro birth planning, ensuring universal immunisation and will have positive impact on important health indicators like Infant Mortality Rate and Maternal Mortality Ratio.
- It will also help in evidence based planning and continuous assessment of service delivery to pregnant women and children.

Check Your Progress 4

i) Where is the Central Surveillance Unit (CSU) of IDSP located?

A) NCDC B) ICMR C) AIIMS D) Ministry of Health and Family Welfare

ii) Answer whether True or False.

a) The toll free number for disease alerts is 1075. (True/ False)

b) The rapid response team investigates the rising trend of diseases under IDSP. (True/ False)

5.6 COLLECTION, ANALYSIS, INTERPRETATION AND USE OF DATA

Let us now learn the data collections, types of analysis and use of data in detail:

5.6.1 Collection of Data

Collection of data involves gathering of the desired information in a proper manner to answer related questions and assess results.

Methods of data collection

1) Primary Source
   - Observation
   - Interview
   - Questionnaire
2) Secondary Source
   - Reports
   - Previous research
   - Records
   - Census

Importance of collection of data

- To ensures that data gathered are both defined and accurate.
- To ensure that subsequent decisions based on findings are valid.

5.6.2 Analysis and Interpretation of Data

Analysis of data is a process of inspecting, cleaning, transforming, and modelling data with the goal of discovering useful information, suggesting conclusions, and supporting decision-making.

Purpose

- Summarising and describing of data
- Identification and comparison of associations between variables
- Estimating results

Types of analysis

Qualitative analysis - Based on quality or attribute and not on precise measurement.

- Religion
- Sex
- Tall/ short
- Blood group

Quantitative analysis - Based on precise measurement.

- Frequencies/ percentages
- Mean
- Median
- Mode
- Standard deviation

Interpretation of data - Last step in the research which includes summary, conclusion and recommendations.

5.6.3 Use of Data

The different uses of data are:

- Population estimation and forecasting
- Identification of health needs and problems
- Analysis of health trends
- Planning and evaluation of health programme
- Health education

The examples related to indicators are discussed in practical section of the course.

5.7 COMMON SAMPLING TECHNIQUES, FREQUENCY DISTRIBUTION

As you have learnt population is huge large in number, and it is not easy to study each and every individual, hence a sample is selected through various methods which is representative of the population under study. These methods are briefly described as follows:

5.7.1 Random Sampling Techniques

- Sampling is a technique to do research in large populations.
- By selection of a small group from the population, that can be studied, the results are extrapolated for the whole population. (Fig. 5.3)

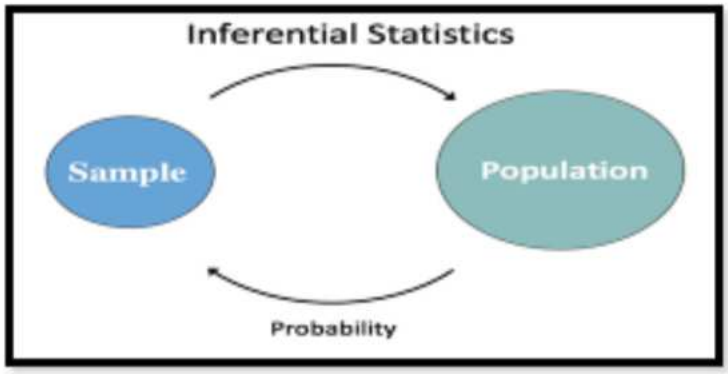


Fig. 5.3: The relationship between sample and population

- In a random sampling technique, sample has a known probability of being selected.
- But a sampling frame is required. A sampling frame is a complete list of people in the whole population under study.
- Sample is representative of underlying population.
- Each unit of the sample is selected randomly from the sampling frame.

1) **Simple random sampling**

- Every member of the population is equally likely to be selected.
- The sample are withdrawn with the help of random number table.

2) **Systematic random sampling**

- The first sample is selected randomly.
- The remaining sample is drawn using systematic pattern i.e. at fixed k^{th}(every 100^{th}, 3^{rd}, 10^{th} etc.) interval.

3) **Stratified random sampling**

- Divide the population into homogeneous groups/ strata E.g. On the basis of gender or religion or caste.
- Derive the sample randomly from each homogeneous groups/strata.
- Very important technique, if the underlying variable is presumed to be differentially distributed.

4) **Cluster random sampling**

- Divide the population into clusters (clusters are defined by geographical boundaries).
- Select the required number of clusters randomly.
- Derive the sample randomly from each selected cluster.

5.7.2 Non-Random Sampling Techniques

- In non-random sampling techniques, the sample does not have known probability of being selected.
- Does not require sampling frame.
- Sample does not represent underlying population.
- Non-random selection of unit of sample.

1) **Purposive sampling**

- Volunteers willing to participate in study are used.

2) **Convenient sampling**

- Selection of subjects that are easily available.

3) **Quota sampling**

- Selection of predefined numbers of subjects from specified subgroup of population.

4) **Snowball sampling**

- Identification of first eligible subject.
- Thereafter, identification of other eligible subject with the help of first eligible subject and so on.

Check Your Progress 5

1) Which of the following sampling technique ensures that the sample is representative of the population

A) Non-Random sampling B) Random Sampling C) Convenience based sampling D) Snowball sampling.

2) Answer whether True or False.

   i) Random sampling requires sampling frame. (True/ False)

   ii) Quota sampling is an example of random sampling. (True/ False)

3) Explain random sampling techniques.

   .....

.....

5.8 DISAGGREGATION OF DATA

Let us learn the disintegration of data based on gender, caste and socio-economic status as follows:

- Sometimes, the raw data does not show the true differences within the population groups.
- In these cases, the data must be disaggregated in terms of the differential groups.
- Gender is one such variable. The literacy rate of India is 73.0%, according to 2011 census. But, if it is disaggregated, it is a substantially high 80.9% in males, whereas, only 64.6% in females.
- Rural-Urban disaggregation is also important. For example–literacy rate in rural areas is 67.8% but 84% in urban areas.
- The disaggregated data helps to prioritise our interventions and programmes.
- Similarly, disaggregation of data in terms of caste and socio-economic differences is important to understand the differences in prevalence of diseases, healthcare access and affordability, apart from other differences.

5.9 LET US SUM UP

In this unit you have leant the demographic cycle, trends, sources of vital statistics, These are section on implications of declining sex ratio on society. Registration of birth and death are vital to be registered within 21 days. You have also learnt importance of data collection, analysis, and methods to select the sample out of the large population. After that at the end of the unit we discussed about the disaggregation of data.

