University of Mosul
College of Nursing

Epidemiology

Fourth Stage

Lecture ONE

Introduction of Epidemiology

Lecture One

Introduction to Epidemiology

The term epidemiology derives from three Greek words: epi meaning among, demos or people, and logos meaning discourse or study. Literally, then, epidemiology is a study of what occurs among the people.

A more formal definition of epidemiology is the science that deals with the study of the causes, distribution, and control of disease in populations.

In its modern application epidemiology is defined as:

Epidemiology is the study of the *frequency*, *distribution* and *determinants* of diseases and other health related conditions in human populations, and the application of this study to the promotion of health, and to the prevention and control of health problems.

History of Epidemiology:

Some of those who participate in development of epidemiology:

1. HIPPOCRATES (400 BC): "On Airs, Waters, and Places" –Hypothesized that disease might be associated with the physical environment, including seasonal variation in illness.

2. JOHN GRAUNT (1662): "Nature and Political Observations Made upon the Bills of Mortality" – First to employ quantitative methods in describing population vital statistics. Showing the value of a system of disease surveillance

3. JOHN SNOW (1850): Formulated natural epidemiological experiment to test the hypothesis that cholera was transmitted by contaminated water.

4. DOLL & HILL (1950): Used a case-control design to describe and test the association between smoking and lung cancer.

5. FRANCES et al. (1950): Huge formal field trial of the Poliomyelitis vaccine in school children.

6. DAWBER et al. (1955): Used the cohort design to study risk factors for cardiovascular disease in the Framingham Heart Study.

Epidemiology and Population Health Nursing:

Epidemiologic perspectives on the factors that contribute to disease and illness have changed remarkably over time, and some authors describe four eras of epidemiologic thought:

The first was the sanitary era, with interventions based on the ancient theory of miasmas is an obsolete medical theory that held that diseases such as cholera were caused by a miasma , a noxious form of "bad air".

The second era was that of communicable diseases, in which interventions were based on the germ theory.

The third era or chronic disease era was on multiple layers of personal risk factors contributing to chronic diseases.

The fourth era at the beginning of the 21st century, remains to be seen, but the focus of era may turn out to be what some have termed an "eco social" perspective, emphasizing the multiple interactions among biological, environmental, and social factors that lead to health or illness in population groups.

Major components of the Epidemiology definition:

1. ***Population.*** *T*he main focus of epidemiology is on the effect of disease on the population rather than individuals.

2. ***Frequency:*** quantification of disease and other health related conditions occurrence in human population.

3. ***Health related conditions***. Epidemiology is concerned not only with disease but also with other health related conditions because everything around us and what we do also affects our health.

4. ***Distribution.*** Distribution refers to the geographical distribution of diseases, the distribution in time, and distribution by type of persons affected.

5. ***Determinants.*** Determinants are factors which determine whether or not a person will get a disease. Determinants that influence health may consist of behavioral, cultural, social, psychological, biological, or physical factors.

Elements of Epidemiology:

• All population

• All diseases (communicable, chronic, epidemic disease, injury,

phenomena:(violence, ignorance, poverty)

• Ecological approach.

• (man's total environment).

Two dimensions of epidemiology:

1- **Distribution of diseases:**

major questions:

• ***Who*** is affected by problem?

• ***Where*** does problem occur?

• ***What*** is the nature of the problem?

• ***When*** does problem occur?

Answers to these questions provide clues to factors which determine occurrence of diseases.

2- Determinants of diseases:

major questions:

• *Why* does problem occur?

• *How* can we prevent the problem?

Objectives of the Epidemiology:

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

4. Identification of determinants i.e., etiological factors causing health and health related problems.

5. Evaluating the effectiveness of the programmes to provide feedback.

Uses of the Epidemiology:

1. Identification causative factors and risk factors for health condition affecting population.2.
2. Diagnosing the health status of population groups.
3. Understanding of geographical or local pattern of the diseases.
4. Describing signs and symptoms and course of disease.
5. Evaluating the effectiveness of existing health programs and mode of health care delivery.
6. Provide a basis for health policy development.

Principles of epidemiology:

1. Epidemiology deals with population rather than individual cases.

2. Epidemiology deals with comparison between people have diseases and those who have not.

3. Epidemiology deals with causation and association that's why epidemiology called master of sciences.

Summary:

Epidemiology is the study (scientific, systematic, data-driven) of the distribution (frequency, pattern) and determinants (causes, risk factors) of health-related states and events (not just diseases) in specified populations (patient is community, individuals viewed collectively), and the application of (since epidemiology is a discipline within public health) this study to the control of health problems.

Lecture Two

Epidemiology and Population Health Nursing

Lecture Two

Epidemiology and Population Health Nursing

Learning Outcomes:

After reading this chapter, you should be able to:

1. Describe at least two theories of disease causation.
2. Identify at least three criteria for determining causality in a relationship between two events.
3. Define risk, relative risk, and absolute risk.
4. Distinguish between morbidity and mortality rates.
5. Identify the six steps of the epidemiologic process.
6. Apply three epidemiologic models.

Basic Epidemiologic Concepts :

Three basic concepts underlie epidemiologic perspectives on health and illness. These concepts are

A. Causality.

B. Risk.

C. Rates of Occurrence.

A. Causality: The concept of causality is based on the idea that one event is the result of another event. The main purpose of epidemiology is to identify causal links between contributing factors and resulting states of health and illness.

Historical Development of Theories of causation:

1. **Religious era (2000–600 CE)** Disease is thought to be caused by divine intervention, possibly as punishment for sins or as a test of faith.
2. **Environmental era** (circa 400 CE) Disease is believed to be caused by harmful miasmas, or mists, or other substances in the environment.

3. **Bacteriologic era** (1870–1900) Disease is thought to be caused by specific bacteriologic or nutritive agents.
4. **Era of multiple causation/Eco social perspective** (1900 to present) Occurrence of disease and other health problems is a result of the interaction of multiple individual risk factors and population exposure patterns.
5. **Molecular epidemiology perspective** (future) Occurrence of health-related conditions results from a complex interaction of genetic and environmental factors.

Criteria for Determining Causality:

1. **Consistency:** The association between the supposed cause and its effect is consistent and always occurs in the same direction. For example, people cannot develop measles without being exposed to the measles virus.
2. **Strength of Association:** The greater the correlation between supposed cause and effect, the greater the possibility the relationship is a causal one. For example, not every susceptible person who is exposed to the measles virus develops the disease, but most of them do.
3. **Specificity:** The supposed cause always creates the same effect. For example, exposure to measles virus results only in measles, not mumps or varicella (chicken pox).
4. **Temporal relationship:** The supposed cause always occurs before the effect. For example, one has to be exposed to the measles virus before, not after, one gets the disease.
5. **Coherence:** The supposition that one event causes another is coherent with another existing knowledge. For example, Snow's hypothesis that the water from the Broad Street pump was the cause of the cholera epidemic.

B. Risk: Risk is the probability that a given individual will develop a specific condition. Risk may be absolute or relative.

Absolute risk is the probability that anyone in a given population will develop a particular condition.

Relative risk is the probability that someone in a group of people with a particular characteristic will develop the condition when compared to people without that characteristic.

For example, the absolute risk of breast cancer is about one in every eight U.S. women, but the relative risk of developing breast cancer is much higher for women with a family history of breast cancer than for those without a family history.

