College of Health and Medical Science

Department of Environmental health

Course: Residential and Institutional health for Environmental health students

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CHAPTER ONE

Introduction To Residential And Institutional Health

1.1 Learning Objectives

At the end of this chapter, the student will be able to:

1. Define housing and other related terms
2. Enumerate factors affecting the quality of housing and explain how these factors influence housing
3. Describe health importance of housing

- Why human being need shelter?
- Some literatures have evidently shown that humans in the prehistoric periods used the existing natural physical structures to protect themselves against those factors that put potential risks to their life.
- These structures have been used mainly to overcome
- adverse weather conditions,
- frightening wild animals, and
- to store some foodstuffs.

➢ It is therefore, understood that the quest for shelter has emerged from the time when people have appeared on earth .

- The present modern buildings are believed to be fruits of development or gradual progresses of human history.
- The basic fact of this is that human settlements are one of the basic factors governing the physical, mental, and social wellbeing of an individual and the family.
- Various studies conducted in different parts of the world have revealed that there is a direct and indirect association between health status of the inhabitants and the condition of housing.
- Thus, the quality of life of people depends on the general condition of their residences, which is the immediate human environment.

- Although rudimentary and unorganized efforts have been made in improving housing through environmental health programs, there was no significant improvement achieved
- This is in part due to economical problem, lack of organized program and a government policy with regard to housing.
- Housing improvement is generally linked with or affected by factors such as:

✓ economic status,
✓ social conditions,
✓ educational status,
✓ custom, traditions,
✓ governmental and local housing policies and
✓ geographical conditions

- Hence, a concerted and integrated effort of different concerned sectors including the occupants is necessary for effective housing program and improvement.
- In Ethiopia, poor housing conditions attributed by
- overcrowding,
- poor housekeeping,
- poor designing and construction, etc. are the major factors for presence of substandard housing and poor health status of the occupants.
- These problems are now rather increasing at an alarming rate particularly in developing countries including Ethiopia as homelessness, formation of slums and squatter settlement are becoming major problems especially in towns and big cities.

- Population growth, immigration of people from rural to urban areas in search of job, natural and man-made disasters, is creating an extreme overcrowding and poor housing in urban settings
- For instance, the housing and population census of 1984 indicated that 81.4 per cent rural and 28.6 per cent urban dwellings in former **Shewa region** were single –room houses, each occupied by four persons on average.
- The census conducted in the same year also revealed that 52.2 per cent and 29.2 per cent of housing unit in the city of Addis Ababa had no ceilings and toilet facilities respectively.
- From health standard point of view each family and individual should have a decent home and a suitable living environment.

- Clear air, pure and adequate water, safe food, adequate shelter, unpolluted land and freedom from excessive noise and odors are the most important requirements.
- However, large segments of Ethiopian urban and rural population do not enjoy these fundamental needs.

Definition of Terms

***Housing or Residential Environment*:-** The WHO Expert Committee defined housing as follows: "**Housing** is the physical structure that man uses for shelter and the environment of that structure including all necessary services, facilities, equipment and devices needed and desired for the physical and mental health and social wellbeing of the family and the individual."

Examples: caves(natural or artificial), simple sheds, huts or tukuls, modern buildings, tents, caravans, vans and etc. have all temporarily or permanently been used as residential environment although they might not satisfy all the basic needs

Institution is a complete property with building, facilities, and services having a **social, educational, or religious purpose.** E.g. Colleges and universities, schools, hospital, jails and prisons

- ***Housing Sanitary Code*:-** is the set of rules which deals with the sanitary conditions of the housing from public health point of view.

Example:

- It deals with possibility of disinfecting water,
- application of vector control measures,
- environmental sanitation, etc. in or around residential environment

- **Housing code**- (Laws, rules, ordinances) enforcing on the legal control of housing

These laws are used to clearly regulate.

a) The physical condition of a house

- Location
- Soil formation
- Flooding
- Arthropod & Rodent infestation
- Water supply systems
- Light, heat, ventilation, overcrowding

b) The biological conditions (Bacterial factors)

c) Social Environement - Disturbance due to Noise

- Smell (bad odor)
- Smoke
- Drainage

- ***Zoning Code*:-** involves the division of the area into a series of zones or districts according to the desired plan.
- *Example:* residential zone, market zone, industrial zone, etc
- ***Dwelling*:-** is any part of a house, which is occupied by an individual family.
  ***Premises*:-** is any house with building or land near to it that is owned by the same person.
- ***Standard Housing*:-** is a house that is properly planned and constructed, comfortable, safe to live in and fulfill the basic housing necessities (constructed in proper site, provided with safe and adequate water supply, safe and proper waste disposal , adequate light, space, well ventilated, etc

***Substandard Housing*:-** is a house, which is poorly sited, planned and constructed, inadequate floor space for the family (overcrowded), poorly maintained and does not in general comply with the more important sanitary facilities.

Slum:- is an area in which substandard housing predominates and frequently accompanied with overcrowding.

***Blighted area*:-** an area, which is undesirable for residential, agricultural, commercial, industrial or recreational purpose.

Examples:- Marshy and rocky areas, gorges and mountainous areas, and plots nearer to sources of noise.

Note: *Avoid blight areas in town planning & zoning as they are likely to develop into slums.*

Types of housing

1. **single-family home:** The single-family dwelling is defined as **one unattached dwelling unit inhabited by an adult person plus one or more related persons.** Single-family homes vary from small cabins to mansions.

- The significance of the single-family home is that it contains only family members or close friends, thereby reducing the potential for conflict and neglect of property.

2. **multiple-family dwellings:** A multiple-family dwelling is any shelter containing two or more dwelling units, rooming units, or both.

3. Travel Trailers / Mobile Homes: These units are neither large enough nor properly equipped to fill the needs and requirements of a permanent dwelling.

- In addition, dangerous storms{ኣውሎ ንፋስ} frequently cause serious damage to this type of housing

4. Transient housing: Motels, hotels, and lodging houses are transient dwellings where occupants reside for a day, a week, and possibly longer.

- The problems emanating from this type of housing are similar to those found in hospitals, nursing homes, recovery homes, and other short-term medical facilities.
- The major difference is the individuals within transient housing units are supposedly healthy individuals and are under no form of supervision.

- Many individuals fall ill when traveling, or may be carriers of a variety of diseases and spread the microorganisms throughout the transient housing environment.
- The motel or hotel has the same basic problems as the medical facilities involving housekeeping, laundry, food, solid waste disposal, insects and rodents, and so forth, but to a lesser degree.

5. **Dormitories**: College dormitories are basically similar to hotels, with the principal difference that individuals occupy dormitories for several months instead of several days.

- ✓ The one problem that frequently occurs in dormitories is the spread **of contagious or infectious diseases.**
- ✓ In the event of illness, a dormitory resident should be removed to the student health center, placed in isolation, if necessary, and properly treated.

6. Emergency housing: Emergency housing consists of the use of trailers provided by the **Housing** and **Urban Development** (HUD),gymnasiums, churches, or any other available buildings for use when normal housing has been destroyed, made unsafe, or inundated by floods.

- Emergency housing should be closely supervised{የሚቆጣጠረው} by environmental health and other public health authorities to prevent the outbreak of contagious or infectious diseases

Public Health Importance of Housing

- Inadequate housing conditions expose people to
  - Physical hazards
  - chemical hazards
  - biological hazards, and
  - various adverse psychological and social factors.

Housing Conditions That Affect Health

Categories:

1. Sufficient Scientific Evidence
2. Some Scientific Evidence
3. Insufficient Evidence

WORLD HEALTH ORGANIZATION
EUROPE

Report on the WHO technical meeting on quantifying disease from inadequate housing

Bonn, Germany, 28-30 November, 2005

Sufficient Scientific Evidence

- **PHYSICAL FACTORS:**
  - Heat and related temperatures and winter excess mortality
  - Cold indoor temperatures and winter excess mortality
  - Energy efficiency of housing and health
  - Radon exposure in dwellings and cancer
  - Neighborhood and building noise and related health effects

- **SOCIAL FACTORS:**
  - Multifamily housing, high-rise housing, housing quality and mental health
- **CHEMICAL FACTORS:**
  - ETS(Environmental Tobacco Smoke) exposure in dwellings and respiratory and allergic effects
  - Lead-related health effects
- **BIOLOGICAL FACTORS:**
  - Humidity and mold in dwellings and related health effects

SOME EVIDENCE (WHO, 2005)

- **PHYSICAL FACTORS:**
  - Ventilation in the dwelling and respiratory and allergic effects
- **CHEMICAL FACTORS:**
  - VOCs and respiratory, cardiovascular and allergic effects
- **BIOLOGICAL FACTORS:**
  - Cockroaches and rodents in dwellings and respiratory and allergic effects. Cats, dogs and mites in dwellings and respiratory and allergic effects

- **BUILDING FACTORS**:
  - Sanitation and hygiene conditions and related physical health effects
- **SOCIAL FACTORS**:
  - Social conditions of housing and fear/fear of crime
  - Poverty and social exclusion and related health effects
  - Crowding and related health effects
  - Social factors/social climate and mental health

- These health problems arising from poor housing be happening or may be aggravated as a result of:
  - lack of awareness of the inhabitants,
  - poor design and construction of the house,
  - inadequate illumination and ventilation,
  - lack of maintenance and
  - due to poor housekeeping practices.

- The level of hygiene in the dwelling is another environmental factor that should never be neglected especially for those who spend most of their time indoors,
  - such as infants,
  - young children,
  - the elderly, and
  - handicapped.
- Housing, along with food and clothing, is thus, a basic necessity for one's life.