5.10 MODEL ANSWERS

Check Your Progress 1

1) C

2) Answer whether True (T) or False (F):

   i) F ii) T iii) T

3) The important sources of vital statistics in India are

   1) Population Census

   2) Civil Registration System (CRS)

3) Demographic Sample Surveys such as those conducted by the National Sample Surveys Organisation (NSSO)

4) Sample Registration System (SRS)

5) Health Surveys, such as National Family Health Surveys, (NFHS) and District Level Household Surveys (DLHS-RCH) conducted for assessing progress under the Reproductive and Child Health programme

Check Your Progress 2

1) A

2) Answer whether True (T) or False (F):

i) T ii) F iii) T

3)
- The declining child sex ratio depicts an unfortunate trend of selective abortion of females.
- According to CGHR estimates, about 4–12 million girls have been aborted in the last 3 decades, despite the fact that prenatal sex diagnosis is banned in the country.
- The skewed sex ratio depicts a socio-cultural bias that exists in our country representing a feudal mindset that considers women as objects and not similar to men.
- The social implications of the poor child sex ratio means that less women of marriageable age group will be available and a significant proportion of men will have to delay their marriage.
- The poorest males will be most severely affected due to the skewed child sex ratio by the marriage trends.

Check Your Progress 3

1) D

2) Answer whether True (T) or False (F):

i) F ii) T iii) T

3)
- It keeps a check on demographic changes.
- Defined by the United Nations as "legal registration, statistical recording and reporting of the occurrences of, and the collection, compilation, presentation, analysis and distribution of statistics pertaining to vital events i.e., live birth, death, fetal death, marriages, deaths, adoptions, legitimations, recognitions, annulments and legal separations".
- **"The central birth and death registration act 1969"**, provides for the compulsory registration of births and death in the entire country. Both birth and death are to be registered within 21 days.

Check Your Progress 4

1) A

2) Answer whether True (T) or False (F):

i) T ii) T

Check Your Progress 5

1) B

2) Answer whether True (T) or False (F):

   i) T ii) F

3) Simple random sampling

- Every member of the population is equally likely to be selected.
- The sample are withdrawn with the help of random number table.

Systematic random sampling

- The first sample is selected randomly.
- The remaining sample is drawn using systematic pattern i.e. at fixed k (every 100, 3, 10 etc.) interval.

Stratified random sampling

- Divide the population into homogeneous groups/ strataeg. On the basis of gender or religion or caste
- Derive the sample randomly from each homogeneous groups/ strata.
- Very important technique, if the underlying variable is presumed to be differentially distributed.

Cluster random sampling

- Divide the population into clusters (clusters are defined by geographical boundaries).
- Select the required number of clusters randomly.
- Derive the sample randomly from each selected cluster.

5.11 REFERENCES

1) U.N., Department of Economic and Social Affairs, Statistics Division- "Principles and Recommendations for a Vital statistics system, revision 2" ST/ESA/STAT/Series. M/19 /Rev 2.

2) Ministry of Statistics and Programme Implementation Government of India. Manual on Vital Statistics. New Delhi; 2010 p. 88.

3) Census of India. Available at: Census.gov.in

4) Centre for Global Health Research (CGHR). Available at: cghr.org/girls

5) Sapsford R, Jupp V. Data Collection and Analysis. SAGE publications. ISBN 0-76195046X.

6) Dixit JV. Principles & practice of Biostatistics. Bhanot publishers. ISBN 978-81-906079-6-4.

7) Integrated Disease Surveillance Program. Available at: http://www.idsp.nic.in/index.php

UNIT 6 BIO-MEDICAL WASTE MANAGEMENT AND INFECTION CONTROL

Structure

6.0 Introduction

6.1 Objectives

6.2 Bio-Medical Waste Management

- 6.2.1 Type of Waste
- 6.2.2 Sources of Bio-Medical Wastes
- 6.2.3 Goals of Bio-Medical Waste Management
- 6.2.4 Steps of Bio-Medical Waste Management
- 6.2.5 Flow of Bio-Medical Waste Management

6.3 Bio-Medical Waste Management Rules, 2016

- 6.3.1 Segregation of Wastes
- 6.3.2 Categories of Bio-Medical Waste
- 6.3.3 Containers for Bio-medical Wastes Storage
- 6.3.4 Benefits of Using Colour Coded Waste Containers
- 6.3.5 Collection and Storage of Bio-Medical Waste Bags
- 6.3.6 Packaging and Labelling
- 6.3.7 Transportation of Bio-Medical Waste

6.4 Advantages of Bio-Medical Waste Management

6.5 Infection Control

- 6.5.1 Principles of Infections Control
- 6.5.2 Components of Infection Control and Prevention

6.6 Nosocomial Infection

- 6.6.1 Causative Micro-Organisms of Nosocomial Infection
- 6.6.2 Prevention of Nosocomial Infection
- 6.6.3 Objectives
- 6.6.4 Infection Control Components
- 6.6.5 Infection Control Committee– Roles and Responsibility
- 6.6.6 Infection Control Team

6.7 Education and Training of Health Care Staff

6.8 Nosocomial Infection Surveillance

6.9 Let Us Sum up

6.10 Key Words

6.11 Model Answers

6.12 References

6.0 INTRODUCTION

"Bio-medical waste" means any solid and/or liquid waste that is generated during the diagnosis, treatment, or immunisation of human beings or animals, or in related research activities, or in the production or testing of biologicals. Biomedical waste, if not properly handled, treated, or disposed of, poses a significant risk to human health and causes environmental pollution.

In developed countries, approximately 1–5 kg of waste is generated per bed per day. In India, this figure is around 1–2 kg per bed per day, with variations between government and private healthcare establishments. According to the Central Pollution Control Board (CPCB), less than 60% of biomedical waste is treated and disposed of in accordance with the prescribed standards.

It is the legal responsibility of every occupier of an institution generating biomedical waste—such as hospitals, nursing homes, clinics, dispensaries, veterinary institutions, animal houses, pathological laboratories, and blood banks—to ensure that such waste is managed without any adverse impact on human health or the environment. These obligations are governed under the Biomedical Waste Management Rules, 2016 (as amended), and require strict segregation, storage, transport, treatment, and disposal of waste according to the color-coded categories.

The primary aim of any healthcare facility is to deliver safe health services to patients. However, healthcare-associated infections (HAIs), commonly referred to as hospital-acquired infections, remain a frequent and serious concern. These infections can result in delayed recovery, increased healthcare costs for patients and providers, and in some cases, mortality. Evidence shows that such infections can largely be prevented through effective infection control practices, including proper hand hygiene, use of personal protective equipment (PPE), sterilization procedures, and environmental cleaning protocols.

The Biomedical Waste Management (Amendment) Rules, 2018 and 2019 focused on phasing out chlorinated plastic bags and gloves, excluding blood bags, from healthcare facilities by March 27, 2019.

These amendments also addressed the use of barcode and Global Positioning System (GPS) for handling biomedical waste.

6.1 OBJECTIVES

After completing this unit, you should be able to:

- discuss the risk of waste and need of biomedical waste management;
- explain importance of infection control; and
- describe the various methods of bio-medical waste management and infection control.