Susceptibility is the ability to be affected by factors contributing to a particular health condition. For example, very young unimmunized children are susceptible to, and constitute the greatest population at risk for, pertussis (whooping cough). In this case, the basis for increased risk lies in the increased susceptibility of this group. Children who have been immunized against pertussis are less likely to develop the disease and therefore are not part of the population at risk.

Exposure potential is the likelihood of encountering or being exposed to factors that contribute to a condition. For example, those most at risk for sexually transmitted diseases are adolescents and young adults.

The relative risk ratio is derived by comparing the frequency of occurrence of the condition in a group exposed to known risk factors with its occurrence among individuals who have not been exposed. For example, if 50% of smokers develop heart disease versus only 5% of nonsmokers, smokers have a relative risk ratio of 10:1, or have a 10 times greater risk of heart disease than their nonsmoking counterparts.

The target group includes those individuals who would benefit from an intervention program and at whom the program is aimed. The target group for an immunization campaign against pertussis, for example, would include unimmunized children under the age of 10 as well as college students whose immunity is waning.

C. Rates of Occurrence: are statistical measures that indicate the extent of health problems in a group. A rate is simply the number of a particular event (e.g., cases of illness) divided by the size of the population at risk for the event in a given time period (e.g., annually, per quarter). Rates of occurrence allow comparisons between groups of different sizes with respect to the extent of a particular condition.

For example, a community with a population of 1,000 may report 50 cases of syphilis this year, whereas another community of 100,000 persons may report 5,000 cases.

1- Mortality is the ratio of the number of deaths in various categories to the number of people in a given population. Mortality rates describe deaths.

2- morbidity is the ratio of the number of cases of a disease or condition to the number of people in the population. morbidity rates describe cases of health conditions that may or may not result in death.

The Epidemiologic Process:

Epidemiologists use a systematic process, similar to the nursing process, to study states of health and illness in an effort to control disease and promote health. The steps of the epidemiologic process are:

1. Defining the condition.
2. Determining the natural history of the condition.

3. Identifying strategic points of control.
4. Developing control strategies.
5. Implementing control strategies.
6. Evaluating the effects of control strategies.

Epidemiologic Models

three epidemiologic models

1- the epidemiologic triad.

2-the web of causation model.

3- determinants-of-health models.

The Epidemiologic Triad Model :In this model, data are collected with respect to a triad of elements: host, agent, and environment. The interrelationship of these elements results in a state of relative health or illness.

Host. The host is the client system affected by the particular condition under investigation. A variety of factors can influence the host's exposure, susceptibility, and response to an agent. Host-related factors include intrinsic factors (e.g., age, race, and sex), physical and psychological factors, nutritional status, genetics, and the presence or absence of disease states or immunity, among others.

Agent. The agent is the primary cause of a health-related condition. After specific microorganisms were found to cause specific diseases, the concept of agents of disease originated in the context of communicable diseases. Agents can be classified into six types:

1. physical agents include heat, trauma, and radiation.
2. Chemical agents include various substances to which people may develop untoward reactions.
3. nutritive elements.

4. infectious agents.
5. genetic agents.
6. psychological agentssuch as stress can produce a variety of stress-related conditions.

Environment. The third element of the epidemiologic triad includes factors in the physical, biological, and socioeconomic environments that contribute to health-related conditions. Environmental factors affect both host and agent.

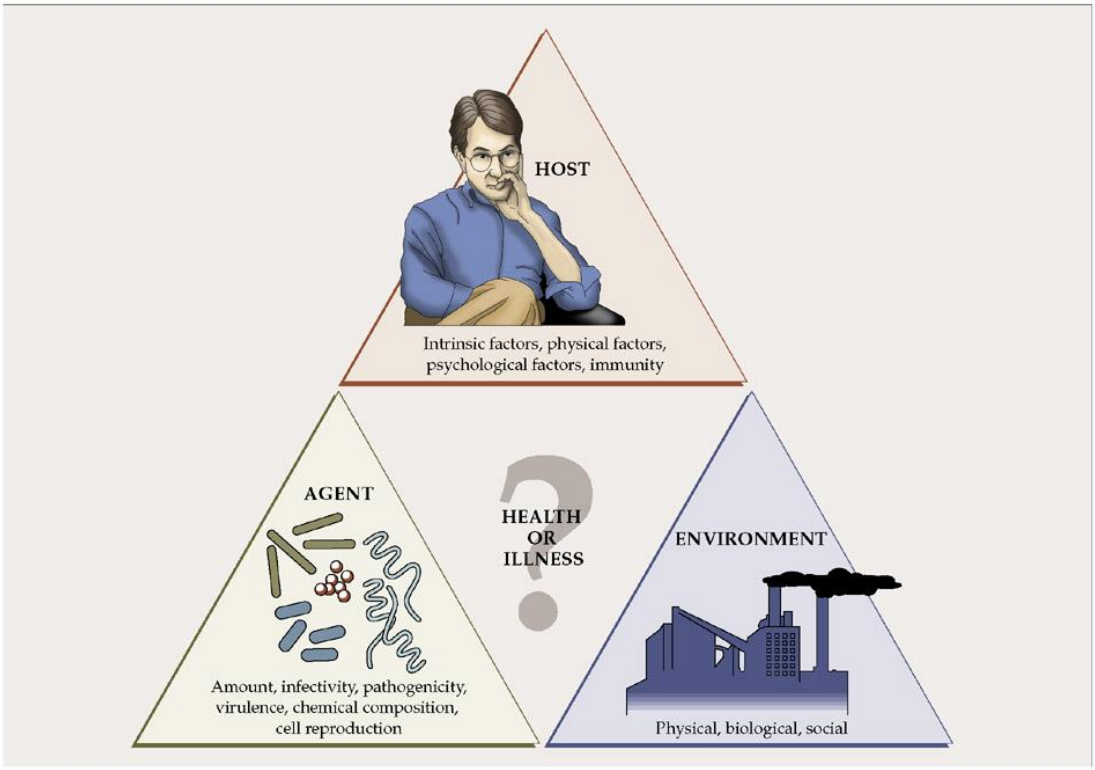


Figure 1 Elements of the Epidemiologic Triad Model.

2-The web of causation model:

The "web of causation" is a second model for exploring the influence of multiple factors on the development of a specific health condition. A map of the interrelationships among factors contributing to the development (or prevention) of a particular health condition. Identifies both direct and indirect causes of health conditions.

Lecture Tree

Concepts Of Epidemiology

Lecture Three

Concepts in Epidemiology

Epidemics, Endemics, and Pandemics

Epidemic:

• **An epidemic** is the occurrence of cases of an illness, specific health-related behavior, or other health-related events clearly in excess of normal expectancy in a community or region.

• Public health officials often use the term "outbreak" synonymously with epidemic, but an outbreak actually refers to an epidemic that is confined to a localized geographic area.

• Epidemics are often described by how they spread through the population. Two primary types of infectious-disease epidemics are **common-source and propagated**.

- A common-source epidemic arises from a specific source (e.g., cholera)
- A propagated epidemic arises from infections transmitted from one infected person to another (e.g., tuberculosis).
- Some disease outbreaks may have both common-source and propagated epidemic features. **A mixed epidemic** occurs when victims of a common-source epidemic have person-to-person contact with others and spread the disease, resulting in a propagated outbreak.

Pandemic:

• **A pandemic** is an epidemic that affects or attacks the population of an extensive region, country, or continent.