- principles regarding the relationship between housing condition and human health.
  - Protection against communicable diseases;
  - Protection against injuries,
  - Prevention of poisonings and chronic diseases;
  - Reducing psychological and social stresses to a minimum;
  - Improving the housing environment;

Substandard Housing and Slums

- These housing problems usually prevail in nations with low socioeconomic status.
- Substandard housing is particularly the problem of both rural and urban areas, while the formation of slum area predominates in urban settings, especially in unplanned towns and cities.
- Globally, **some six hundred million urban dwellers and one billion rural inhabitants** live in **life threatening** housing conditions characterized by
  - ✓ **lack of water and sanitation services**
  - ✓ **proper and safe housing and**
  - ✓ **lack of basic sanitary and housing facilities.**

- The following **conditions directly or indirectly** are responsible for the occurrence of substandard housing:

- ✓ **With the movement of people to cities, urban areas are congested, and desirable housing become unattainable.**
- ✓ **Inadequate transportation facilities to and from work place makes it necessary for any people to accept less desirable housing, in the cities, closer to their work places.**
- ✓ **Low income to afford satisfactory housing.**
- ✓ **Slow measures by the local governmental units, to control potential problems, and lack of integrated efforts to control the problem.**

- **Lack of housing legislation to enforce suitable zoning, building, and sanitation and poor support from courts.**
- **Mismatch of the rate of construction of housing and rehabilitation to keep pace with population growth**
- Obsolescence and lack of awareness (about disease prevention, sanitation and personal hygiene), are some of the other factors that cause growth of slum areas.
- Tenants or inhabitants may hesitate to be interested in maintenance work, especially when the houses are rented.
- Substandard housing conditions are intimately linked with three of the leading pediatric health concerns:
  - Asthma
  - Lead poisoning
  - Household Injuries

- Dwellings having four or more of the following basic deficiencies are considered to be an extreme slum:

1. Provided with inadequate and contaminated water supply
2. Lack of toilets or space to construct outside of the structure
3. Lack of bathing facility inside or outside the structure
4. Greater than 1.5 persons per habitable room
5. Overcrowding of sleeping rooms (less than 3.6 m2.) of sleeping area per person)
6. Lack of dual egress (doors for emergency exits)

7. Lack of installed electricity

8. Rooms lacking windows for light and ventilation

9. Lack of waste disposal facilities

10. Having problems of arthropods and rodents

11. Lack of proper drainage

12. Lack of open spaces, pathways, and all weather roads between individual structures and etc.

UN-Habitat slum indicators

- **lacking one or more of the following five facilities:**

1. Durable housing (a permanent structure providing protection from extreme climatic conditions);
2. Sufficient living area (no more than three people sharing a room)
3. Access to **improved water** (water that is sufficient, affordable and can be obtained without extreme effort)
4. Access to improved sanitation facilities (a private toilet, or a public one shared with a reasonable number of people); and

Slum reduction strategy Global Vs Ethiopian

- According to UN-HABITAT slum reduction takes a combination of five specific, complementary approaches:

  (1) awareness and support

  (2) long-term political commitment

  (3) policy reforms and institutional strengthening

  (4) implementation and monitoring

  (5) scaling-up of successful local projects

CHAPTER TWO

Basic Principles of Healthful Housing

2.1 Learning Objectives

Upon successful completion of this chapter, the student will be able to:

1. List the basic principles of healthful housing
2. Identify housing conditions that may affect normal physiological activities of occupants
3. Describe housing conditions that may affect psychological well being of the occupants
4. Mention factors associated with indoor accident and causation of communicable diseases
5. Explain sources, health effect and preventive measures of noise pollution

Introduction

Basic principles of healthful housing include all those fundamental requirements the house should fulfill and maintain them all the time to avoid health risks in the residential environment.

- Satisfaction of physiological needs and
- psychological needs of the family members,
- protection of the family against communicable diseases,
- Protection against accidents and excessive noise are among these requirements.
- The attainment of most of these fundamental requirements demands due attention during planning, designing, and construction of the house so that none of the important installations and important facilities are not missed or overlooked.

- Proper housekeeping and other hygienic aspects are maintained as regular practices.

1. Satisfaction of Fundamental Physiological needs

- Any housing meant for human habitation should avoid all factors that may affect the normal physiological activities of the body of occupants.
- **The conditions listed below have direct or indirect associations with physiological and metabolic activities of the human body**

1. The house should maintain thermal environment that will avoid undue heat loss from the human body during cold weather conditions i.e heating of building or blockage of entry of cold air draught to the house

2. Provision of adequate day light (sunlight) illumination and avoidance of undue day light glare such as unnecessary reflection in the room.

3. Protection against excessive outdoor and indoor noise.

4. Provision of adequate artificial light preferably electricity to avoid possible indoor air pollution.

5. Provision of adequate space for exercise, gardening and for the play of children

6. Provision of atmosphere of reasonable chemical and bacteriological purity i.e. indoor atmosphere should be free of chemical substances, dust particles, smoke, microorganisms and particulate

2. **Satisfaction of Fundamental Psychological Needs**

The house should also secure the family members from the frightening conditions such as robbers, wild animals, reptiles, scorpions, etc, which under some circumstances may cause hallucination to them.

Seven fundamental psychologic needs for healthy housing include the following:

1. adequate privacy for the individual,
2. opportunities for normal family life,
3. opportunities for normal community life,
4. facilities that make possible the performance of household tasks without undue physical &mental fatigue,
5. facilities for maintenance of cleanliness of the dwelling and of the person,

6. possibilities for aesthetic satisfaction in the home and its surroundings, and

7. concordance with prevailing social standards of the local community.

3. Protection against Communicable Diseases

- A good house must satisfy the need for protection of occupants from risk of communicable diseases through
  - provision of safe water supply,
  - proper excreta and refuse disposal,
    - Safe liquid waste and storm water mgt.
    - Personal and domestic hygiene

- Safe food hygiene
- prevention of vermin, insects, rodents,
- proper storage for foods.
- Provision of adequate sleeping spaces minimizes the spread of contagious infections such as scabies, and other dermatological problems, pediculosis, etc.

4. Protection against accidental Injuries

- The incidence of indoor accidents is directly related to the housing condition, its engineering design and arrangements of physical objects in the house such as the different household equipment, and work methods etc.
- Improving housing and maintaining it, somehow can significantly reduce the rate of such accidents

- In general the following considerations should be given due attention.
  - Structural features and furnishings safety
  - Indoor pollution, Chemical safety
  - Electrical control and safety provisions
  - Fire control and safety provisions and need to escape
  - Protection against gas poisoning
  - Traffic accidents

5. Protecting the population at special risk

- Priorities for high risk population groups – children, women, elders, the sick and disabled
- Those who live in substandard housing: urban slums, squatter settlements
- Displaced and mobile population.

6. Improving Housing Environments

- Access to security and emergency service: fire, rescue, emergency medical service
- Access to social services: health service, school, communication, water supply, waste disposal, etc

Protection Against Excessive Noise

- Noise is defined as unwanted sound.
- Sound is any pressure vibration or stimulus, which produces sensory responses in the brain. Noise pollution is practically observed to be a problem of urban settings than rural. (why noise is the problem of urban rather than rural?)
- Towns and cities in Ethiopia are established with no prior planning to meet the town planning and zoning regulations.
- The consequence of this is that large population of such towns has faced the problems of noise pollution.
- It may be of public concern especially, where apartments or residential houses are located near airports, roads,

The principal sources of community noise pollution:-

1. Transportation facilities such as automobile or truck traffic, railways and other train transit systems.
2. Building equipment, such as air-conditioning blowers, compressors, etc
3. Construction and maintenance equipment such as stone crushers, concrete mixers, compactors, etc.
4. Electric distribution transformers
5. Factories from which noise escape to the surrounding area
6. Stadiums and other noisy sport centers when located close to homes
7. Mills & welding units
8. Loud music shops and etc. are all sources of noise pollution

Health Effects of noise

- The direct health effects of noise exposure depend on
- pressure level of noise,
- frequency of noise,
- daily exposure time, and
- total duration of exposure in a lifetime.
- Noise may be considered as disturbing sound, which interferes with work, comfort, sleep and rest of the family, especially children, the sick, and elderly.
- Hearing is likely to be permanently impaired among those constantly exposed to loud noise.
- It also triggers cardiovascular and digestive disorders such as increase in blood pressure and rate of heartbeat(tachycardia)

- It causes irritability, tension, insomnia(sleeplessness), moodiness, and interfere with normal development of infants.
- Noise decreases efficiency of workers and cause fatigue, which may lead to accidents.
- **Measuring Noise Level**
- The Decibel (dB) scale is the more commonly used unit to measure or express sound / noise level.
- **N.B.**: Most authorities agree that noise levels above 85 decibels present risks of hearing loss(deafness).
- Nevertheless repeated doses of even lower levels of noise may also present harm
- Level of Noise recommended at office, dwelling, and sleeping rooms

Place Noise Level (Decibel)

- ✓ Dwelling Less than 50
- ✓ Offices Less than 35
- ✓ Sleeping room Less than 30

❑ **Noise Prevention**

❖ Overcoming the community noise nuisance therefore, require the following actions:

- Education of the public about the health effects of noise and how to control it at the local level using for example, soundproof construction materials.
- Mutual cooperation of industrial firms, utility companies, truck owners, businessmen, city authorities in the control of noise

- Formulation and application of regulations of a reasonable and enforceable anti noise ordinance
- Refrigerators, heating equipment, pumps etc. should be firm not to give vibrations in the house or proper arrangement of equipment.
- Site of housing should be away from sources of excessive noise such as factories, high ways, railways, athletic fields (stadiums) sea and airports, etc.
- In a house all plumbing, steam pipes and valves should be correctly constructed to stop hammering and singing.
- Houses should be constructed in a way to reduce noises and be fitted with facilities, which reduce noise transmission

QUIZ(5%)

1. List the main direct health effects determinants of noise exposure?(1.5)
2. Reason out why noise is the problem of urban setting rather than rural?(1.5)
3. List the main sources of noise formation/ pollution and its preventions ?(2)

CHAPTER THREE
Zoning and Town Planning

12/18/2025

- **Learning Objectives**
  Upon completion of this chapter, the student will be able to:
  1. Define zoning and town planning
  2. Enumerate advantages of zoning
  3. Describe how zoning and town planning help to develop healthy cities

Introduction

- Town planning is the activity where future direction of development of a certain town is designed to improve physical and social environments through wise use of community resources.
- It enables people to support each other in performing all the functions of life and in developing to their maximum potential.
- Town planning is therefore, becoming more and more important in urban affairs.
- Zoning is the division of land (town/city) into different districts with particular characteristics.
- It is an integral part of town planning and help to ensure or facilitate appropriate distribution and design of municipal services that include

- water supply,
- waste disposal,
- fire protection and
- public facilities such as recreation areas, schools, burial sites and other social facilities.
- Town planning and zoning controls land utility to conform to certain regulation when they develop the land for residential or business purposes.
- Zoning also controls the type of building to be erected in a given section of the community and helps to avoid the overcrowding traffic movements thereby reducing accidents.
- It provides a degree of uniformity in planning special planting commissions in some community, to promote attractiveness/ beauty of the city.