6.2 BIO-MEDICAL WASTE MANAGEMENT

Bio-medical waste refers to waste generated in healthcare settings that can transmit infections to healthcare workers, patients, and the public if not managed properly. It may also harm the environment if disposed of without treatment. To address this, the Bio-medical Waste (Management and Handling) Rules were introduced in 1998 under the Environment Protection Act, 1986. These rules have been amended over time, with major updates in 2016 and the latest in 2018. The 2018 amendment mandated phasing out chlorinated plastic bags and gloves (except blood bags), introduced barcoding and GPS tracking, and required annual reports to be uploaded on facility websites.

6.2.1 Types of Waste

Majority of waste produced in health care facilities is non-hazardous waste. Only a small percentage is harmful waste that needs to be properly treated so that it is rendered harmless.

As per WHO, of the total amount of waste generated by health-care activities, about 85% is general, non-hazardous waste. The remaining 15% is considered hazardous material that may be infectious, toxic or radioactive.

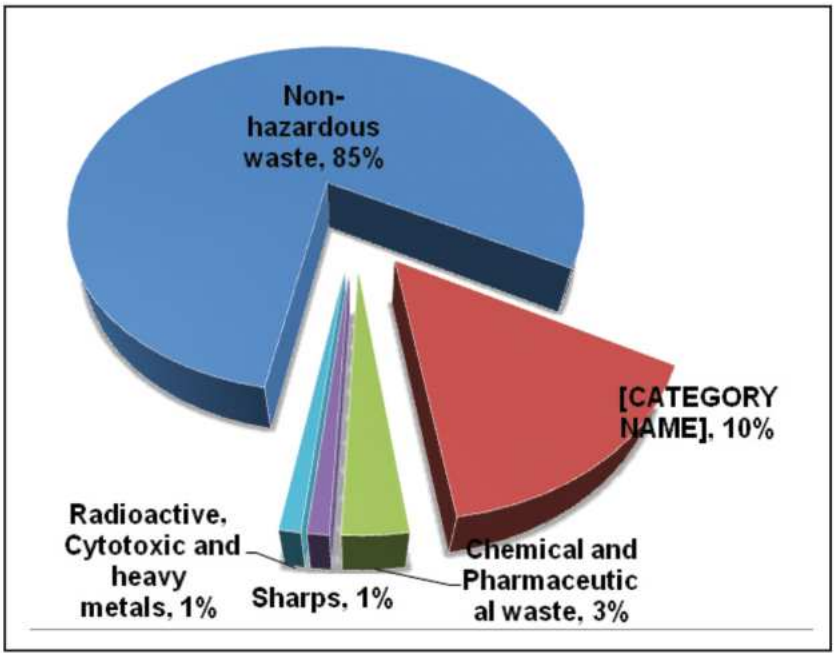


Fig. 6.1: Types of waste

6.2.2 Sources of Bio-Medical Waste

There are almost everyplace of healthcare setting where waste is generated. But not all waste is hazardous and need special treatment.

Major Sources		Minor Sources	
a)	Hospitals	a)	Clinics
b)	Labs	b)	Dental clinics
c)	Research centers	c)	Home care
d)	Animal research	d)	Cosmetic clinics
e)	Blood banks	e)	Paramedics
f)	Nursing homes	f)	Funeral services
g)	Mortuaries	g)	Institutions
h)	Autopsy centers	h)	First aid room of schools
i)	Immunization sites (Outreach)		

6.2.3 Goals of Bio-Medical Waste Management

Most of the waste generated can be infectious or hazardous to patients, healthcare worker or community and should be managed properly. Goals of the Biomedical waste management are as follows:

1) To reduce the infectious/hazardous nature of the waste
2) To reduce the volume of the waste
3) To prevent misuse or abuse of the waste
4) To ensure occupational safety and health of health workers
5) To reuse the items that can be of repeat utility

6.2.4 Steps of Bio-Medical Waste Management

1) Segregation
2) Collection and storage
3) Packaging
4) Transport
5) Treatment
6) Disposal
7) Maintain records/ returns/ accidents/follow-ups

6.2.5 Flow of Bio-Medical Waste Management

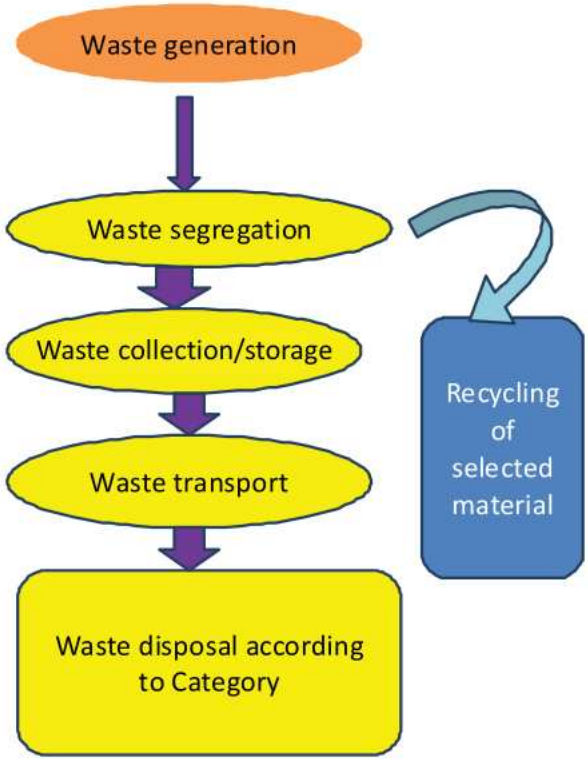


Fig. 6.2: Flow of Bio-medical waste management

Check Your Progress 1

1) Explain types of wastes.

.....

.....

2) List source of Bio-Medical wastes.

.....

.....

3) List steps in Bio-Medical Waste Management.

.....

.....

6.3 BIO-MEDICAL WASTE MANAGEMENT RULES, 2016

The Bio-medical Waste Management Rules apply to all individuals and entities involved in the generation, collection, reception, storage, transportation, treatment, disposal, or handling of bio-medical waste (BMW) in any form. These rules are structured into four schedules:

Schedule	Provision
I	Details the categories of biomedical waste along with their respective segregation, collection, treatment, processing, and disposal methods.
II	Specifies the standards for treatment and disposal of bio-medical waste.
III	Lists the prescribed authorities and outlines their corresponding duties.
IV	Provides guidelines for labeling bio-medical waste containers or bags and for transporting them.

Source - https://bnrc.springeropen.com/articles/10.1186/s42269-022-00847-4?utm_source=chatgpt.com

6.3.1 Segregation of Waste

It is the most crucial step in BMW management. It is to be done at the site of generation of BMW. Waste segregation is the process of keeping source separated wastes apart during handling, accumulation interim storage, storage and transport and to assist recovery (reuse, recycling and energy recover), and ensure appropriate designated treatment and disposal. Waste is then labelled for name of department, date, time, transportation site etc. It is responsibility of the waste producer to segregate the waste at the site of waste generation itself. Segregation is done in colour coded bags as explained later.