Endemic:

• **Endemic** refers to the ongoing, usual, or constant presence of a disease in a community or among a group of people; a disease is said to be endemic

when it continually prevails in a region. For example, although influenza follows a seasonal trend, with the highest number of cases in the winter months, it is considered endemic if the pattern is consistent from year to year

Case Concepts in Epidemiology:

• A **case** is a person in a population who has been identified as having a particular disease, disorder, injury, or condition.

• **Case definition** is a set of standard criteria for classifying whether a person has a particular disease, syndrome, or other health condition. Case definition ensures that cases are consistently diagnosed, regardless of where or when they were identified and who diagnosed the case.

• **The primary case is** the first disease case in the population.

• **Index case** is the first disease case brought to the attention of the epidemiologist. The index case is not always the primary case.

• **Secondary case** is a person who becomes infected and ill after a disease has been introduced into a population and who is infected as a result of contact with the primary case.

• A **suspect case** is an individual (or a group of individuals) who has all the signs and symptoms of a disease or condition but has not been diagnosed as having the disease or has the cause of the symptoms connected to a suspected pathogen (i.e., any virus, bacteria, fungus, or parasite)

• When all criteria are met for the case definition, the case is classified as a **confirmed case**.

The Epidemiology Triangle:

• Three interrelated epidemiologic variables were involved and are present in any disease occurrence (1) the host; (2) the agent; and (3) the environment. The traditional triangle of epidemiology is shown in figure1.

• The agent is the cause of the disease;

• The host is a human or an animal that is susceptible to the disease (e.g., healthcare workers, patients, unvaccinated individuals);

• The environment includes those surroundings and conditions external to the human or animal that cause or allow disease transmission;

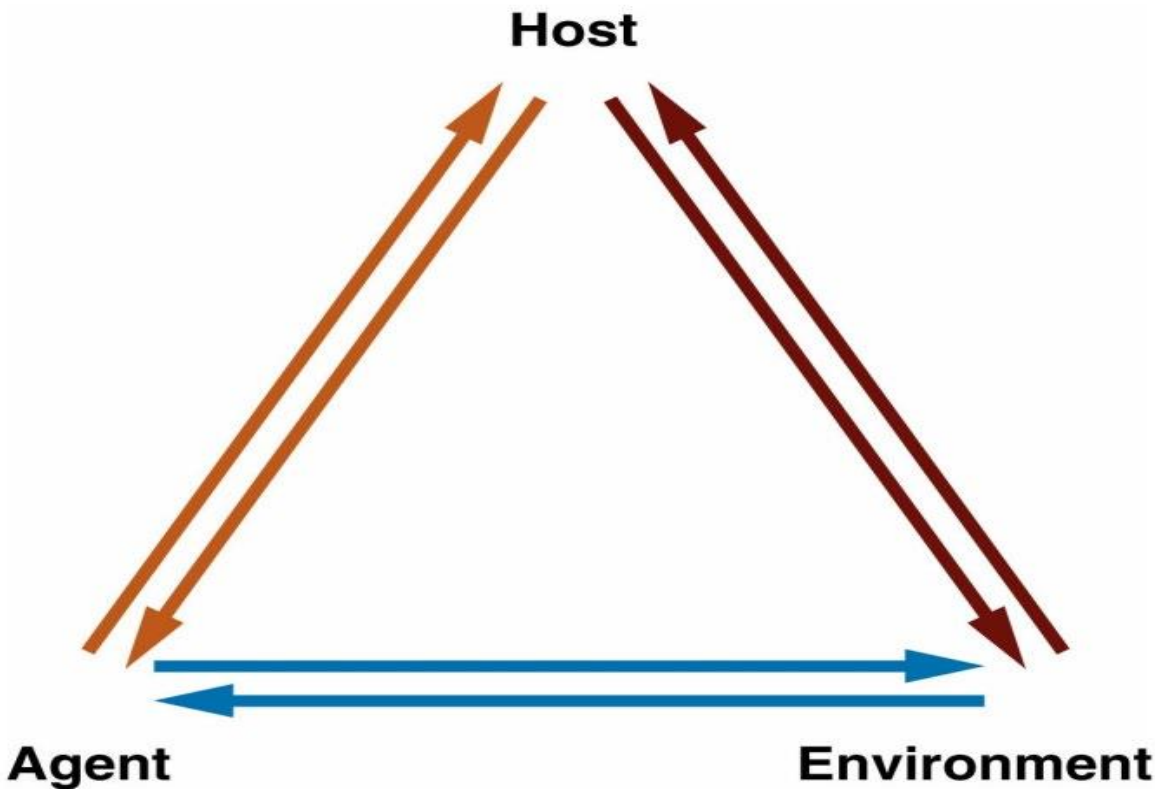


FIG. 1 Epidemiological triangle.

Some Disease Transmission Concepts:

Several disease transmissions concepts that relate to or influence the epidemiology triangle are fomites, vectors, reservoirs, and carriers.

• A **fomite** is an object such as a piece of clothing, a door handle, or a utensil that can harbor an infectious agent and is capable of being a means of transmission.

• A **vector** is an invertebrate animal (e.g., tick, mite, mosquito, bloodsucking fly) that transmits infection by conveying the infectious agent from one host to another.

○ Transmission may be either mechanical (i.e., the agent does not multiply or undergo physiologic changes in the vector) or biological

(i.e., the agent undergoes part of its life cycle inside the vector before being transmitted to a new host).

• A **reservoir** is the habitat (living or nonliving) in or on which an infectious agent lives, grows, multiplies, and on which it depends for its survival in nature. Reservoirs are humans, animals, or certain environmental conditions or substances (e.g., food, feces, decaying organic matter) that are conducive to the growth of pathogens. Two types of human or animal reservoirs are generally recognized: symptomatic (ill) persons who have a disease and carriers who are asymptomatic and can still transmit the disease.

• **Zoonosis** is an infectious organism in vertebrate animals (e.g., rabies virus, bacillus anthracis, Ebola virus, influenza virus) that can be transmitted to humans through direct contact, a fomite, or a vector.

• A **vehicle** is a nonliving intermediary such as a fomite, food, or water that conveys the infectious agent from its reservoir to a susceptible host.

• A **carrier** contains, spreads, or harbors an infectious organism. The infected person (or animal) harboring the disease-producing organism often lacks discernible clinical manifestation of the disease; nevertheless, the person or animal serves as a potential source of infection and disease transmission to other humans (or animals).

Carriers have been found to have several different conditions or states. Traditionally, five types of carriers have been identified by the public health and medical fields:

1. **Active carrier**. Individual who has been exposed to and harbors a diseasecausing organism (pathogen) and who has done so for some time, even though the person may have recovered from the disease.

2. **Convalescent carrier**. Individual who harbors a pathogen and who, although in the recovery phase of the course of the disease, is still infectious.

3. **Healthy carrier** (also called **passive carriers**). Individual who has been

exposed to and harbors a pathogen but has not become ill or shown any of the symptoms of the disease. This could be referred to as a subclinical case.

4. **Incubatory carrier**. Individual who has been exposed to and harbors a pathogen, is in the beginning stages of the disease, is displaying symptoms, and has the ability to transmit the disease.

5. **Intermittent carrier**. Individual who has been exposed to and harbors a pathogen and who can spread the disease in different places or at different intervals

Modes of Disease Transmission

The two general **modes of disease transmission** include direct transmission and indirect transmission.