Therefore, it will be apparent that zoning and housing are allied.

- A city that is logically zoned has a significant role in improving housing in several ways.
- Zoning ensures better living conditions in newly constructed dwellings.

The purpose of zoning and housing are:

1.To control the density of population per unit area,
2. Locate residential, commercial and industrial areas
3. Mark roads and highways,
4. Determine street width that will accommodate the traffic requirements;
5. Ensure safety of the population from other hazards including air pollution, noise pollution and other stresses arising from industries or commercial business centers

3.3 Types of Zoning/Districts

A well planned and zoned town or city may be divided into the following zones or district:

3.3.1 Residential Zone

- This zone is assigned for residential purposes where residential dwellings predominate.
- The rapid growth of unplanned small towns and rural villages has led most of them to an **overcrowding, poor housing** and **socio- economic condition**.
- Populations living in such unzoned residential environments usually suffer from truck noises released from motor vehicles, industrial and commercial units, wastes and other nuisances arising from factories, industries, and establishments.

- Locating separate districts for residential area is a good remedy to overcome and control all the problems that may be resulted from unplanned towns.
- Zoning ordinances in around residences is very explicit as to spacing individual houses from each other to ensure sufficient lot, air, and light.
- **Every One should therefore, consider the following criteria while selecting suitable site for the residential district:-**

  1. Nearness to work place
  2. Availability of construction materials
  3. Availability of water, electricity for construction purposes and domestic use
  4. The area should be free from dampness

- 5. Level ground for building; but the whole area for the city or town, should be slightly sloping for ease of rainwater drainage and sewage disposal. But if it is flat what is problem?
  6. The area should be open for easy air movement(absence overcrowding)
- 7. The site should be accessible to the road, commercial, and other social services (market, schools, recreational areas, health facilities).
- The residential zone may be further subdivided into different sub zones if need arises, based on the type and standards of the houses erected, such as thatched roof houses, apartments, villas, etc

- Such division may be of a particular advantage to provide the residential zone with basic services like water, electric light, telephone, appropriate disposal facilities for household wastes, etc.
- NB. In the residential zone industries and commercial firms are prevented from being established to stop the potential hazards they may cause to the environment.

Commercial (Business) Zone

- Commercial zone may also encompasses variety of business needs such as neighborhood shopping centers which serve the day to day needs and sub urban shopping center for the residents
- Markets and shopping centers are usually located along streets and central business districts

- Zoning of commercial sectors into separate units is not only beneficial to promote community health, but it is also convenient for easy transportation, storage, and display of the products.
- The size of free spaces between individual commercial sectors, allocating minimum distance from main street, placement of each commercial unit with respect to their type and services they render are all governed by the zoning ordinance.

3. Industrial Zone / District

Industrial zone may also have several subdivisions such as large or small scale or cottage industries.

- Establishment of separate district for industries prevents building of high or hazardous structures in residential areas.
- Industries are better located at out skirt of the town or city to isolate industrial pollutants such as smoke, hazardous chemical wastes, and noise from the population and minimize frequency of exposure.
- Separate handling and treatment of these industrial hazardous substances safeguard both the aquatic and terrestrial ecosystem from health effects of industrial discharges and scraps

4. Recreational Zone

- Recreational zones include: beaches(የባህር ዳርቻ), swimming pools, hotels, camps, motels, clubs, sport fields, etc.
- These places accommodate many people per day mainly those who wants to relax themselves especially on holidays or weekends.
  - Such areas used for mental refreshment should be considered during town planning, and logically zoned as a separate unit in the town
  - Zoning of relaxation sites is important to create many entertainment alternatives for the local residents and tourists.
  - It is also convenient for controlling contamination or pollution of the site and to take appropriate measures immediately

5. Institutional Zone (schools, hospitals and etc)

- Zoning of institutes is carried out with respect to proximity to source of noise, possibility of safe and adequate water supply, solid and liquid waste disposal systems, accessibility to roads, etc.

CHAPTER FOUR
Facilities Required for Healthful Housing

Learning Objectives

- Upon completion of this chapter, the student will be able to:

1. Define ventilation, explain types of ventilation and its applications
2. Describe methods of illuminating houses
3. Explain methods of heating buildings
4. Identify factors affecting heat loss from human body
5. Mention some recommended number of persons per unit area of sleeping and living rooms.

Introduction

- The extent at which the housing conditions promote health depends on the availability and adequacy of different life supporting requirements.
- These include **ventilation, illumination, heating systems to** maintain optimum human body temperature, etc.

1. Ventilation

- Ventilation is the process of supplying air to or removing it from any enclosed space by natural or mechanical means.
- The consumption of oxygen in breathing, results in a reduction of the amount of oxygen in the atmosphere of a closed room and a proportional increase in the amount of Carbon dioxide (Co2).

- In breathing, adults contribute about 0.67 cubic meter of carbon dioxide per hour to the atmosphere.
- Children contribute somewhat less. The average in mixed group is about 0.6 cubic meter per hour.
- The reduction of oxygen and the increase of carbon dioxide may not be alarming except in tightly closed living or working environment.
- The reduction of oxygen and the increase of carbon dioxide content in a closed environment accommodating humans **create a stagnant air** and moisture in the breath.
- In addition perspiration and evaporation from the skin increases the humidity in the room.

- If people are in a room full of stagnant air, the air quickly becomes hot by the heat from the bodies of people and saturated with the moisture from their lungs. Such elevated heat is lost from houses mainly by convection
- Most system of ventilation of houses depends on these methods of heat loss
- Some studies revealed that a 0.5% of CO2 increase in the living environment would require a slight increase of lung ventilation while 10% CO2 increase cannot be endured (suffered) for more than few minutes.

- **Ventilation** is therefore, aimed at removing these undesirable effects of poor ventilation from indoor environment.
- The motion of ambient air governs the effectiveness of ventilation as discussed below.
- The cooling power of air is mainly dependent upon its temperature and motion.
- Anemometers with rotating or deflecting vanes are used for rough measurements of air motion.
- The katathermometer also known as comfort meter, is an instrument used to measure the cooling effect of the air in a given place.

- The recommended velocity of air to attain comfort is 20 to 50 feet per minute (6.1 to 15.2 meter/ minute), with the lower values applying to heating systems and the higher to cooling.
- In having adequate ventilation, care must be taken so that fresh air is not admitted at too high velocity since it may be felt as an air draught.
- A draught is a steady stream of cold air directed upon the body, resulting in contraction of the capillaries of the skin and producing a feeling of chill.

Table 3. Air space volume per person used as a general guideline in the estimation of dimensions of the buildings.

	Types of Building	**Air space volume per person (m3)**
1	General Hospital	34
2	Infectious disease Hospital	53
3	Sleeping rooms	14.2
4	School class rooms	3.54
5	Dormitories	8.49
6	Cow sheds	22.7

- A person requires generally 300 ft3 (8.49 m3) of air per hour.

It can be supplied to the room with out causing a draught by changing the air three times per hour and as such 1000 ft3 (28. 3 m3) of space is allotted to each person.

Methods of Ventilating a House

There are two means of ventilation: -

- Natural ventilation
- Artificial ventilation

1. Natural ventilation

- It involves the use of natural forces of air diffusion and current by having properly built doors, windows, (such as fanlight, hopper or sliding sash windows).
- Natural ventilation is an efficient, cheap and satisfactory

- Natural ventilation might not be used successfully in theaters, auditoriums, large schools, or large churches, but it is applicable in homes and small offices.
- Such institutions require mechanical ventilation for efficient distribution and evacuation of contaminated air
- It should be kept in mind that air movement into rooms through windows and a door depends up on winds and temperature differences between inside and outside air
- The disadvantages of natural ventilation are:
  - It is dependent upon wind direction
  - It does not control the possibility of entrance of smoky, dusty, and generally undesirable air.

- **Types of Windows commonly used for natural ventilation:**
  a. ***Fanlight windows*:** is the small window or opening installed at the top of the doors or other windows.
- It has a small opening at the top made to open independently of the rest of the window.
- It may remain open at night or in bad weather, continuously supplying the room with fresh air when the main part of the window is closed
- In hot countries and for a cheaper class of building, the space usually occupied by the fanlight may be left empty and covered with wire gauze as a protection against mosquitoes and other insects.

b. *Hopper windows*: are very suitable for schools, hospitals and similar buildings.

- They are windows, which are hung at the bottom, wings being provided to close the sides
- Incoming air is directed upwards and is not felt a draught.
- These windows may be allowed to remain open even during heavy rain.

c. *Sliding sashes*: this is a window made with sliding sashes and is a very good type of ventilating houses.







Other means of natural ventilation include the following:

- In houses built of mud and poles, the mud is omitted from the top most part of the eaves to ventilate and illuminate the house

- Air perforated bricks and chimney flues may be used to construct the house.
  - Simple wooden frame works also allow good fresh air circulation and adequate illumination
- **Methods of natural Ventilation**
  Air Inlets and Outlets
  These are the openings through which the process of ventilation is carried out.
- Inlets are intended for entrance of fresh air and the outlets are for escape of exhausted air. Warm air is less

- Because removal of warm air from a room is necessary, outlets should be placed near the top part of a room.
- In order to properly admit cold air, which is denser than warm air, inlets should be arranged at lower level.
- The best height for inlets is at a point a little above the head of a person sitting down, i.e. about 5 ft (1.5 meters).
- ***Provision of windows***
- All habitable rooms, bathrooms, lavatory, staircase etc. need to have sufficient number of windows, in order to allow the entrance of enough light and ventilation.
- Total area of windows should be equal to 1/10 or 10% of the floor area.

- The area of windows that will be erected on walls butting to a verandah, beneath a canopy or balcony, the area must be increased by 5% for each 30 centimeter and for over one meter of extension of the verandah, balcony or canopy
- With regard to school the window area is the same as above (10% of floor area) under normal condition.
- But the size of windows can be as large as 20% if air movement is very slow or the house is located between objects that may prevent free air movement such as trees, high storey buildings.

There are two methods of ventilation of houses.

a. *Through ventilation:-* The windows are placed opposite to each other so that a current of air passes straight through the room.