Rules for segregation

The segregation is important for waste management. The waste is categorise according to the treatment option therefore segregation should be carried out according to colour coded container/liner.

1) Segregation should be done at source
2) Location of container should be determined on the basis of categories of waste generated.
3) Instruction should be pasted at each waste collection point
4) If non-hazardous and hazardous waste are accidentally mixed, the entire should be treated as hazardous waste
5) Should never attempt correction of errors of segregation

Benefits of segregation

1) Minimised the amount of potentially hazardous waste
2) Enabling better accounting within health care institution
3) Reduce occupational health and safety risks
4) Improve infection control within the health care facility
5) Facilitate proper packing and labelling of wastes
6) Establishes uniform waste management practices,
7) Increase the patients and their relative participation.

6.3.2 Categories of Bio-Medical Waste

Biomedical wastes categories and their segregation, collection, treatment, processing and disposal options

Category	Type of Waste	Type of Bag or Container to be used	Treatment and Disposal options
(1)	(2)	(3)	(4)
Yellow	**(a) Human Anatomical Waste:** Human tissues, organs, body parts and fetus below the viability period (as per the Medical Termination of Pregnancy Act 1971, amended from time to time).	Yellow coloured non-chlorinated plastic bags	Incineration or Plasma Pyrolysis or deep burial*
	(b)Animal Anatomical Waste : Experimental animal carcasses, body parts, organs, tissues, including the waste generated from animals used in experiments or testing in veterinary hospitals or colleges or animal houses.		
	(c) Soiled Waste: Items contaminated with blood, body fluids like dressings, plaster casts, cotton swabs and bags containing residual or discarded blood and blood components.		Incineration or Plasma Pyrolysis or deep burial* In absence of above facilities, autoclaving or micro-waving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery.
	(d) Expired or Discarded Medicines: Pharmaceutical waste like antibiotics, cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials etc.	Yellow coloured non-chlorinated plastic bags or containers	Expired `cytotoxic drugs and items contaminated with cytotoxic drugs to be returned back to the manufacturer or supplier for incineration at temperature >1200 ^{0}C or to common bio-medical waste treatment facility or hazardous waste treatment, storage and disposal facility for incineration at >1200^{0}C Or Encapsulation or Plasma Pyrolysis at >1200^{0}C. All other discarded medicines shall be either sent back to manufacturer or disposed by incineration.
	(e) Chemical Waste: Chemicals used in production of biological and used or discarded disinfectants.	Yellow coloured containers or non-chlorinated plastic bags	Disposed of by incineration or Plasma Pyrolysis or Encapsulation in hazardous waste treatment, storage and disposal facility.

	(f) Chemical Liquid Waste : Liquid waste generated due to use of chemicals in production of biological and used or discarded disinfectants, Silver X-ray film developing liquid, discarded Formalin, infected secretions, aspirated body fluids, liquid from laboratories and floor washings, cleaning, house-keeping and disinfecting activities etc.	Separate collection system leading to effluent treatment system	After resource recovery, the chemical liquid waste shall be pre-treated before mixing with other wastewater. The combined discharge shall conform to the discharge norms given in Schedule-III.
	(g) Discarded linen, mattresses, beddings contaminated with blood or body fluid, routine mask and gown [inserted by G.S.R. 234 (E) dt.16.03.2018]	Non-chlorinated yellow plastic bags or suitable packing material	Non- chlorinated chemical disinfection followed by incineration or Plazma Pyrolysis or for energy recovery. In absence of above facilities, shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery or incineration or Plazma Pyrolysis.
	(h) Microbiology, Biotechnology and other clinical laboratory waste: Blood bags, Laboratory cultures, stocks or specimens of micro-organisms, live or attenuated vaccines, human and animal cell cultures used in research, industrial laboratories, production of biological, residual toxins, dishes and devices used for cultures.	Autoclave or Microwave or Hydroclave safe plastic bags or containers [substituted by G.S.R. 234 (E) dt.16.03.2018]	Pre-treat to sterilize with non-chlorinated chemicals on-site as per World Health Organisation guidelines on Safe management of wastes from health care activities and WHO Blue Book, 2014 and thereafter sent for incineration. [substituted by G.S.R. 234 (E) dt.16.03.2018]
Red	**Contaminated Waste (Recyclable)** (a) Wastes generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes (without needles and *fixed needle syringes*) and vaccutainers with their needles cut) and gloves.	Red coloured non-chlorinated plastic bags or containers	Autoclaving or micro-waving/ hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent to registered or authorized recyclers or for energy recovery or plastics to diesel or fuel oil or for road making, whichever is possible. Plastic waste should not be sent to landfill sites.

White (Translucent)	**Waste sharps including Metals:** Needles, syringes with fixed needles, needles from needle tip cutter or burner, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes both used, discarded and contaminated metal sharps	Puncture proof, Leak proof, tamper proof containers	Autoclaving or Dry Heat Sterilization followed by shredding or mutilation or encapsulation in metal container or cement concrete; combination of shredding cum autoclaving; and sent for final disposal to iron foundries (having consent to operate from the State Pollution Control Boards or Pollution Control Committees) or sanitary landfill or designated concrete waste sharp pit.
Blue	**(a) Glassware:** Broken or discarded and contaminated glass including medicine vials and ampoules except those contaminated with cytotoxic wastes.	(a) Puncture proof and leak proof boxes or containers with blue colored marking [substituted by G.S.R. 234 (E) dt.16.03.2018]	Disinfection (by soaking the washed glass waste after cleaning with detergent and Sodium Hypochlorite treatment) or through autoclaving or microwaving or hydroclaving and then sent for recycling.
	(b) Metallic Body Implants	(b) Puncture proof and leak proof boxes or containers with blue colored marking [substituted by G.S.R. 234 (E) dt.16.03.2018]	

*Disposal by deep burial is permitted only in rural or remote areas where there is no access to common bio-medical waste treatment facility. This will be carried out with prior approval from the prescribed authority and as per the Standards specified in Schedule-III. The deep burial facility shall be located as per the provisions and guidelines issued by Central Pollution Control Board from time to time.