• **Direct transmission** is the direct and immediate transfer of an infectious agent from one person to another. Direct transmission requires physical contact between an infected host and a susceptible person, and the physical transfer of a pathogen. Examples include sexually transmitted diseases (e.g., HIV/AIDS, Chlamydia, Gonorrhea, Hepatitis B, Herpes simplex virus, Herpes), perinatal mother-to-child transmission (toxoplasmosis), and skinto-skin (e.g., warts, impetigo, athlete's foot) transmission.

• **Indirect transmission** occurs when an agent is transferred or carried by some intermediate item, organism, means, or process to a susceptible host, resulting in disease. Air currents, dust particles, water, food, oral–fecal contact, and other mechanisms that effectively transfer disease-causing organisms are means of indirect disease transmission.

- **Airborne transmission** occurs when droplets or dust particles carry the pathogen to the host and cause infection (e.g., respiratory viruses, pertussis, pneumococcal pneumonia, diphtheria, rubella).
- **Vector-borne transmission** is when an arthropod (e.g., mosquito, flea, tick, lice) conveys the infection agent.

- **Vehicle-borne transmission** is related to fomites, food, or water that acts as a conveyance. For example, this occurs when a pathogen such as cholera or shigellosis is carried in drinking water, swimming pools, streams, or lakes used for swimming.

Chain of Infection and Immunity:

There is a close association between the triangle of epidemiology and the **chain of infection** (**FIGURE 1-2**).

• Disease transmission occurs when the pathogen leaves the reservoir (e.g., food, water, feces) through a **portal of exit** (e.g., nose, mouth, rectum, urinary tract, blood, other bodily fluids) and is spread by one of several modes of transmission.

• The pathogen or disease-causing agent enters the body through a **portal of entry** (e.g., mucous membranes, wounds) and infects the host if the host is susceptible.

• Once a pathogen leaves its reservoir, it follows its mode of transmission to a host, either by direct transmission (person-to-person contact) or by indirect transmission (airborne droplets or dust particles, vectors, fomites, and food).

• The final link in the chain of infection is, thus, the susceptible individual or host, usually a human or an animal.

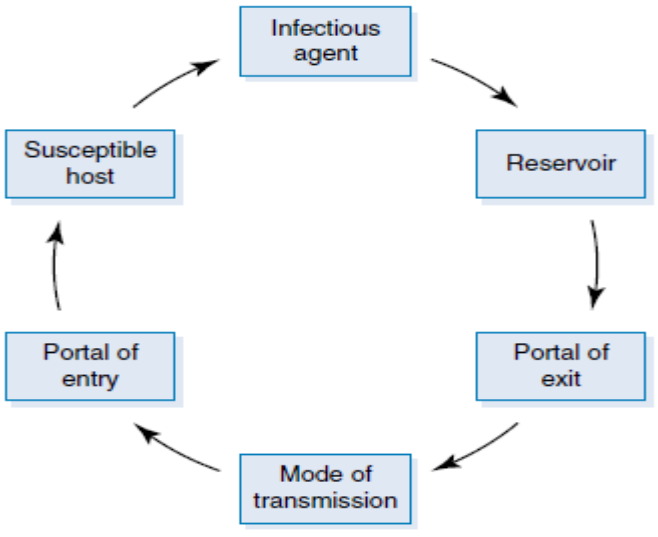


FIGURE 1-2 The chain of infection.

Practical Disease Concepts in Epidemiology:

• **Disease** is an interruption, cessation, or disorder of body functions, systems, or organs. Diseases arise from infectious agents, inherent weaknesses, lifestyle, or environmental stresses. Often a combination of these factors influences the onset of disease.

Communicable and Noncommunicable Diseases and Conditions:

• Infectious diseases are caused by invading organisms called pathogens.

• Infectious diseases may or may not be contagious. When an infectious disease is contagious, or capable of being communicated or transmitted, it is called a communicable disease. Examples of infectious communicable diseases are HIV/AIDS, cholera, and influenza.

• Noninfectious diseases may be referred to as noncommunicable diseases and conditions, such as heart disease, most forms of cancer, mental illness, and accidents.

• Infectious communicable diseases may be transmitted through vertical or horizontal transmission.

o **Vertical transmission** refers to transmission from an individual to its offspring through sperm, placenta, milk, or vaginal fluids.

o **Horizontal transmission** refers to transmission of infectious agents from an infected individual to a susceptible contemporary.

• Five different means of transmission can be used to classify certain infectious diseases. The five classifications are

1. Airborne or respiratory transmission,

2. Transmission through intestinal (alvine) discharge (which includes waterborne and food-borne diseases),

3. Transmission through open lesions,

4. Zoonotic or vector-borne transmission, and

5. Fomite-borne transmission.

Diseases are classified as acute and chronic:

• Acute: relatively severe disorder with sudden onset and short duration of symptoms.

• Chronic: less severe but of continuous duration, lasting over long time periods if not a lifetime. Infectious and noninfectious diseases can be acute or chronic.

Classifying Disease:

Diseases can be classified into five general categories: congenital and hereditary diseases, allergies and inflammatory diseases, degenerative diseases, metabolic diseases, and cancer. Each of these is defined as follows:

• **Congenital and hereditary diseases** are often caused by genetic and familial tendencies toward certain inborn abnormalities; injury to the embryo or fetus by environmental factors, chemicals, or agents such as drugs, alcohol, or smoking; or innate developmental problems possibly caused by chemicals or agents.

• **Allergies and inflammatory diseases** are caused by the body reacting to an invasion of or injury by a foreign object or substance. An allergen is a substance that can cause an allergic reaction.

• **Degenerative diseases** cause a lower level of mental, physical, or moral state than is normal or acceptable. Degenerative diseases are often associated with the aging process but in some cases may not be age related. Arteriosclerosis, arthritis, and gout are examples of degenerative chronic diseases.

• **Metabolic diseases** cause the dysfunction, poor function, or malfunction of certain organs or physiologic processes in the body, leading to disease states. Glands or organs that fail to secrete certain biochemicals to keep the metabolic process functioning in the body cause metabolic disorders. For example, adrenal glands may stop functioning properly causing Addison's

disease; the cells may no longer use glucose normally, causing diabetes; or the thyroid gland might fail, resulting in a goiter, hyperthyroidism, or cretinism (hypothyroidism).

• **Cancer is** a collective name that refers to a group of many diseases with one common characteristic: uncontrolled cell growth or the loss of the cell's ability to perform apoptosis (cell suicide). The gradual increase in the number of uncontrolled dividing cells creates a mass of tissue called a tumor (neoplasm). When a tumor is malignant, meaning it is capable of spreading to surrounding tissue or remote places in the body, it is called cancer.

Classification of disease according to their source (Table 1):

Table 1	Classification of Sources of Disease or Illness
Classification	**Examples of Sources**
Allergic	Mold, dust, foods
Chemical	Drugs, acids, alkali, heavy metals (lead, mercury), poisons (arsenic)
Congenital	Rubella, cytomegalovirus, syphilis, toxoplasmosis, alcohol abuse
Hereditary	Familial tendency diseases such as alcoholism, genetic or chromosome structure that passes disability, disease, or disorders on to offspring.
Infectious	Bacteria, viruses, parasites
Inflammatory	Stings, poison ivy, wounds, slivers or impaled objects, arthritis, allergic reactions
Metabolic	Dysfunctional organs within the body producing hypothyroidism, hyperthyroidism
Nutritional	Vitamin deficiencies such as scurvy or protein deficiencies such as kwashiorkor

Physical agent	Excessive cold or heat, electrical shock, radiation, injury
Psychological	Biochemical imbalances in the brain as in schizophrenia; loss of or destruction of brain tissue such as in Alzheimer's disease
Traumatic	Wounds, bone fractures, contusions, mechanical injury
Tumors	Environmental or behaviorally stimulated tumors, such as cancer of the lung from smoking
Vascular	Smoking, stress, lack of proper diet, lack of exercise, and other behaviorally related implications that contribute to heart and cardiovascular diseases

Immunity:

Two classifications of disease **immunity are active or passive.**

• **Active immunity,** the body produces its own antibodies against a specific invading substance, called an antigen, thereby providing very selective protection. This can occur through a vaccine or in response to having a specific disease pathogen invade the body. Active immunity is usually permanent, lasting throughout one's lifetime.