Cross ventilation:- the windows are placed diagonally so that a current of air circulates and passes across the room

Artificial (mechanical) Ventilation

- It involves the use of mechanical apparatus such as fans and air conditioners.
- Such mechanical ventilators set air current in motion.
- **Fans** are either the extraction type (exhaust vacuum system), propulsion (plenum) type, or the balance system that combines both systems.

- ***a. Exhaust vacuum system of ventilation:*** is the type of ventilation in which the air is exhausted to the outside by fan or blower, there by causing a lower pressure inside and a leakage inward through windows, doors, and walls.
- This method is largely used in kitchens to remove odors and smoke, in industrial plants and factories to remove dangerous dusts and fumes, the inlets to the ducts being placed near the point of their production, and in other circumstances where local ventilation is required.

  b. *The plenum system*: is the type of ventilation which forces air into the room and cause a leakage outward, although exhaust ducts may also be provided.

- The forcing is accomplished by centrifugal fans, which operate in a manner similar to that of the centrifugal pump, or by impeller fans
- The air in this method is introduced at a low level near the floors, so that the breathing line is completely bathed by the incoming air.
- ***c. The balance system*:-** is a combination of the exhaust and plenum system.
- Air is drawn in through ducts by centrifugal fan and extracted at suitable points by exhaust fans.
- For the efficient working of this system, it is essential that there should be no leakage through windows or doors.
- In artificial ventilation, the air can be warmed, cooled, filtered, or humidified before allowing it to enter the

- It can also be supplied at any rate and at any level in side the room.
  It has the following disadvantages:-
- It is expensive to be used by the average population particularly in developing countries, adopted rarely to the existing buildings, and requires skilled persons for its application.
- Therefore, the environmental health professionals and other concerned bodies need to analyze these advantages and drawbacks before recommending certain types of artificial ventilation.

Lighting of a House (Illumination)

- Light is related to health in several ways.
- Light (sunlight) helps in **combating diseases and in promoting metabolism**.
- The ultraviolet rays have a beneficial effect in the health of the body as in the prevention of rickets by helping the body produce its own vitamin D.
- The ultraviolet rays have also bactericidal effect, and thus, may kill pathogens that are sensitive to light.

- The environmental health worker is more concerned with the inside illumination.
- This concern in illumination has resulted in recognition of the effect of insufficient lighting upon the eyes, the comfort, and effect on work and productivity and upon the efficiency on school children.
- The importance of good lighting in reducing accidents and the need for street lighting that can cope with modern high-speed traffic is also of significance for public safety
- Proper lighting is essential for cleanliness, accident prevention and to reduce fatigue in the homes

- It also takes into consideration the task, spacing of light sources, elimination, shadows and glare, control of out side light and lightness of working surfaces, walls, ceilings, fixtures, trim and floors.
- An object can be seen if light coming from the object reaches the eye.
- The following are examples of visible objects.
  1. **A luminous object:** emits light. It is seen by its own light. E.g. Sun, stars, incandescent lamp, lighted candle.
- 2. **An illuminated object:** this reflects the light from luminous sources. e.g. the moon, planets, earthly objects such as hills, people, table, etc.

3. **Translucent object**: This allows some light to pass through it; the rest is reflected and absorbed. E.g. waxed paper, frosted glass.
4. **A transparent object:** this allows light to pass through it. E.g. water, window, glass
5. An opaque object: An opaque object does not allow light to pass through it.

- The light is either absorbed or reflected.
- Dark colored objects absorb light while light colored objects reflect light.
  E.g. a mirror reflects light but walls of a room absorb and reflect light.

- **Measurement of light**
  ***Intensity of a light source*:** The luminous intensity or brightness of a source of light is measured in candle power (cp.)
- A candle power is the brightness of the light produced by a "**standard candle"** which have been internationally agreed upon so that it is approximately uniform.
- . E.g. A modern 40-watt incandescent lamp furnishes about 40 candle power.
  ***Intensity of illumination*:** The intensity of illumination that a surface received at a certain distance from a source of light is measured in foot-candles (ft-c).

- A foot-candle is that intensity of illumination received by a surface 1 ft distant away from a 1-cp light source.
- The intensity of illumination varies directly as the candlepower of the source of light and inversely to the distance from the source of light.
- This fact is known as the law of intensity of illumination and may be expressed by the following formulae:

  $$\text{Foot-candles} = \frac{\text{Candle power}}{d^2}$$

  Where, d - distance
- ***Luminous flux*:** is amount or quantity of light and it is the rate of flow of light. Its unit is the lumen.

- If an area A is 1 sq. ft and is 1 ft. away from the candle, it is illuminated to an intensity of 1 foot candle.
- The total amount of light passing through area A, if the area is considered to be transparent, is 1 lumen.
- Therefore the lumen is the quantity of light required to illuminate 1 sq. ft to the intensity of 1- foot candle.
- The lumen is useful in specifying the amount of light, which a light source must supply.
- For examples, if 100 sq.ft must be illuminated to an intensity of 10 ftc, 100x10=1000 lumens will be required.
- If a 1-cp lamp is radiating light uniformly in all directions, it gives of 4π, or 12.57 lumens.

- Light meter (photometry) is an instrument used to measure the intensity of luminous source or the brightness of an illuminated surface.
- The devise is also used to determine the luminous intensity of unknown intensity and make use of the inverse square law.
- Light Meters are also called photometers, or foot-candle meters.
- For practical measurement of illumination of rooms, it may be difficult to get an access to these instruments. The Sanitarian, in this case may use heuristic methods.
- For instance, it may be considered that the habitable room is adequately illuminated if persons can read pencil written (normal letter size) papers sitting at the center of

- **N.B**. Work places should be well illuminated than homes.
- **Types (source) of Lighting**
  There are two types (source) of lighting:
  1. Natural lighting
  2. Artificial lighting
  1. Natural Lighting: This is the natural day light from the sun. Light enters through doors and windows and is reflected from surfaces.
- Amount of daylight entering the house through windows or doors largely dependent upon the sky area visible at that point.

- Windows facing blank walls get and transmit only the reflected light
- The lighting values of such windows, therefore, depend on the reflection factors of the outside surfaces.
- The minimum intensity of illumination in any occupied space should be 6 foot-candles on a horizontal plane and 30 inches above the floor. Natural lighting at any cost should therefore meet this minimum requirement.
- The window-glass area should be10% – 20 % the floor area, provided also that walls and ceiling are light in color
- It is advisable to use maximum window size if windows are made from opaque materials or installed in the corridor walls.

- Windows extending to less than 30 inches from the floor tend to cause glare and obstruct furniture placement without increasing illumination to any extent.
- Inside walls should have reflection factors of at least 50 per cent, ceiling 70 percent, and floor and furniture 30% - 35%.
- Direct sunlight is desirable, for at least part of the day for all dwellings especially in cold seasons or regions
- For dwellings constructed in rows a desirable orientation of windows is to face 200 to 300 east or west or south
- 2. **Artificial Lighting:** These are the systems of artificial (man made) lighting.

- Artificial lighting can be sub-divided into five i.e.
  - Direct,
  - Direct-indirect,
  - Semi-direct,
  - Semi-indirect,
  - Indirect.

a. ***Direct Lighting*:** In this case, the light passes through transparent material.

- It is highly efficient and little or no light is absorbed before striking the work area.
- 90 to 100 per cent of the light of the luminaries is directed towards the usual working area.
- When direct lighting is used the luminaries should be placed high, preferably not less than 20 ft (6m) unless and otherwise enclosed in diffusing glassware to prevent glare

- Direct lighting has the advantage of being highly efficient, as no light is absorbed before striking the work.
- However, it causes harsh shadows, and glare results from reflection on smooth or glazed surfaces.

b. ***Semi- Direct Lighting*****:** 60 – 90 per cent of the light is directed downward to the work.

The remaining percentage is directed up ward. Such illumination may not be sufficient for electronic and watch repairs, and for reading.

c. ***Direct-Indirect Lighting*****:** is designed to provide generally diffused lighting, with nearly equal distribution in all directions (both up ward and down ward).

d. ***Semi-Indirect Lighting*****:** 60 to 90 per cent of the light is directed to the ceiling and upper walls. The direct light is 40 per cent or below.

e. *Indirect Lighting:-* 90 – 100 per cent of the light is directed towards the ceiling and upper side walls from which it is reflected to all parts of room and 10% of the diffused light falls upon the working area.

- **N.B.** No one system can be recommended to the exclusion of others.
- All have characteristics useful in varying degrees and their combination is useful for efficient performance, maximum comfort and prevention of accident and glare

- **Characteristics of good lighting**
  Good lighting systems are those that fulfill the following characteristics:
  a. Must be adequate in power
  b. Constant and uniform
  c. Flickers and vibrations are absent
  d. Absence of glare and shadows.
  Factors affecting good lighting in the house;-
  1. Room dimension
  2. Direct source of wattage
  3. Spacing of luminaries
  4. Routing of luminaries
  5. Reflection factors

- Smooth surfaces reflect more light than rough surfaces.
- Walls, ceilings, and furniture painted light colors reflect more colors and thus increase brightness
- Example:- White paint on smooth surfaces reflects 90-92% of light it receives.
  - o Light yellow paint reflects 65% of light it receives.
  - o Light blue paint reflects 61% of light it receives.
- o Light green paint reflects 47% of light it receives
  - o Red light reflects 13% of light it receives.
  - o Black paint reflects 0-5% of light it receives.

Consideration for proper lighting

- o The task associated with lights
- o Spacing of the light source
- Elimination of shadows
- o Elimination of glare
- o Control of outside light
- o Lightness of working surfaces, walls, ceilings, fixtures, etc.

Methods of attaining adequate illumination in the room

1. Placing buildings within a reasonable distance from each other.
2. Install at least one external window per existing rooms.
3. Paint internal physical structures of the room with selected appropriate color.

- Good lighting safeguards the eyesight, reduces accident hazards, and also saves the workers time, and thus economically profitable.
- Good lighting is also conducive to rest, comfort, sleep, study and thinking

Heating of a House

- Heating system of a building is necessary to maintain body temperature specially in cold regions
- Heat is energy in transit and it refers to the energy only while it is being transferred from one object to another during a temperature change or during change of state of matter.
- Heating mechanisms of buildings therefore, need review of the ways in which heat is transmitted from place to place, namely conduction, convection and radiation

1. **Conduction:** is the transfer of heat by direct contact from molecule to molecule. E.g. heating an iron rod.