Fig. 6.3: Containers for Bio-medical waste management (Yellow bin)



Fig. 6.4: Container for Bio Medical Waste Management (Red Bin)

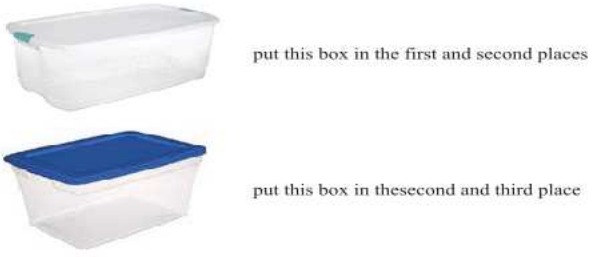


Fig. 6.5: Disposal of Sharp

6.3.3 Containers for Bio-Medical Waste Storage

1) Containers must be made of plastics or metals and should be color-coded as per Schedule I guidelines.
2) The inner and outer surfaces must be smooth to allow effective cleaning and prevent waste accumulation.
3) Containers should always be kept securely closed to avoid leakage or exposure.
4) For potentially infected waste, a minimum of 10% sodium hypochlorite solution with 30% residual chlorine should be added, with a contact time of at least 30 minutes (as updated post-2018), or an equivalent chemical that provides Log_{10}^4 microbial reduction efficiency, as mentioned in Schedule III.
5) Waste must be weighed prior to removal, and containers should not be filled beyond 2/3 of their capacity or stored for more than 48 hours to prevent degradation or risk.
6) Chlorinated plastic bags and gloves must be completely phased out, and only non-chlorinated, non-PVC bags should be used for incinerable waste, as per the March 27, 2019 deadline introduced in the 2018 amendment.

6.3.4 Benefits of Using Colour Coded Waste Container

1) Assists healthcare staff in accurate and safe segregation of waste at the point of generation, reducing cross-contamination risks.
2) Enables easy identification of waste categories (e.g., yellow for incinerable waste, red for recyclable contaminated waste, white for sharps, blue for glassware), improving compliance with Schedule I.
3) Helps identify associated health and environmental hazards, supporting safer handling and disposal.
4) Supports barcoding and GPS tracking systems (mandated post-2018) by ensuring uniform waste categorization and traceability across collection and disposal points.
5) Facilitates regulatory audits and documentation, enhancing institutional accountability and public health safety.

6.3.5 Collection and Storage of Bio-Medical Waste Bags

1) Bags are tightly closed or sealed when they are about three-quarters full
2) They are collected on daily basis
3) Stored in a separate area/room
4) No bio-medical waste shall be stored beyond 48 hours from the time of generation. If for any reason it is not possible to dispose of the waste within 48 hours, the facility must inform the prescribed authority and take appropriate measures to ensure safety (as emphasized in the 2018 amendment).

6.3.6 Packaging and Labelling

Following is symbol of biohazard. This label should be present on every bag as well as container containing BMW.



Fig. 6.6: Symbol of Biohazard

General rules of labelling

1) Name of Ward should be specified
2) Date and time of packaging should be mentioned
3) Destination (Treatment Site) should be written
4) Biohazard/Cytotoxic Symbol should be clearly visible
5) Weighing and recording of waste is specified
6) Separate register (Log book) should be made having above stated details

7) Daily digital or manual tracking of BMW movement is mandatory, and facilities are required to implement barcoding and GPS tracking systems (as per 2018 amendment).
8) Annual reports based on these records must be uploaded to the SPCB website by all healthcare facilities generating waste.

6.3.7 Transportation of Bio-Medical Waste

On-site transport

Dedicated Wheeled trolleys, containers, or carts that are not used for any other purposeshould be used for transportation. The vehicles should be cleaned and disinfected daily with an appropriate disinfectant.

Off-site transportation of waste

Manual loading should be avoided as far as possible. A signed document by Nurse/ Doctor/designated person mentioning date, shift, quantity and destination should be present always. All transport vehicles must be GPS-enabled and barcoded, as mandated in the 2018 amendment, to allow real-time tracking and prevent illegal dumping. There are registered, authorised, BMW transporters that should be used for each facility.

A common bio-medical waste treatment and disposal facility

In off site biomedical waste management common biomedical waste treatment and disposal facility has been suggested by the BMW rules 2016. According to them the every operator should perform following activities:

a) Take all necessary steps to ensure that the bio-medical waste collected from the occupier is transported, handled, stored, treated, and disposed of, without any adverse effect to human health and the environment, in accordance with these rules and guidelines issued by the Central Government or, as the case may be, the Central Pollution Control Board from time to time. Operators must also ensure that waste is tracked and monitored through barcoding and GPS systems as mandated post-2018.
b) Ensure timely collection of bio-medical waste from the occupier as prescribed under these rules and ensure pre-treatment (as per CPCB/WHO guidelines) of microbiology, lab waste, and blood bags by the occupier before collection.
c) Establish barcoding and global positioning system for handling of bio-medical waste within one year. As per 2018 rules, this was required to be implemented by March 27, 2019, for real-time monitoring.
d) Inform the prescribed authority immediately regarding the occupiers which are not handing over the segregated bio-medical waste in accordance with these rules, and maintain records of such non-compliance.
e) Provide training for all its workers involved in handling of bio-medical waste at the time of induction and at least once a year thereafter. This includes regular updates on GPS/barcoding procedures introduced post-2018.
f) Assist the occupier in training conducted by them for bio-medical waste management, and promote uniformity in segregation and labelling standards.
g) Undertake appropriate medical examination at the time of induction and at least once in a year and immunise all its workers involved in handling of bio-medical waste for protection against diseases, including Hepatitis B and Tetanus, that are likely to be transmitted while handling bio-medical waste, and maintain the records for the same.
h) Ensure occupational safety of all its workers involved in handling of bio-

medical waste by providing appropriate and adequate personal protective equipment. This includes safety protocols for handling chemical disinfectants and incineration ash.

i) Report major accidents, including accidents caused by fire hazards or blasts during handling of bio-medical waste, and the remedial action taken and the records relevant thereto (including nil report) in Form I to the prescribed authority and also along with the annual report. As per 2018 guidelines, this should be submitted digitally if facilities are available.
j) Maintain a log book for each of its treatment equipment according to weight of batch; categories of waste treated; time, date and duration of treatment cycle; and total hours of operation. This record should be retained for a minimum of 5 years and be compatible with GPS/barcoding system logs.
k) Allow occupier, who are giving waste for treatment to the operator, to see whether the treatment is carried out as per the rules. This transparency is also to be extended via display of authorization, compliance status, and annual reports on the CBWTF's official website, as mandated post-2018.
l) shall display details of authorisation, treatment, annual report etc on its web site;
m) after ensuring treatment by autoclaving or microwaving followed by mutilation or shredding, whichever is applicable, the recyclables from the treated bio-medical wastes such as plastics and glass, shall be given to recyclers having valid consent or authorisation or registration from the respective State Pollution Control Board or Pollution Control Committee;
n) supply non-chlorinated plastic coloured bags to the occupier on chargeable basis, if required;
o) common bio-medical waste treatment facility shall ensure collection of biomedical waste on holidays also;
p) maintain all record for operation of incineration, hydroclave, autoclaving for a period of five years; and
q) upgrade existing incinerators to achieve the standards for retention time in secondary chamber and Dioxin and Furans within two years from the date of this notification.

Guidelines for Authorising Vehicle for Transportation of Bio-Medical Waste

The operator of a common bio-medical waste treatment facility shall transport the bio-medical waste from the premises of an occupier to any off-site bio-medical waste treatment facility only in the vehicles having the label as provided in the Bio-Medical Waste Management Rules, 2016.