• **Passive immunity** involves the transfer of antibodies to one person produced by another person. Passive immunity may be acquired through transplacental transfer or breastfeeding. Passive immunity can also come from the introduction of already-produced antibodies by another host (e.g., immune globulin). Passive immunity is comparatively short lived, usually lasting a few weeks or months**.**

• **Herd immunity is** based on the notion that if the herd (a population or group) is mostly protected from a disease by immunity then the chance that a major epidemic will occur is limited.

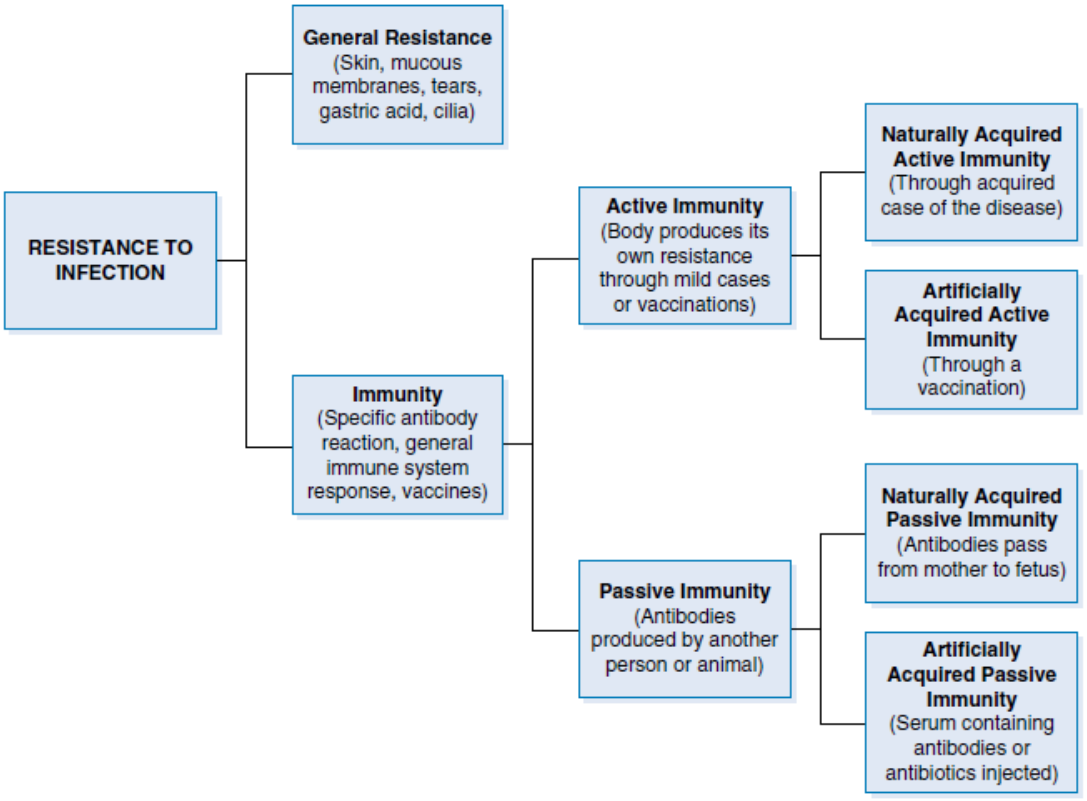


FIGURE 3-1 How the human body resists infections.

Natural History of Disease:

Each disease has a natural history of progression if no medical intervention is taken

and the disease is allowed to run its full course. There are four common stages relevant to most diseases.

1. Stage of susceptibility
2. Stage of presymptomatic disease
3. Stage of clinical disease
4. Stage of recovery, disability, or death

• **The stage of susceptibility** precedes the disease and involves the likelihood a host has of developing ill effects from an external agent**.**

• **The stage of presymptomatic disease** begins with exposure and subsequent pathologic changes that occur before the onset of symptoms. This is also typically called the incubation period. For chronic diseases, the time from exposure to clinical symptoms is typically called the latency period.

• **The stage of clinical disease** begins when signs and symptoms are manifest**.**

• **The final stage** reflects the expected prognosis**.**

• Several factors may influence these stages including early detection and effective treatment. With regard to prevention, **primary prevention** may occur during the stage of susceptibility. **Secondary prevention** may occur during the stage of presymptomatic disease or the stage of clinical disease, and **tertiary prevention** may occur during the stage of clinical disease or in the final stage.

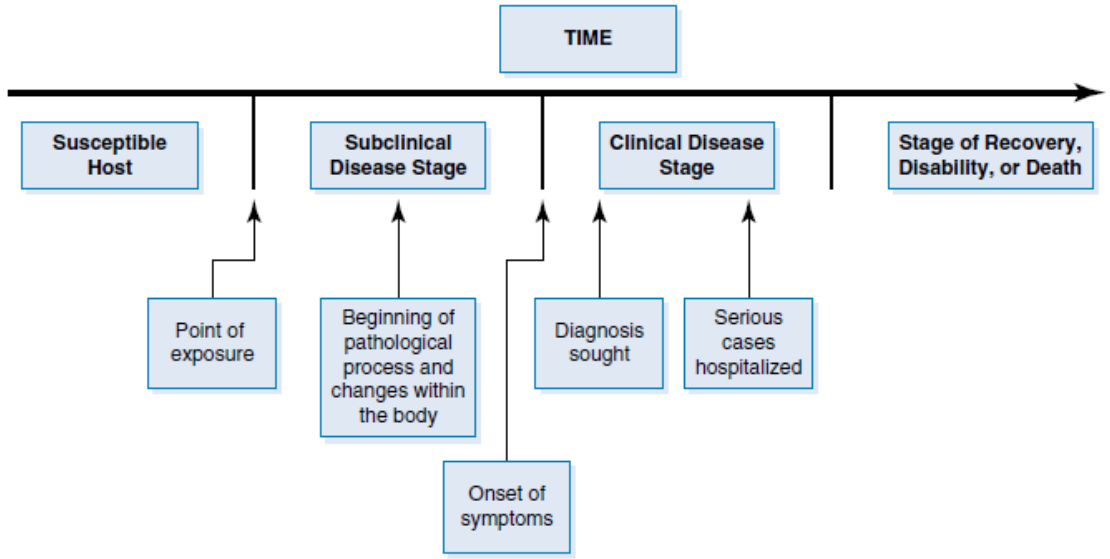
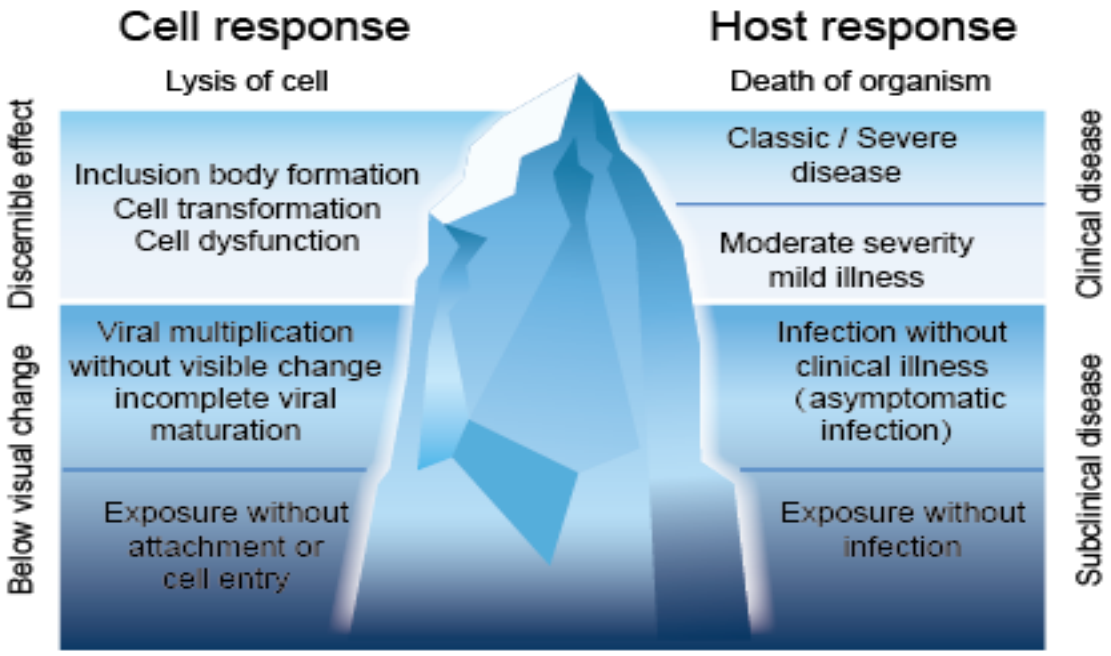