- 2. **Convection:** is the transfer of heat in liquids and gases by means of motion of the liquid or gas. E.g. the hot air furnace and hot water furnace for heating a buildings work entirely by convection.
- A hot radiator in a room heats only the air in contact with it by conduction.
- The room is heated almost entirely by convection.
- A refrigeration unit is placed at the top of a refrigerator in order to create a convection current of air with in the box.

- 3. **Radiation:** is the transmission of heat from a body (e.g. Sun) across empty space.
- As the radiant heat waves strike matters, they are either absorbed or reflected and otherwise transmitted.
- By radiation heat is lost from a warm body to a cool one without warming the intervening air.
- For example, in a thermos flask equipped with a glass vacuum, the radiated heat is reflected by the silvered walls to prevent heat transfer by conduction or convection.

- **Methods of Heating a Building**
  The methods of heating buildings may be classified under the following:-
  1. **Direct heating:** the source of heat emitting device is placed in the room. E.g. Stove, open fire, radiator
- 2. **Indirect heating:** employs a central heating unit, which may be an ordinary furnace or steam coils over which the air passes, and the heated air is furnished to the room through the duct by fans or gravity.
- Rooms are heated by circulating hot water or hot air
- through coils of pipe in the floors, ceilings or walls.
- The function of this system may be controlled automatically by means of thermostats in order to keep rooms at the desired temperature.

- *The advantage of this method over the other is:-* • No radiator or duct interfere with floor area
- Absence of air current, therefore, curtains remain clean
- Greater comfort is obtained particularly near the floor as heat is supplied where it is most needed

3. **Direct-indirect heating system:** this method uses heat source inside the room as well as introduces warm air from outside central furnace.

- Other economical methods of attaining comfort are through insulation of buildings, and the stoppage of draft from doors, windows and fireplaces.
- Weather stripping of the exposed doors and windows may result in 20 per cent fuel saving.

- Complete house insulation (includes wall and roof) and weather stripping may save 60 per cent of fuel consumption.
- In addition, such insulation greatly increases comfort by preventing unduly cold walls and ceilings as the warmer bodies of occupants radiate heat and in the summer the cooler ceiling and walls do not radiate so much heat to the occupants.
- In hot environment buildings may also need to be cooled by passing cold air or cold water over coils in the walls or ceilings.
- Mechanical refrigeration is also used frequently to cool a building. All the above mentioned ways of air conditioning of a building may be included under air conditioning system.

- **Heat Loss from the Body**
- Air conditioning is primarily the control of the indoor air environment by addition or removal of heat and secondly the removal of dust, fumes and odors.
- For a great comfort, air conditions should be maintained in the rooms so that necessary heat loss from the body could take place without causing unnecessary strain to the occupants.
- Body heat is generally lost by conduction, convection and radiation.
- There is also a loss of heat from human body through evaporation or perspiration.
- ***Factors that control (affect) heat loss from the body***

1. Air temperature

2. Relative humidity of the air

3. Air movement

4. The temperature of surrounding surfaces such as walls, ceilings, floors, and radiators

Operative temperature: is the mean temperature between the air and wall temperature.

- Operative temperature for normal person (normally closed and at rest) should be 65 F (18.3 0c) and at knee height (45 centimeter) in order to prevent chilling of the legs and feet.
- Operative temperature for old people and young children is 70oF (21.o C) at knee height

- ***When does heat loss from the body become rapid?***

1. When there are cold objects in the room like walls, because radiation is high.

2. When the air temperature is low. In this case heat is lost from the body by conduction.

3. When there is enough air movement to prevent a blanket of warm air from enveloping the body.

4. When the skin surface is moist and cooling by evaporation is in process.

5. When the relative humidity of the air is low, which speeds up heat loss by evaporation.

- **Effective temperature:** is an arbitrary index of the degree of warmth or cold felt by the body in response to the combined effects of temperature, humidity and air movement.

Physiological effects of heat

- In order to maintain a constant body temperature, human body is continually adjusting itself to the effective temperature of the air.
- In cold weather somewhat more heat is generated and most of the changes involve the skin and the blood vessels that are directly beneath.
- If the air is cold, the blood vessels beneath the skin get constricted and blood is withdrawn from the skin to the inner parts where great loss of body heat is prevented.

- If the air is warm, but still cooler than the blood, the capillaries or small blood vessels beneath the skin expand, there by bringing blood nearer the surface and allowing excess heat to flow from the body.
- The greater the difference between body and air temperature (cooler air) the faster is the heat loss.
- Perspiration is secreted by the skin and its evaporation lowers body temperature.
- Therefore, there must be considerable air movement that aids evaporation and results in cooling of the body.

- Low air temperature combined with high humidity, is likely to cause discomfort because the accumulation of moisture in small amounts in the clothing lessens its efficiency as a non conductor (as insulation) of heat.
- Draughts or currents of cold air on the face or sudden temperature change cause contraction of the blood vessels and may cause local anemia.
- This loss of protecting blood supply allows an increase of bacteria and may result in the development of colds or other respiratory infections.

- **Factors affecting the designing of heating facilities in the House**
- 1. ***Climate*:** affects both the designing of heating facilities and housing.

2. ***Insulation*:** it is useful in reducing heating costs and it is an important tool in reducing temperature difference from floor to ceilings.

- Flooring materials of high heat (cold) conducting

potential, such as concrete or tile should be avoided particularly in a place where children play on a floor.

3. ***Ventilation*:-** ventilating enclosed space by natural or mechanical means promotes heat loss from the house.

- Complete air conditioning is the control of all those factors affecting both physical and chemical conditions of the atmosphere within any structure.
- These factors include temperature, humidity air movement (motion), dust, odors, toxic gases and bacteria, most of which affect in greater or lesser degree human health or comfort.

4. The objective of ventilation is, therefore, to achieve a comfortable indoor environment by the removal of slowly and continuously of vitiated air and the replacement of it with fresh out door air of a suitable temperature and humidity.

Signs observed on occupants of used up or vitiated air

1. Occupants with fair skin will show flushed face
2. Some occupants will experience headache
3. Occupants will sweat
4. Some occupants may experience dizziness
5. Some may be fatigued
6. Some occupants may also faint.

PUBLIC HEALTH IMPORTANCE OF HEAT

- **Heat cramps** — Heat cramps refer to painful muscular cramping that may occur during or after exertion in hot environments.
- The cramping commonly involves the large muscle groups of the legs (e.g, quadriceps, gastrocnemius), abdomen, or arms.
- **Heat stroke** is defined as a core body temperature usually in excess of 40ºC with associated central nervous system dysfunction.

- Frequently encountered complications include acute respiratory distress syndrome (ARDS), acute kidney injury (i.e., acute renal failure), hepatic failure, hypoglycemia and seizures.
- There are two types of heat stroke:
  - Classic (non-exertional) heat stroke – Classic heat stroke affects individuals, most often the elderly, with underlying chronic medical conditions that either impair thermoregulation or prevent removal from a hot environment.

- Exertional heat stroke – Exertional heat stroke generally occurs in young, otherwise healthy individuals who engage in heavy exercise during periods of high ambient temperature and humidity. Typical patients are athletes and military recruits in basic training.

- **Heat exhaustion** — Patients with heat exhaustion have known heat exposure and an elevated core body temperature between 37ºC (98.6ºF) and 40ºC (104ºF).

- **Additional symptoms include:** Tachycardia Sweating (especially when associated with exercise) Nausea, vomiting Headache

- Fatigue, weakness, Dizziness Syncope with prompt return of normal mental status, Severe thirst Normal mental status or mild confusion that responds rapidly (within 30 minutes) to cooling Signs of mild to moderate dehydration
- There is some overlap of symptoms between heat exhaustion and heat stroke

Space and Occupancy

- There is a direct relationship between good housing and good mental health, since suitable housing is a prerequisite for a mental wellbeing

- The house therefore, needs to satisfy the following requirements in order to promote the psychological wellbeing of the inhabitants:-

a) **Provision of adequate privacy for family members:-**

- Privacy is the ability of a person(s) to carryout an activity commenced without interruption or interference either by sight or sound. It deals with a " room of one's own".

Overcrowding condition is the main cause of lack of privacy.

- The maximum number of persons who may occupy any dwelling house is dependent upon three main factors:-

- 1. Separation of the sexes.
- 2. The number of rooms available.
- 3. The floor area of the rooms to be occupied.

- A dwelling is overcrowded if the number of persons sleeping in it is more than "the recommended number", or it is such that:
- If two or more persons being ten years old or over, of opposite sexes (not being husband and wife) are sleeping in the same room.
- If sleeping room for children over 2 years of age is not separated from the parent's sleeping room.
- According to psychiatric opinion, sleeping rooms of children over two years should be separate from the parents to avoid lack of sleep due to parents discussion and all children may talk what their parents talk

- **Effects of occupancy**
- There are five effects of human occupancy in unventilated rooms. These are:
- 1. Decrease in oxygen content
- 2. Increase the amount of carbon dioxide
- 3. Increase in organic matter (odor, bacteria from mouth, skin, clothing, etc)
- 4. Increase the temperature and humidity of the room.
- 5. Increase the transmission of communicable diseases such as skin disease, TB, etc.
- According to American Public Health Association, the following guideline is used to avoid overcrowding and lack of privacy

- Number of persons permitted to use a house for sleeping: Where the floor area of the room is: -

a) 10.2 m2 or more ----------2 persons.

b) 8.36 m2 to 10.2 m2----------1 1/2 persons.

c) 6.5m2 to 8.36m2---------- 1 Person.

d) 4.6m2 to 6.5m2----------1/2 Person.

e) Under 4.6m2 ---------- nil.

- Some other countries such as England also recommend room occupancy of one room for two persons, two rooms for three persons, three rooms for five persons, four rooms for seven and a half person.

- Bathrooms are not counted as rooms.
- Kitchens or rooms used for preparation of food shall not be less than 4.0 m2 and should have a minimum width of 1.4m.
- **N.B.:-** In counting the number of persons, each children under ten years of age & over one year counts as half a person; and a child of less than one year is not counted at all.

Standards

- Four levels of health have been enunciated by the WHO Experts Committee on Public Health aspects of housing such as:

1. The prevention of premature death,
2. The prevention of disease, illness and injury,

- The need for a good privacy and adequate space for each family member is therefore, aimed to bring occupants to such levels of health.
- These standards for housing would depend on the level of health aimed at and this again would depend on the country’s resources.
- The following minimum areas of habitable room are also stipulated:
- 50 m2 – for a family of three
- 55-60 m2 – for a family of four
- 70 m 2 – for a family of five
- A single person requires 1000 ft3(28.34cubic meter)fresh air per hour.