As per the 2018 amendment, such vehicles shall also be GPS-enabled and integrated with barcoding systems to ensure real-time tracking and traceability of waste during transportation. These vehicles shall be dedicated, closed, leak-proof, and easy to disinfect, and must not be used for any other purpose.

The details of vehicle authorization, tracking logs, and waste pick-up records must be maintained and submitted to the prescribed authority along with the annual report. All vehicle-related data shall be made available for inspection and uploaded on the operator's website where applicable.

6.4 ADVANTAGES OF BIO-MEDICAL WASTE MANAGEMENT

Advantages of Bio-Medical Waste Management includes:

1) Control nosocomial infections
2) Reduce HIV, sepsis, hepatitis transmission

3) Cut chain of transmission of infection
4) Reduce community exposure
5) Reduced Cost
6) Prevent illegal repackaging
7) Reduce long term risks
8. Minimise the amount of waste produced

Check Your Progress 2

1) Draw table to categorise bio-medical wastes.

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.....

2) List the Waste to be collected in yellow Bin.

.....

.....

3) List the waste to be collected in Red Bin.

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6.5 INFECTION CONTROL

The emergence of life-threatening infections such as severe acute respiratory syndrome (SARS), ebola, zika virus and re-emerging infectious diseases have highlighted the need for efficient infection control programmes in all health care settings. Health care workers need to be trained effectively and proper infection control measures should be taken in all health facilities. It is the duty of the healthcare worker to prevent the infection to occur while dealing with patient. Disease transmission can be prevented if the personal hygiene, using of personal protective equipment and proper biomedical waste management are carried out.

6.5.1 Principles of Infection Control

Agent, host and environment constitute epidemiological triad. Following are principles of infection control focusing on triad and their interaction.

1) **Microbes (Agent)**
   a) Identification of causative agent
   b) Specific measures to prevent their spread

2) **Patient (Host)**
   a) Admission for absolutely needed patient
   b) Barrier nursing for patient with depressed immunity
   c) Provision of isolation ward
   d) Hospital stay should be minimum possible

3) **Environment**
   a) Designing the health care institutions in such a way so that chances of transmission of infection are minimised.

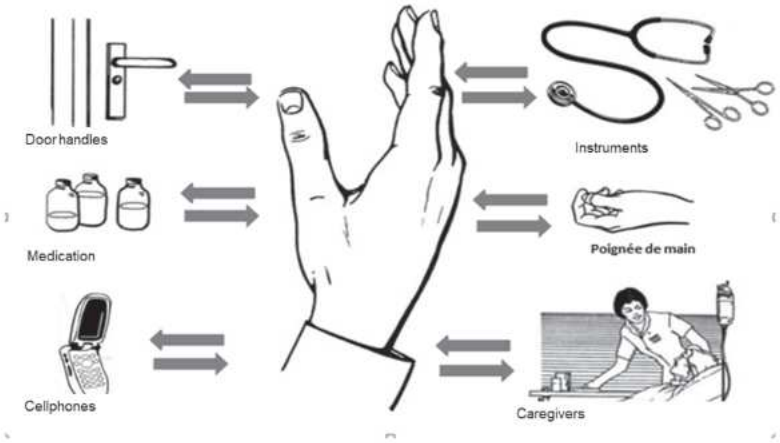
b) Positive pressure ventilation in high risk area

c) Effective bio-medical waste management

d) Effective Cleaning, disinfection and sterilisation

Hand Hygiene

- Best way to prevent the spread of germs in the health care setting and community
- Our hands are our main tool for work as health care workers- and they are the key link in the chain of transmission



Hand hygiene:
WHO 5 moments



https://www.who.int/infection-prevent

6.5.2 Components of Infection Control and Prevention

Infection control and prevention needs following components to be included in every activity planned for it-

a) Basic measures for infection control, i.e. standard precautions;

b) Education and training of health care workers;

c) Protection of health care workers, e.g. immunisation; protective equipments

d) Identification of hazards and minimising risks;

e) Effective work practices and procedures (such as environmental management practices, management of hospital/clinical waste, support services (e.g., food, linen)

f) Surveillance

g) Monitoring

h) Research

6.6 NOSOCOMIAL INFECTIONS

Nosocomial infections are important contributors to morbidity and mortality. They will become even more important as a public health problem with increasing economic and human impact because of:

a) Increasing numbers and crowding of people.

b) More frequent impaired immunity (age, illness, treatments)

c) New emerging microorganisms

d) Increasing bacterial resistance to antibiotics

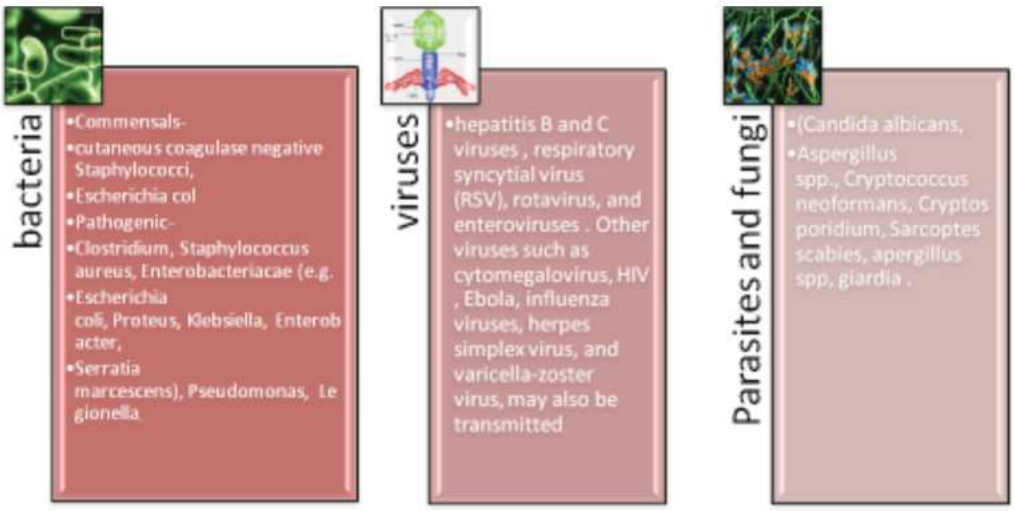


Fig. 6.7: Causative Microorganisms of Nosocomial infections

6.6.2 Prevention of Nosocomial Infection

Nosocomial infection at the healthcare setting are common and main cause delay in healing, cure and treatment outcome. All health workers should aimed to decrease the nosocomial infection. It is not possible at the individual level, therefore at all level of health system various activities are required.

National level

The responsible health authority should develop a national (or regional) programme to support hospitals in reducing the risk of nosocomial infections.

6.6.3 Objectives

1) To minimise the risk of infection to patients, staff and visitors.