FIGURE 3-2 Natural course of communicable disease.

The Iceberg concept:

The iceberg phenomenon describes a situation in which a large percentage of a problem is subclinical, unreported, or otherwise hidden from view. Thus, only the "tip of the iceberg" is apparent to the epidemiologist. Uncovering disease that might be below "sea-level" by screening and early detection often allows for better disease control.



Iceberg concept of viral infection

Lecture Four

Causal Inference in Epidemiology

Lecture Four

Causal Inference in Epidemiology

Concepts of Disease Occurrence:

A critical premise of epidemiology is that disease and other health events do not occur randomly in a population, but are more likely to occur in some members of the population than others because of risk factors that may not be distributed randomly in the population. As noted earlier, one important use of epidemiology is to identify the factors that place some members at greater risk than others.

Definitions:

Causality: Is the relationship between an event (the *cause*) and a second event (the *effect*), where the second event is understood as a consequence of the first.

Cause: An event, condition, characteristic (or a combination) which plays an important role / regular / predicable change in occurrence of the outcome (e.g. smoking and lung cancer).

Causes may be "genetic" and / or "environmental" (e.g. many NCDs including: diabetes, cancers, COPD, etc).

Effect: Standard dictionary defines effect as result, consequence or aftermath of a cause.

Deterministic causality: Cause closely related to effect, as in "necessary" / "sufficient" causes.

Necessary cause: Must always PRECEDE the effect. This effect need not be the sole result of the one cause

Sufficient cause: Inevitably initiates or produces an effect, includes component causes"

Component causes: Together they constitute a sufficient cause for the outcome in question. InCDs, this may include the biological agent as well as environmental conditions (e.g. TB, measles). In NCDs, this may include a whole range of genetic, environmental as well as personal / psychosocial / behavioral characteristics (e.g. diabetes, cancers, IHD).

Factors in Causation :

1- Predisposing factors:

Factors that prepare, sensitize, condition or otherwise create a situation (such as level of immunity or state of susceptibility) so that the host tends to react in a specific fashion to a disease agent, npersonal interaction, environmental stimulus or specific incentive. Examples: age, sex, marital status, family size, education, etc. (necessary, rarely sufficient).

2- Precipitating factors:

Those associated with the definitive onset of a disease, illness, accident, behavioral response, or course of action. Examples: exposure to specific disease, amount or level of an infectious agent, drug, physical trauma, personal interaction, occupational stimulus, etc. (usually necessary).

3- Enabling or Disabling Factors:

Like low income, malnutrition, unsafe housing, and inadequate health care delivery all these factors improve the diseases development. Otherwise, many factors help cure from disease or maintain health.

4- Reinforcing Factors:

Recurrent exposure, environmental conditions and heavy work increase severity of disease.

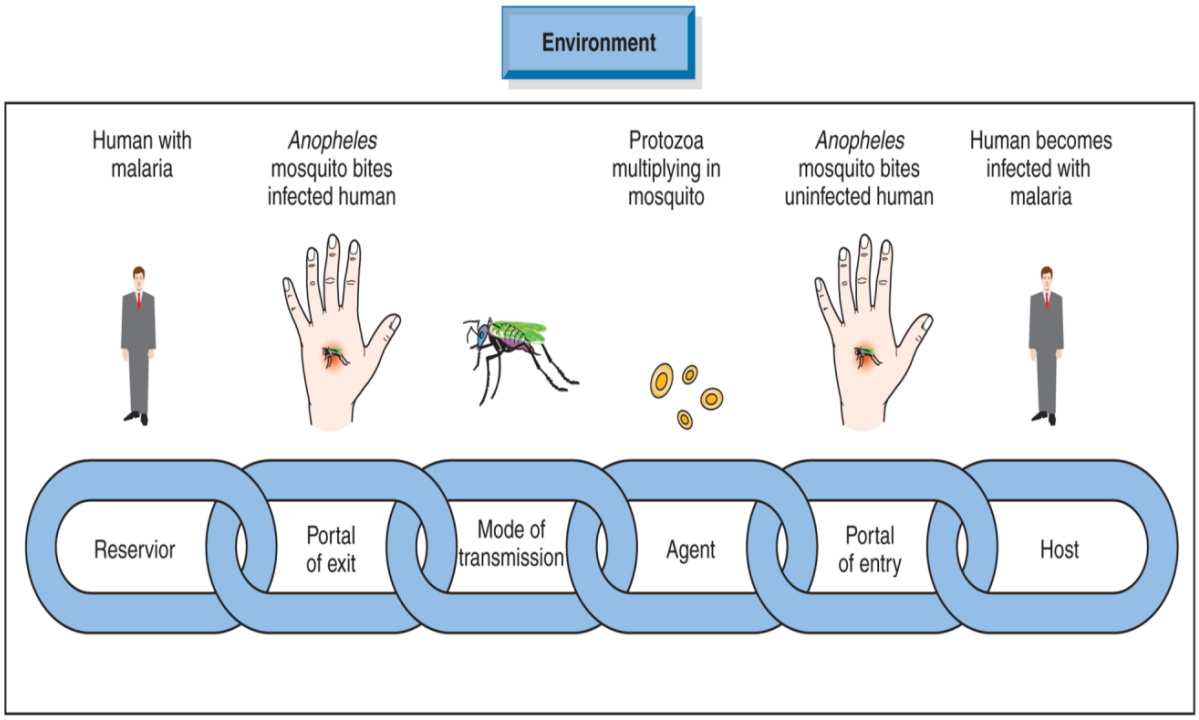
Theories of Causality in Health and Illness:

- Relationship between a cause and its effect
  - Chain of causation
  - Causation in noninfectious disease: environmental exposure and potential

health outcomes.