- In a dwelling house where the temperature is not less than 22.5 0c (72.50 F) and not more than 29.5 0C (85 0F) the relative humidity should not be less than 20% and not more than 50%.
- **General guides of air space by type of dwelling**

Type of building Air space per person

1. Sleeping rooms 14,5 m3
2. Dormitories 8.5 m3
3. Class rooms 3.6 m3
4. General hospital 34.2 m3
5. Infectious disease hospital 53 m3

Housing Sanitation

- A home is the most immediate environment for a family. People cook, eat, relax, sleep, and read, etc in their houses.
- The house should also provide the necessary shelter and comfort to the occupants.
- A good house is that which prompts health and enjoyable living. It has the following characteristics:-

a. That which is sited in a well drained areas with good construction

b. That which provides separate accommodations for human and animals

c. That which is free from dampness and wetness

d. Have adequate natural and artificial light and ventilation

e. Should have a separate kitchen and store

f. Should be rodent proof

g. Should have clean and cleanable latrine

h. Should have proper sewerage system

i. Should have an appropriate way of removing refuse

j. Must have safe and adequate supply of water within or near by.

k. Has adequate space for recreation, play of children, and for physical exercise

CHAPTER FIVE
Indoor Air Pollution

5.1. Learning Objectives

- Upon successful completion of this chapter, the student will be able to:

1. Define indoor air pollution
2. List specific air pollutants and their sources
3. Describe acute and chronic health effects of indoor air pollution
4. Explain preventive measures against indoor air pollution

Introduction

- Air is absolutely essential for sustainability of life.
- It is a mechanical mixture of gases and not a chemical compound.
- The pure ambient air that envelops the overlying earth's surface is the composition of various elements as shown in the following proportion by volume:
- Nitrogen---------- 78.1%
- Oxygen----------20.9%
- Carbon dioxide---------0.03%
- Indoor air pollution is defined as "The presence of one or more contaminants such as solid, liquid, or gases, in the indoor air in concentrations injurious to the inhabitants or which unreasonably interfere with comfort or enjoyment of humans''.

- It occurs through enrichment of indoor air with noxious gases, dust, bacteria, fungi, solvents, and other undesirable substances. Indoor air pollution is mainly caused by an inefficient and smoky fuels burned for cooking and heating.
- They are a troubling source of serious air pollution in many developing societies that uses biomass fuel.
- The use of such fuels causes air pollution problems both indoors and outdoors.
- For many decades the public at large was made aware of the ambient air pollution problems.
- Such concept is even more dangerous and misleading to citizens, scientist and government officials of developing countries.

- What is bad is all want to relate air pollution to industrialization and to the ambient (out door) air only neglecting the contribution of indoor pollution.
- Recent studies however, brought the problem of air pollution closer to home and proved now and again that the polluters are not only industries but also the activities of man inside his home.
- It has been found that levels of several health threatening air contaminants are now found to be significantly higher indoors than outdoors.
- This truth is harmful because most people (the young, the old, the sick and the disabled) are restricted to spend much more time in the homes and normally all people spend half of the day at home

Sources of indoor air pollution

- Indoor air pollutants are generally grouped into the following major sources:

1. Radon gas
2. Combustion products
3. Building materials and chemicals
4. Biological aerosols and house hold dusts
5. Decomposition processes
6. Respiration

1. Radon gas

- Radon gas seeps in to homes from the soil, brick, concrete and stone.

- It is produced from radioactive by-products of stone and soil under the house.
- The level and effect of radon accumulation is very high in unventilated buildings. It is estimated that in USA, 10% of lung cancer deaths may be attributed to radon gas exposure.

2. Product of incomplete combustion

- The use of biomass fuel, gas appliances such as gas stove, kerosene heaters, and cigarette smoke contributed to indoor air pollution.
- The incomplete combustion of raw biomass product and appliances for heating purpose produce different chemical compounds.
- Some of which are Carbon monoxide, oxides of nitrogen, sulfur dioxide and different hydrocarbons etc.

a) Sulfur dioxides

- The major sources of this colorless pollutant gas are fuel or coal combustion in the presence of sulfur as an impurity in it. When sulfur-containing fuels are burned the sulfur is oxidized to form sulfur dioxide.
- Its reaction with water vapor produces different dangerous sulfur compounds.

Possible Reactions include:

- Coal + Oxidation sulfur compound
- $S + O_2 = SO_2$
- $SO_2 + 2H_2O = H_2SO_4$ (Acid) + H_2
- $2SO_2 + 2H_2O = 2SO_3 + 2H_2$

b) Oxides of Nitrogen

- This compound is formed when combustion occurs at very high temperature.
- It is one of the major cause for Acid rain in the out side environment.

Reactions

- $N_2 + O_2$ (High Temperature)$= 2NO + O_2 \rightarrow 2NO_2$
- $2NO_2 + 2H_2O = 2\ HNO_3$ (Acid) $+ H_2$

c) Carbon monoxide

- It is a colorless, odorless, and non-irritating poisonous gas produced by incomplete combustion of carbonaceous fuel. It is a poisonous gas with a high fatality rate

Poisoning is possibly caused by:-

- Leaks in an automobile exhaust system
- Faulty appliances that lead to incomplete combustion
- Local or open wood -burning for cooking or space heating.
- Running a gasoline or diesel engine indoors.
- Insufficient combustion of animal dung
- bed room heaters
- Clogged chimney or vent, kitchen stoves.
- Improperly operating gas refrigerators.
- Motor vehicles are also the principal sources of carbon monoxide air pollution
- Concentrations of 70-100 ppm of carbon monoxide are usually common in city traffics.

d) Particulate Matter

- Particulate matters occurs either in solid or liquid form including dust, tiny aerosols, poly aromatic hydrocarbon etc.
- Poly aromatic hydrocarbon (PAH) is formed by incomplete combustion of wood burning in homes.
- From all causes of indoor air pollution, biomass fuel accounts the greatest share particularly in developing countries
- Respiratory problems and cancer are believed to be the common health problem observed usually among females mostly exposed to smoke and other combustion products.

- **Biomass fuel includes:-**
- Wood logging wastes,
- Saw dust,
- Animal dung
- Vegetable matters such as grass, leaves,
- Crop residue and agricultural wastes.

Biomass fuels are generally composed of organic matters (cellulose and vegetable protein) carbohydrates, and trace amount of toxic metals such as cadmium and lead.

3. Building materials, furniture's and chemical products

- A wide variety of household products contain formaldehyde and other hydrocarbons.

- These include foam insulation floor covering(carpet) and textile products, furniture polish, disinfectants, solvents, paint, etc, which largely contribute to the indoor air impurity.

4. Biological aerosols and house hold dusts

- Pathogenic or any microbial pollutants, household dusts that contain organic or inorganic chemicals are the common pollutants.
- Animals living in the house also contribute to aerosolized pollutants
- The great source of air bacteria is soil, which is teeming with microorganisms. Microbes are also emitted during coughing, laughing. Speaking and sneezing.

- Germs float in the air at optimum height eventually falling down to the ground depending on the indoor air movement.
- Pathogenic microorganisms are not present in the air except at proximity to patients or carriers whose exhaled air is charged with bacteria.
- The inorganic particles of dusts to be met with in the air are chiefly composed of silica, aluminum, silicate, carbonate, or phosphate of ca, mg, Na, chloride, etc.
- Those found in the indoor are due to debris arising from the wear and tear of articles in domestic use such as dust, soot and ashes.
- Mineral dusts from the neighboring industries, factories, and construction activities may likewise find access into houses through existing air inlets such as windows and doors.

- ***5. Decomposition***
- Animal and vegetable matters when putrefy around the houses, gives off offensive poisonous and marsh gases (such as, hydrogen sulfide, ammonia, methane) and carbon dioxide.
- ✓ Bacteria, molds, and fungi grow rapidly in such rooms. Presence of 0.2% of hydrogen sulfide in the indoor air may produce unconsciousness

6. Respiration

- Impurities of air due to respiration are chiefly carbon dioxide, water vapor and organic matters.
- When the amount of carbon dioxide in the air of a particular room rises from 0.03% to 0.06%, air becomes perceptibly stuffy to a person entering from fresh air environment

- and the occupants of the room begins to suffer from the unusual symptoms such as drowsiness, headache, nausea, vomiting, etc. which are common in overcrowded rooms.

- **Table 1**. Proportion of gases, in the inspired and expired air per 100 parts.

Gases	Inspired Air	Expired Air
Oxygen	20.9%	15.5%
Nitrogen	78.1%	79%
Carbon dioxide	0.03%	4.4%
Water vapor	Varies	Saturated
Temperature	Varies	At body temperature

- **General and Specific Health Effects of Indoor Air Pollution General Health Effects**
- The chronic effect of biomass fuel use is a major public health problem especially to women and children of developing countries.
- Nearly 60% of the global population of 5.3 billion live in developing countries.
- If we assume one woman in a household who does all the cooking, roughly 700 million women world wide are affected making this **the largest single "Occupational health**" problem for women. example, pregnant women usually cooking over an open stove using biomass fuel had almost 50% chance of stillbirth.

- The most serious health risks are from the domestic use of biomass that result in smoke inhalation and burns such as:
- Burns and scalds are common
- Initial heat damage to the conjunctiva and cornea
- Prolonged exposure will lead to keratitis causing impaired vision, cataract and ultimately blindness.
- Of the principal categories of indoor pollution: combustion products, chemicals, biological agents and combustion generated pollutants mainly from solid-fuel-fired cooking stoves are widely studied in developing countries..
- Half of the world population is cook using these unprocessed fuel items in conditions where much of the airborne pollutants is released into the living area.
-

- The housing type in Ethiopia is such that it is constructed without separate kitchen, windows, chimneys or other openings to release the pollutants

Specific Health Effects of Indoor Air Pollution upon Occupants:

- The direct exposure may cause:- Bronchitis, predisposing factor for tuberculosis and Asthma
- Physiological and mental discomfort due to odor from skin and cloth of the occupants and increase in temperature as a result of heat generated from human body is significant.