2) To identify the roles and responsibilities of key personnel involved in the prevention and control of infection

3) To recommend antibiotic policy for the hospital and identify areas of irrational use of antibiotics and curb irrational use of antibiotics. The antibiotic policy of the health care setting is framework of using antibiotics, based upon experience of the doctors using different types of antibiotics for health conditions. Those antibiotics which are showing resistance are removed from drug list. Beside this proper drug doses and combination of antibiotics use are also part of policy.

6.6.4 Infection Control Components

1) A yearly work plan to assess and promote good health care, appropriate

isolation, sterilisation, and other practices, staff training, preparation of infection control manual and epidemiological surveillance should be developed.

2) Hospital infection control policy- outlines the broad principles of infection Control

3) Infection control manual- A nosocomial infection prevention manual, compiling recommended instructions and practices for patient care. It should be developed and updated by the infection control team, with review and approval by the committee.

6.6.5 Infection Control Committee – Roles and Responsibility

Infection control committee is located in general hospital at the district level and above. This committee should include wide representation from relevant departments and stakeholders.

Members-

a) Head, Microbiology – Chairman

b) Infection control officer/practitioner – Secretary

c) Infection control nurse

d) Medical superintendent

e) Nursing superintendent

f) Quality assurance officer

g) Heads of all clinical dept

h) Representation from relevant departments: e.g. management, physicians, other health care workers, clinical microbiology, pharmacy, sterilising service, maintenance, housekeeping.

Roles and responsibilities

a) To review and approve a yearly programme of activity for surveillance and prevention

b) To review epidemiological surveillance data and identify areas for intervention

c) To assess and promote improved practice at all levels of the health facility

d) To ensure appropriate staff training in infection control and safety

e) To review risks associated with new technologies, and monitor infectious risks of new devices and products, prior to their approval for use

f) To review and provide input into investigation of epidemics

g) To communicate and cooperate with other committees of the hospital with common interests such as pharmacy and therapeutics or antimicrobial use committee, biosafety or health and safety committees, and blood transfusion committee.

6.6.6 Infection Control Team (ICT)

Infection control committee should form the Infection control team which is directly responsible for day to day activities in the hospital. Following are members of ICT

a) Infection control officer (ICO)

b) Microbiologist (if not ICO)

c) Infection control nurse

d) Epidemiologist

e) Clinician interested in Hospital acquired infection

This team should consist of individuals who are specialists in infection control or contributing to it in any way. These individuals have a scientific and technical support role in-

a) Surveillance of infection

b) Regular training of members

c) Develop and update by the infection control manual

d) Advice control measures and periodically check its efficacy

e) Prepare fact sheet on available data related to infection

f) Outbreak management

g) Day-to-day sterilisation, disinfection process

h) Report back to infection control committee

Check Your Progress 3

1) List Infection Control components.

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6.7 EDUCATION AND TRAINING OF HEALTH CARE STAFF

The infection control team should:

- Organise regular training programmes for the staff for essential infection control practices that are appropriate to their job description;
- Provide periodic re-training or orientation of staff;
- Assess training needs of the staff and provide required training;
- Review the impact of training.

6.8 NOSOCOMIAL INFECTION SURVEILLANCE

The specific objectives of a surveillance programme include:

a) To improve awareness of clinical staff and other hospital workers (including administrators) about nosocomial infections and antimicrobial resistance.

b) To monitor trends: incidence and distribution of nosocomial infections, prevalence and, where possible, intra- and inter-hospital comparisons.

c) To identify the need for new or intensified prevention programmes, and evaluate the impact of prevention measures.

d) To identify possible areas for improvement in patient care, and for further epidemiological studies (i.e. risk factor analysis).



Fig. 6.8: Implementation of Surveillance

6.9 LET US SUM UP

'Bio-medical waste' means any solid and/or liquid waste including its container and any intermediate product, which is generated during the diagnosis, treatment or immunisation of human beings or animals or in research pertaining thereto or in the production or testing thereof. Major steps in biomedical waste management are segregation, collection and storage, packaging, transport, treatment and disposal. Bio-medical waste management rules 2016 are framed which are applicable on all persons who generate, collect, receive, store, transport, treat, dispose or handle BMW in any form. The rules have 4 schedules which has guidelines for BMW management. Segregation is done in colour coded bags. There are 4 categories of BMW and different disposal methods are specified according to categories. All waste bags are properly labelled and transported to the site of disposal. Advantages of BMW management are prevention of nosocomial infections, reduce HIV, sepsis, hepatitis transmission, reduce community exposure, reduced cost and prevent illegal repackaging. The emergence of life-threatening infections has highlighted the need for efficient infection control and prevention strategies in all health care settings. The aim is to provide administrators and health care workers with the tools to enable them to implement the infection control programmes effectively. Infection control addressed the factors related to spread of infections, prevention(via hand hygiene/hand washing, cleaning/disinfection/sterilisation, vaccination), surveillance and outbreak investigation and management (interruption of outbreaks). The responsible health authority should develop a national (or regional) programmes to support hospitals in reducing the risk of health-care-associated infections.

6.10 KEY WORDS

1) **Wastes** : It is viewed as discarded materials, much of which can be reused or recycled (cardboard, paper, plastic, etc.).

2) **General Waste or Non-infectious Waste** : It includes domestic waste, packing materials, non-infectious waste bedding, food and kitchen waste, wastewater from laundries, etc., which do not pose any special hazard.

3) **Animal Waste** : Discarded materials including carcasses, body parts, body fluids, blood, or bedding originating from animals known to be contaminated with infectious agents (i.e. zoonotic organisms) or from animals inoculated during research, production of biologicals, or pharmaceutical testing with infectious agents.

4) **Chemical Waste** : Includes discarded solid, liquid and gaseous chemicals from diagnostic procedures. Chemical waste may be (a) Non-hazardous, or (b) Hazardous - toxic, corrosive, flammable, reactive (or explosive), or genotoxic in nature.

5) **Health-care waste** : Includes all the waste generated by Health-care establishment, research facilities, laboratories and minor or scattered sources.

6) **Contaminated Wastesmeans** : The waste carrying invisible disease causing microorganisms. These microorganisms are passed from the fluids, tissues, human wastes or contaminated clothes and sheets of infected people to anything that is used to treat them.

7) **Cytotoxic Drugs and Cytotoxic Waste** : Include antineoplastic agents and chemotherapy drugs, such as actinomycin-D, Bleomycine, busulfan, chlorambucil, cisplastin, cyclophosphamide, methotrexate, nitrogen mustard, uracil, vinblastin, vincristine etc.

8) **Infectious Wasteis** : Defined as "waste capable of producing an infectious diseases," on the basis of four factors - (1) presence of a virulent pathogen, (2) sufficient dose, (3) portal of entry, and (4) resistance of the host.

9) **Infection control** : The discipline concerned with preventing nosocomial or healthcare-associated infection.

10) **Infection control programme** : Puts together various practices which, when used appropriately, restrict the spread of infection.