– Multiple causation

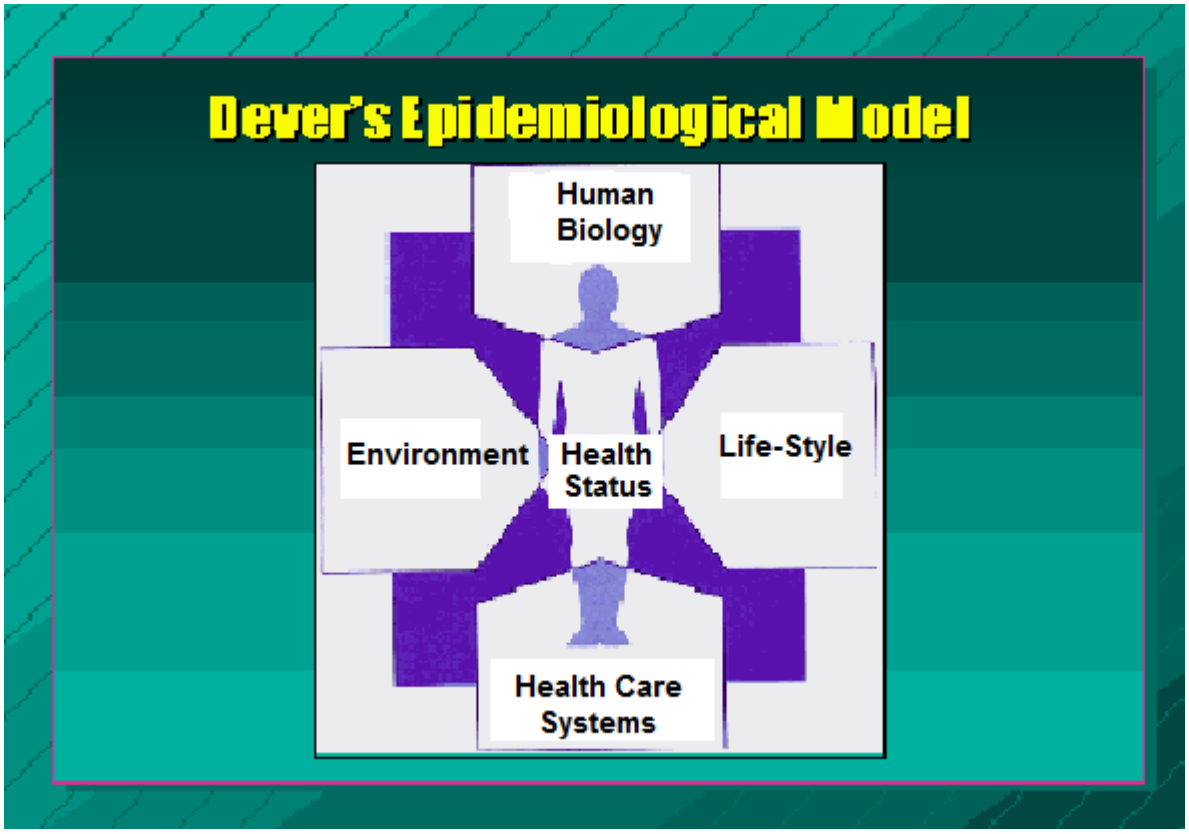
• Dever's epidemiological model, also called the web of causation.



(*Chain of causation in infectious disease*)

Dever's epidemiological model:

- Dever's Epidemiological Model considers the health status of the host and how it is impacted by human biology, life-style, environment, and the health care system.
- Sometimes referred to as a "web of causation," this model attempts to identify all possible influences on the health and illness processes.



1- Human biology factor:

These factors are similar to host-related factors it includes:

A- Genetic inheritance.

For example:

- G.I encompasses influences of human features such as race, gender, also genetic

predisposition of variety of diseases such as cancer, heart disease , diabetes.

B- **Functioning of complex physiological system**

For example:

— State of health and physiological status influences health problems. Fatigue and

malnutrition, also may predisposing to other health problems like influenza and tuberculosis.

— Immunity is another element of physiological state influence susceptibility of disease:

- Active immunity through immunization or disease
- Passive immunity through globulin or mother t child
- Cross-immunity one agent confers to another related agent
- Herd immunity generalized resistance to disease within population which decrease the potential exposure.

C- **Maturation and aging.**

For example:

Very young and very old more vulnerable, personal behaviors- smoking, drug users or abusers.

2- Environment factors:

Physical, psychological and social economical, political cultural factors.

3- Life style factors:

These factors are greatest contributors to most health problems and provide avenue for control those problems, It includes: Employment, consumption behaviors – diet and drinks and physical and leisure activities, exercise.

4- Health care system:

Factors within H.C system and activities and attitudes of H.C providers:

• Prenatal care – protect women

• Health promotion – health education.

• Promotive and rehabilitative – physical disable.

Each one of these elements can be used to identify health problems, recognize health status of population, and recognize an intervention.

Lecture Five

Natural History of a Disease

Lecture Five

Natural History of a Disease or Health Condition

Natural history of disease:

Refers to the progression of a disease process in an individual over time, in the absence of treatment.

In order for a disease to occur (process) there must be a unique combination of events.

1. Harmful agent, that comes in contact
2. Susceptible host in
3. Proper environment.

National history of any disease includes two phases:

I. **pre-pathogenesis period (agent in environment)**

II. **pathogenesis period (agent in host)**

I. ***Pre-pathogenesis phase:***

Is the phase where agent host and environment interact with each other to led agent get access to the host.