Nitrogen Dioxide (NO2)

- Cause respiratory tract irritation and inflammation.
- Cause an increased air-flow resistance in RI.
- Cause an increased risk of the respiratory infection

Carbon Monoxide(CO)

- Carbon monoxide combines readily with blood hemoglobin to form carboxyl hemoglobin, thereby reducing the amount of hemoglobin available to carry oxygen to other parts of the body.
- Hemoglobin has a greater affinity to carbon monoxide than for oxygen.
- Excessive exposure to this gas therefore, results in reduced oxygen available to heart, brain, and muscles leading to weakness, head ache, dizziness, nausea, vomiting, an impairment of psychomotor facilities, dimness of vision, coronary effects and then to death.
- Fortunately, the formation of carboxyl hemoglobin is reversible if a poisoned person is exposed to fresh air soon.

- ***Sulfur Dioxide (SO2)***

Generally, it causes the following specific health problems:

- Broncho-constriction, often associated with wheezing and respiratory distress.

- Impairment of lung function

- Increased asthmatic attack.

- ***Formaldehyde***
- The health effects of formaldehyde include: - irritation of eyes and respiratory tract, cause bronchial asthma at higher doses.
- Cause occupational allergic contact dermatitis and skin irritation.

- ***Tobacco smoke***

 - Eye, nose, and throat irritation

 - Nasal congestion and rhinorrhea.

 - Inflammation of the lower respiratory tract

 - Lung cancer

Fungi and Bacteria

 - Hypersensitivity pneumonitis, causing cough, dyspnea, and fatigue and allergic rhinitis.

-Humidifier fever, causing flu-like illness with fever, chills, myalgia, and malaise.

Prevention of Indoor air pollution

- Generally the control measures for indoor air pollution are:

1. Stove design improvement (to increase the efficiency of complete combustion)
2. Use separate kitchen as much as possible
3. Use of clean fuel
4. Improving house design and construction of proper ventilation
5. Health education on control measures of indoor air pollution.
6. Improving standard of living

CHAPTER SIX
Institutional Health

Learning Objectives

After completing this chapter, the students is expected to:

1. Define an institution
2. Identify basic health services to be offered in schools, hospitals, and prisons
3. Explain roles and responsibilities of health professionals to improve health status in the institution

Introduction

- **An institution** may be defined as any organization established for educational, social, religious, political, etc purposes.
- An Institution accommodates a group of people at a time. **Schools, colleges or universities, hospitals, orphanages, kindergartens, nursing homes, prisons, military concentration camps** are all examples of institutions.
- Institutions have certain basic characteristics in common that require careful planning, design, construction, operation, and maintenance.
- *These includes:*

1. Appropriate site selection, including subsoil investigation,
2. Accessibility to the community,

4. Accessibility to safe and adequate water supply for institutional use and fire protection;

5. Provision of sewers and a waste water/storm water disposal/drainage system;

6. Availability of roads

7. Provision of facilities for the storage, collection, and disposal of all solid wastes generated in the institution.

- The provision and maintenance of an environment conducive to health at institutions of all types including hospital, convalescent homes, maternity hospitals, geriatric facilities, schools, jails and prisons encompass all the features of a well-rounded community public health program.

- To some extent the needs of the various institutions vary depending on the type of services they render, although
- the fundamentals of water supply,
- plumbing, sewage disposal,
- ventilation, vermin control are much the same at all types of institutions
- Standards for lighting, recreational space and special service facilities entail a close study of the type of institution, its uses, and the individuals involved.
- Institutional health is a recognized activity of health departments at any level.

- Local health department have to give consultation services,
- review plans and specification on new institutions,
- establish standards and promulgate rules and regulations which help local representatives to supervise effectively the construction, maintenance and operation of the institutions
- Close relationships between health departments and other agencies, which have concern on the institutions, such as
- the education department for schools,
- prison board for prisons, etc is helpful in carrying out successful health service program in all institutions.

The School Health Programs

- A school is one of the public institutions.
- School health and sanitation program is therefore, very crucial depending upon the size of school, age group of students, the availability of the health services in the school.
- Schools, preferably better have their own health units. In the absence of school health facilities, the local health facilities such as hospital, health center, or health stations should serve school children through frequent visits.
- **Reasons for the Special Need of a health Program for schools**:-

a) Schools give an excellent opportunity for health education or transmitting health information effectively to the students and through them to the families of the students

b) During this part of their life, children are growing & developing both physically and mentally.

- Any improvement in their health, changing attitudes and behaviors of hygiene at this age and correction of their health defects may have a positive impact on their life.
- c) For many children, school is the first time they have come in to contact with people outside their family.
- This change may expose them to infectious diseases.
- Establishment of centers for the prevention of spread of these diseases is therefore, important.

d) The school going age group generally forms larger number of the whole population hence changing behaviors of pupils means changing a large number of populations.

e) The school is always part of the community and it may be one of the important areas where new ideas are transmitted and accepted.

f) Teaching them about disease and their control will keep them free from infectious diseases.

g) To build schools on modern sanitary lines

1. Control of communicable diseases:

- This includes daily observation by the teacher to note signs and symptoms of illness among students.
- Although no attempt should be made to diagnose the specific disease or to treat the illness, the teacher should be able alert to such evident signs as flushed face, rash, difficulty breathing, abnormal cough, chills, fever, headache and diarrhea.

- The child who exhibits such abnormalities should be excluded from the class and sent to the school clinic (if any) or to local health institution to be seen by the health personnel and treated fully before returning to the school.
- Counseling, follow ups, regular inspection and sanitary campaign of the school compound and immunization are integral part of school health programs.

2. Minimizing of non-communicable defects*:*

- This includes observations by the teacher as well as screening by specially trained individuals (such as team of health workers from the near by health center) to detect any evidence of defects in such aspects as:- vision problem, hearing, speech, tooth and posture defects.

Convenience of physical environment such as good seat and desk arrangements, appropriate distance of seats from the blackboard, must be regularly checked.

3. Provision of health essentials in the school envt

- This refers to school sanitation as it is applied to the school environment and classrooms.

a. *Location and space requirement of the school*:

- The school should be located where the buildings could get possible natural daylight in the classrooms.

It should be within reasonable distances from large trees and other neighboring buildings, which may obstruct light.

- The location of the school must be away from sources of dust, gases, odors and noise.

- The following acceptable noise levels in school area should be maintained :-
- Class rooms---------- 34-40 dB
- Cafeteria---------- 50-55 dB
- School Sites(outdoor noise level)------ < 70 dB
- Health care rooms---------- < 40 dB
- Music ---------- < 40 dB
- Presence of factories or railroads, deep rivers or streams and relation to streets where there are much traffic should be avoided from school sites.
- The school ground should be graded, well drained and must be adequate in size to include playgrounds.

***b. Provision of safe and ample water supply for drinking and personal hygiene of students and staff**:*

- About 40 liters per student per day of water in boarding school, and 3-5 liters per student per day(excluding toilet flush and bathing)in day school should be provided.
- A water tap at the rate of one per 50 children should be provided. In communities without a municipal water supply, protected well, spring or a rain water roof catchment system with hand pump may be provided.
- Pupils should be prohibited from using common drinking cup to prevent the transmission of communicable diseases.

c. Lighting, ventilation, and heating:-

- Lighting is one aspect of school sanitation, which should be given due attention.
- If the natural light is stopped by buildings or trees in the neighborhood measures should be taken.
- **Recommended class room reflective values in schools Reflective values**
- Floor----------15-30 %
- Desk Top---------- 35 – 50 %
- Walls above windows--------- 75 – 80 %
- Chalk boards---------- 15_20 %
- Walls---------- 50 – 60 %
- Ceiling and top of the wall---- 80 – 85 %

- **Examples of color selection**:-

1. Ceiling and upper wall-should be painted white plaster
2. Wall----------should be painted light cream
3. Floor------should be painted medium gray or brick red
4. Furniture----------should be painted light gray
5. Black board----------should be painted green
6. Doors---------- should be painted medium gray

- All these surfaces should not be shiny in order to prevent glare.
- Artificial lighting is also necessary when skylight is obscured due to heavy clouds and for evening and night schools

Note: for practical purposes a classroom is considered illuminated if a student is able to read a sentence written in pencil with no difficulty.

The reflective factors of the various colored surfaces are of such importance in imparting proper light brightness to visual task.

Heating and ventilation in school:

- The various part of the school environment must be healthy and comfortable for the particular activities for which the room is used.
- It thus becomes necessary for the heating and ventilation systems to accomplish the following.

1. Supplying of clean air in sufficient quantities to dilute the room air below threshold of body odor detection and remove dust, fumes, obnoxious gases, and humidity.

2. Maintenance of a uniform room temperature without rapid fluctuations.

3. Supplying of heat for balancing losses from the human body (not applicable to tropical climates such as Ethiopia.)

4. Supplying of makeup heat for room and building losses. (not applicable to tropical climates such as Ethiopia.)

5. Removal of excess heat caused by body radiation, conduction, evaporation, or external conditions.

6. Diffusion of the atmospheric temperature without pronounced drafts or stratification

- The classroom should be cross-ventilated by means of windows or openings distributed in positions and in such manners to secure effective exchange of air.

d. Cleaning and maintenance

- Cleaning of all schoolrooms on regular basis and school sanitary campaign at least once a week should be practiced.
- The existing sanitary facilities such as lavatories, latrines, incinerators and etc. must be kept clean and maintained promptly if damaged

e. Proper selection of equipment and furniture to minimize accidents

4. Provision of aid in nutrition
5. Provision of adequate activity for children to promote their physical fitness

6. Health education

Topics selected for health education basically depends on both general and specific local health problems. For instance, general topics such as:

a. Proper habits in diet to prevent malnutrition.

c. Prevention of means of spread of communicable diseases and methods of prevention

d. Proper use and handling of sanitary facilities.

e. Importance of personal Hygiene, etc.

7. Integration of school and community program

School Health standards

The building

- Security- Fire protection & escape doors

Space- Floor area & room volume = $1.4m^2$ $5.7m^3$ resp. per pupil.