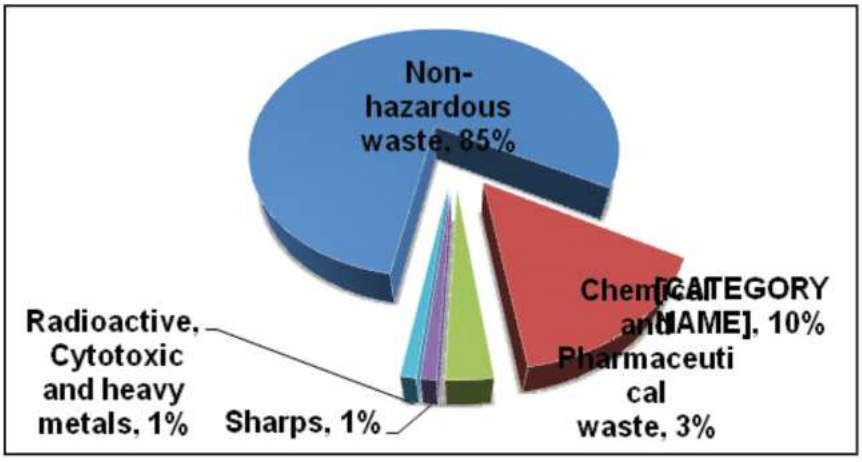
11) **Nosocomial infections or hospital acquired infections (HAIs)** : Defined as an infection occurring in a patient in a hospital or other healthcare facility, in whom the infection was not present neither incubating at the time of admission. It includes infections acquired in the hospital but appearing after discharge and also occupational infections among the healthcare staff. Infections occurring more than 48 hours after admission are considered nosocomial infections.

6.11 MODEL ANSWERS

Check Your Progress 1

1) **Types of Waste**

Majority of waste produced in health care facilities is non hazardous waste. Only a small percentage is harmful waste that needs to be properly treated so that it is rendered harmless.



2) **Sources of Bio-Medical Waste**

There are almost everyplace of healthcare setting where waste is generated. But not all waste is hazardous and need special treatment.

Major Sources	**Minor sources**
j) Hospitals	i) Clinics
k) Labs	j) Dental clinics
l) Research centers	k) Home care
m) Animal research	l) Cosmetic clinics
n) Blood banks	m) Paramedics
o) Nursing homes	n) Funeral services
p) Mortuaries	o) Institutions
q) Autopsy centers	

3) **Steps in biomedical waste management**

1) Segregation
2) Collection and storage
3) Packaging
4) Transport
5) Treatment
6) Disposal
7) Maintain records/ returns/ accidents/follow-ups

Check Your Progress 2

1) Categories of Bio-Medical Waste

BMW is segregated in 4 categories depending upon the treatment options

Category	Colour of Bag	Type of Waste Disposed
Category 1	Yellow	Human anatomical waste, Animal Anatomical Waste, Soiled Waste, Expired or Discarded Medicines, Chemical Waste, Chemical Liquid Waste, Microbiology, Biotechnology and other clinical lab waste
Category 2	Red	Contaminated Waste (Recyclable)
Category 3	White	Waste sharps including Metals
Category 4	Blue	Glassware, Metallic Body Implants

2) Waste to be collected in Yellow Bin

- Soiled linen contaminated gown
- Human anatomical waste placenta
- Pathology Waste-tissues

3) All infectious, non sharp plastic waste, I/V Sets, Plastic culture plates and tubes.

Check Your Progress 3

1) Infection Control Components

- A yearly work plan to assess and promote good health care, appropriate isolation, sterilisation, and other practices, staff training, preparation of infection control manual and epidemiological surveillance should be developed.
- Hospital infection control policy– outlines the broad principles of infection Control.
- Infection control manual– A nosocomial infection prevention manual, compiling recommended instructions and practices for patient care. It should be developed and updated by the infection control team, with review and approval by the committee.

6.12 REFERENCES

1) Kishore J & Ingle GK. Biomedical Waste Management in India. New Delhi: Century Publications 2002Govt of India. Biomedical Waste Management Rules 2016.

2) CPCBhttp://www.who.int/mediacentre/factsheets/fs253/en/Govt of India.

3) National Policy for containment of antimicrobial resistance India 2011. DGHS, MoHFW New Delhi

4) Ayliffe GA, Fraise AP, Geddes AM, Mitchell K (ed). Control of Hospital Infection: A Practical Handbook. Co-published by Oxford University Press, New York 2000.

5) Bhattacharya SK. Protection of Environment and the Role of Law. The Employment News Weekly, Govt. of India 2001; XXV (20):1-2.

6) Burke RA, Garvin GM, Sulis CA. Infection Control and Risk Reduction for Health Care Workers. In Libmam H, Witzburg RA (2nded). HIV infection: A Clinical Manual. Boston: Little, Brown and Company.

7) Central Pollution Control Board. Manual on Hospital Waste Management. CPCB, Ministry of Environment & Forest, Delhi, March, 2000.

8) Dienstag JL, Ryan DM. Occupational Exposure to Hepatitis B virus in Hospital Personnel. Infection or Immunization? Am J Epidemiology 1982 ; 115 : 26

9) Dolk H, Armstrong MVB, Abramsky L, Binchi F, Garne E, Nelen V, Robert E, Scott JES, Stoe D, and Tenconi R. Risk of Congenital Anomalies near Hazardous Landfill Sites in Europ: the EUROHAZCON study.Lancet 1998; 352: 423-427.

10) Gerberding JL. Incidence and prevalence of HIV, Hepatitis B Virus, Hepatitis C Virus and Cytomegalovirus Among Health Care Personnel at Risk for Blood Exposure: A Final Report from Longitudinal Study. J Infect Dis 1994; 170: 1410-1413.

11) Gerberding JL. Management of Occupational Exposures to Bloodborne Viruses. N Engl J Med 1995; 332: 444.

12) Govt. of India. The Environment (Protection) Act, 1986 No. 29 OF 1986 [23rd May, 1986]. Ministry of Environment& Forest, Govt. of India.

13) Kishore J, Goal P, Sagar B, Joshi TK. Awareness about Biomedical Waste Management and Infection Control among Dentists of a Teaching Hospital in New Delhi, India. Indian J Dent Res 2000; 11 (4): 157-61.

14) Kishore J, Joshi TK, B Sagar. Occupational Injuries in a Teaching Hospital. 5th World Conference on Injury Prevention and Control,New Delhi, Feb. 2000a.

15) Kishore J, Joshi TK, Sagar B. Hospital Waste Management in India. Indian J Occu & Environmental Medicine 1999; 3 (2): 79-84.

16) Kishore J, Joshi TK. Biomedical Waste Management. Employment News 2000; Feb. 19-25.

17) Kishore J. A Dictionary of Public Health. New Delhi: Century Publications 2013.

18) World Bank. Healthcare waste management guidance note. Word Bank, May 2000.

19) World Health Organization. 4. Safe Injection Global Network (SIGN) initial meeting report, October 4-5, 1999, WHO headquarters, Geneva, Switzerland. Geneva: WHO, 2000.

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