Sanitary facilities

- If the sanitary facility Is a water flush system one separate seat will be required for 25 boys and girls; one urinal for 15 boys and one seat for 15 girls.
- But when such facilities not exist:.
  - 1 seat hole for every 15-20 boys
  - 1 urinal for every 30-45 boys
  - 1 seat hole for every 10-20 girls
  - But in majority of Ethiopian schools
  - 1 seat hole for 60-90 boys
  - 1 seat hole for 30-45 girls

- **Hospital (Health Institutions) Sanitation**
- Hospitals are health institutions which give health services with at least four sub-specialties such as: medical, surgical, gynecology & obstetrics, and pediatrics.
- They can also be categorized in to three tier systems according to the scope and level of services (status) they provide:
- a) Central Referral Hospital
- b) Regional Referral Hospital
- c) Rural Referral Hospital

- **Special Hospital:-** that which provides medical care for particular groups of population whether different sex or age group or on the type of health problems

Eg:- The Ethio-Sewedish Pediatric Hospital in Addis Ababa gives service to children.

- Ghandi Hospital in Addis Ababa serves the mothers

- Leprosy Hospital in Addis Ababa treats leprosy and skin problems.

- Emanuel Hospital in Addis Ababa treat mental cases.

- Hospitals and other health facilities like health centers are expected to provide an environment that will expedite the recovery and speedy release of the patient.

- However, less care, poor sanitation and various limiting factors in the hospitals have become a means of introducing contaminants and infections to the hospital environment that delay recovery, and may overburden the weakened patient.
- The main health hazards that are potential problem in the hospital setting are;
- bacterial infections caused by streptococcus and staphylococcus, and viral infections such as hepatitis B.
- The central objectives of sanitation in hospitals is therefore aimed at maintaining a high degree of cleanliness and effective sterilization techniques in order to prevent nosocomial infections

- **Nosocomial Infection**
- It is an infection that is acquired in the hospitals.
- Most nosocomial infections cause a considerable morbidity resulting in excess days of hospital stay.
- Infections are considered nosocomial if they first appear 48 hours or more after hospital admission or within 30 days after discharge.
- Common sites usually involving nosocomial infection include the urinary tract, surgical wounds, lower respiratory tracts, etc.
- The main sources of hospital infections are dust accumulated at the corners of walls, droplets, contaminated medical articles and instruments, patients, and health personnel moving from patient to patient.

- **Control procedures of Nosocomial Infections**

1. ***Laundry***

- Patient clothes are one of the vehicles to spread infectious agents in the hospital environment. The clothes of the patients to be admitted should therefore be disinfected and washed as soon as possible.
- Bed sheets and linens should always be placed in the bags at bedside, rather than be carried through the halls to a collection bag.
- These bags used for collection of patient clothes have to be preferably colored for easy identification by the cleaners as well as other people.

- Thorough hand washing and the use of rubber gloves are essentially basic infection control methods particularly while touching clothes and other articles soiled with body discharges.
- ***2. Proper Disposal of wastes Generated in the hospitals and other Health institutions***
- Most of the wastes generated from health institutions may comprise both infectious (biological) and non- infections organic matters such as garbage and rubbish.
- The infectious wastes are characterized by the ability to infect other living organisms including human.

- Wastes specially generated from dressing rooms,
- maternity rooms,
- surgical rooms (pathological wastes),
- biological research institutions (resistance strains),
- laboratories (various specimens), are hazardous to staff and other people visiting these institutions.
- The present practices of handling these infectious

wastes in most governmental health institutions in Ethiopia are not different from those of household wastes.

These problems should come to the attention of all health professionals working in the institutions and the administrative bodies to practically use an appropriate handling and disposal of these wastes.

- Incineration (for combustible wastes) and burying or controlled tipping (for non-combustible wastes, wet wastes due to body discharges and still births) are the best methods of disposal of infectious wastes in the health institutions

3. *House keeping*

- All wastes should be properly stored in a watertight, covered corrosion and wet resistant containers (bins) until properly disposed.
- Dust particles should not be accumulated in hospital wards. Cleaning and sanitization in health institutions is a very important task or activity that must be frequently performed than even schools and hotels

4. *Nursing Staff*

- All nursing personnel must sterilize, disinfect or dispose of contaminated equipment properly so that no hazard exists for others.
- Health professionals helping or visiting patients should always wash his/ her hands thoroughly to minimize the spread of disease causing organism to other patients.
- PP devices such as gowns, masks, gloves and caps must be worn and removed before entering clean areas such as lunchrooms, lounges, cafeteria, and patient rooms.

5. *Dietary*

- Employees working in food preparation areas should be encouraged to stay home when sick and to visit the health services institutions before returning to the job.
- Thorough washing of food ingredients before preparation, and once washed must be separated from the unwashed foodstuffs.
- All the employees should be well trained on hygienic food preparation methods and how to maintain a good personal hygiene.
- Refrigeration of the perishable food products at proper temperature prevents the growth of microorganisms

6. *Personal Hygiene*

- All hospital staff should wash their hands with soap and adequate water after attending a patient and before touching another patient and at all other critical times such as after visiting the toilet.
- Handwashing facilities, toilet facilities, and personal protection devices should be adequately available.
- Nursing and other health staff should avoid wearing jewelers such as rings, especially if they are involved in patient care. Fingernails and hair should be kept short and clean.

7. Maintenance of physical structure

- Regular maintenance of physical structure of hospitals and other health care facilities is important in order to minimize accidents and risk of disease transmission.
- Structures should be constructed from fireproof materials, should have dual egress and proper wiring of electric systems.
- Maintenance of electrical outlet, appliances and servicing of other equipment is mandatory in health care facilities.

8. *Central Supply*

- The central supply and sterilizing area is responsible for the sterilizing any soiled materials used in surgery and treatment rooms.

- Surgical instruments should first be dumped into a disinfectant solution after surgery and before being removed from the Operation Theater.
- They should then be cleaned and sterilized.
- Autoclaves are used to sterilize surgical supplies and equipment, syringe, textile products, enamelware, and rubber gloves.
- Dry heat is preferred for sterilizing needles and sharp cutting instruments

9. *Formation of Infection Control Committee*

- A major hospital acquired infection control mechanism is the establishment of a representative infection control committee.

- Establishment of this committee is important to coordinate and ensure that medical, nursing, house keeping, maintenance, and supportive staff is following good practices and procedures.
- The committee is responsible to follow procedures and activities including nosocomial infection surveillance and control, proper waste handling, good sanitation, safety radiation, and occupational health protection.

- **Prison Health**
- Prison is also an institution where prisoners are kept under custody for a certain period of time.
- If the conditions of a prison are closely observed, one can easily recognizes that the prisoners are under risk of health problems.
- Because, the prisoners usually live in an overcrowded conditions and use a single room for living, sleeping, reading, and etc. Moreover, some prisoners may have an infection before they are sentenced.
- Communicable disease transmission is very rapid in such crowded condition, which is apparent in prison

Aim of Prison Health Services

1. To solve the immediate physical and mental health problems of the prisoners.

2. To teach prisoners the basic principles of healthy living so that when they are released from the prison to join their community once again, they can convey whatever health messages they get in the prison.

3. To prevent the infections diseases specially the chronic ones such as tuberculosis & Leprosy.

4. To advise prison administration on health and environmental conditions of the prison.

Sources of Diseases in the Prison:

Infections may occur from two sources in the prison:

1. Some prisoners may join the prison with apparent or in apparent infection from outside & infect healthy ones.

2. Infection that originate in the prison it self because of poor environment (Poor housing, inadequate ventilation, overcrowding, malnutrition, poor hygiene due to lack of facilities, inadequate water supply, etc).

- Experiences have shown that health problems such as psychological problem, dysentery (due to poor hygiene), febrile illnesses like
- relapsing fever,
- malnutrition and anemia,

- gastrododenites,
- upper respiratory infection,
- skin infection or diseases, etc are common in the prisons.
- Transmission of these health problems is basically prevented through active involvement of the prisoners and the prison administration in the
- ✓ identification,
- ✓ prioritization,
- ✓ planning,
- ✓ implementation and
- ✓ evaluation of preventive measures.

So health workers in health centers and health stations have professional responsibilities to solve health problems that may arise in prisons through the following strategies:

- Discuss and convince the prison administrators to actively participate in the planning and implementation of health activities in the prison environment.

- Organize the prisoners & form health committee to clean their environment on a regular basis.
- Give continuous health education in a language the prisoners understand which is useful for them to solve their immediate health problem.
- Treat cases & do follow ups to ensure relief, recovery and cure.
- Screening the prisoners for any communicable disease

-

- Regular inspection of the prison environment for any actual or potential sources of health risks.

Methods of Prevention and Control of Communicable diseases in the Prison

1. Buildings which are used for prison inmates should be structurally sound, secure, and, fire resistant:

- The cells should be designed to provide at least 5m2 (50 ft2) of floor area for each prison inmate.
- The cells should be provided with a minimum of 30 ft-c illumination.
- A minimum of 4 m2 sleeping area per person is required to avoid overcrowding

- Height of the ceiling should not be less than 2. 35 m and a minimum height of 2.8 m if double beds are used.
- All beds should be raised by 30 cm from the floor.
- There should be a minimum space of 90 cm between two beds and 120 cm if double beds are used

2. Cleanliness and maintenance:-

- There must be provision for cleanliness or personal hygiene of inmates
- The jail/prison authorities are obliged to maintain high standards of maintenance of buildings.

3. Physical examination of inmates and inspection of the basic necessities.

4. Lighting and ventilation: - all rooms should receive natural and artificial light as well as adequate ventilation.

5. Water supply and sewage disposal system:-

Water for prison should be treated and the reservoirs must be washed and disinfected twice a year.

- At least one drinking tap should be provided out side of the physical structure for 100 prisoners.
- Adequate number of showers (at least one shower should be provided per 50 prisoners).
- All the sewage generated in the prisons should be properly disposed in to septic tank or cesspool

6. Prison authorities together with prisoners should be responsible to control vectors such as rodents and insects.

7. There should be a regular inspection of food preparation, proper training to food handlers and regular medical check up of food handlers.

8. The prison should also be provided with appropriate refuse disposal facilities.

9. The prison is recommended to have a day temperature of 200c-22.20c and a night temperature of 15.560c in cells, offices, and similar areas

10. There should be one water closet and one lavatory for eight prisoners, or one seat hole of a pit latrine per 50 prisoners.

- The latrines should be placed 30 m away from prison cells.
- Environmental health programs in prison would minimize the problem of food poisoning, poor and insufficient food, vermin infestations and communicable diseases.
- Overcrowding condition often overtax the ventilation system and sanitary facilities.
- Environmental Health professionals should therefore make regular inspections and reports of the facilities in the same manner as is done for other regular health service programs.


THANK YOU!!

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