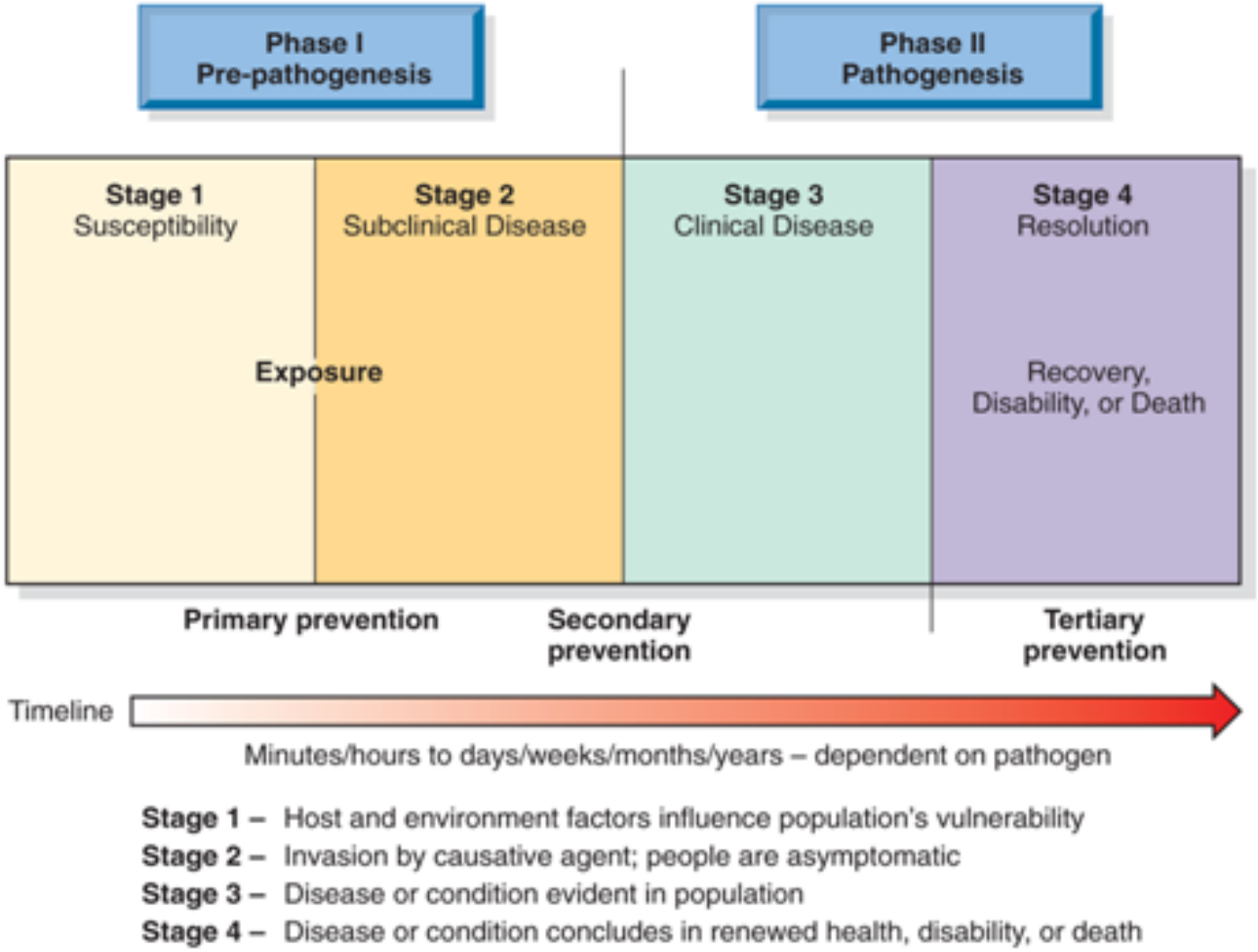
II. ***Pathogenesis phase:***

Is the phase where agent has got access into host and lodged and settled in the host in a manner of signs and symptoms where the outcome will be: (outcome of the phase):

- Recovery
- Disability
- Chronicity
- Death

Natural History of a Disease or Health Condition:

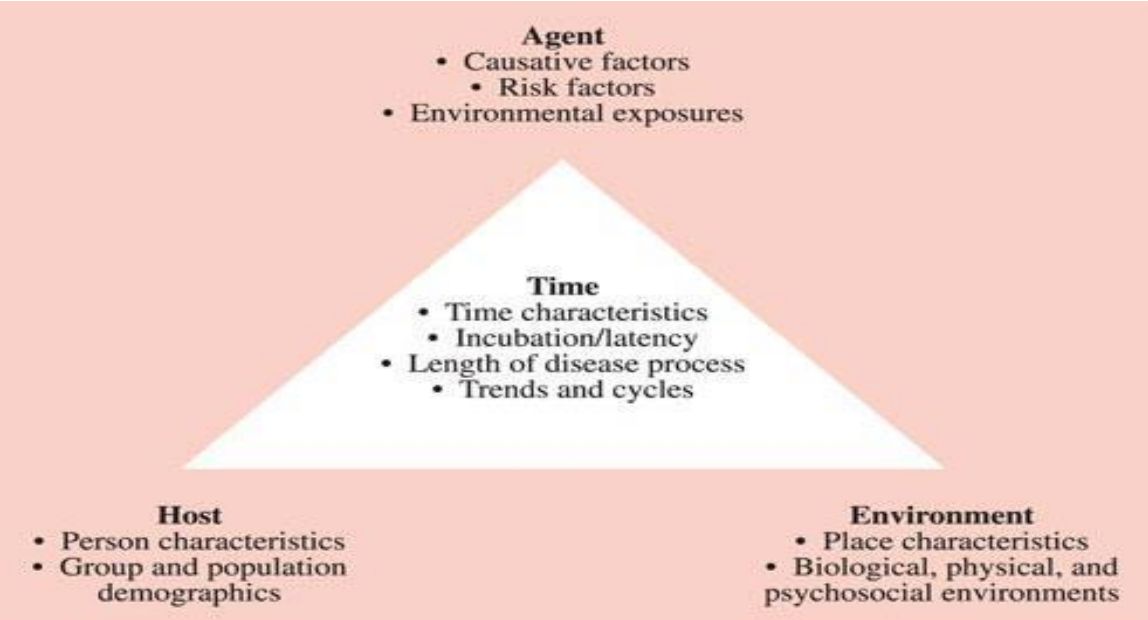
- Susceptibility stage
- Subclinical disease stage
  - Incubation period
  - Induction period
- Clinical disease stage
- Resolution stage



Epidemiologic triangle:

Is a tool that scientists use for addressing the three components that contribute to the spread of disease: an external agent, a susceptible host and an environment that brings the agent and host together.

This model is consistent with infection disease process but also can be applied to chronic disease or non-infectious disease. A disease or outcome is never caused by one event but rather a chain of events, the occurrence of triangle at any of its 3 angles.



1. Agent factors: this factor may be:

- biological – microorganisms
- chemical – toxin, poisons
- nutritional – excess or lack of food, vit. Deficiency
- physical forces– auto mobile, hot water.

The severity and occurrence of disease will be influenced by many factors are contributed.

Characteristic of agent:

1. **Infectivity:** ability of microorganism to infect the host.
2. **viability:** ability of microorganism to keep viable outside host.
3. **invasiveness:** ability of microorganism to invade the host.
4. **virulence:** ability of microorganism to make tissue reactions.
5. **agent-antibody reaction:** each host makes antibody's reaction for each agent.
6. **host selectivity:** ability of agent to select favorable host.
7. **tissue or organs selectivity:** ability of agent to select organ or tissue inside the body.
8. **spores: (**makes spores) Bacilli
9. **morphology:** type of organism (gram +ve)
10. **shape:** encapsulated or unencapsulated.
11. **toxicity:** ability of agent to produce the toxic effect in body's tissue.

2. Host factors: That determine the occurrence of disease includes:

- **Biological traits:** (is born) genetic characteristics, race, ethnic origin, sex, and age.
- **Physical traits:** host develops or acquires from physical factors.
- **Social traits:** these traits are required as host goes through life, marital status; life style, diet, residence, and travel.
- Young children more likely to sub clinical infection, an infant infected with no symptoms.
- Many diseases are rare in adults.
- Infants are likely to expose to communicable disease while adults are likely to expose to chronic diseases.
- Some diseases are common among female rather than male
- some diseases are common among black people rather than white people.

3. Environmental factors:

These factors determine the occurrence of disease:

1. **Physical** include climate (temp., moisture), water, air, food, and housing Manipulating and modifying the physical environment

• smoke detectors

• disposing sewage system

• food control

• water chlorinating

• traffic modification

2. **Biological factors**: Environmental factors are necessary to maintain or allow transmission according to agent characteristics.

3. **Social factors**: including political, social and economic bases of society and its institutions.

How To Break The Epidemiologic Triangle?

To prevent the spread of disease, at least one side of the Epidemiologic Triangle must be broken.

Some things they can do to break the Epidemiologic Triangle include:

1. Follow proper hand hygiene at all times.

2. Wear appropriate personal protective equipment (PPE) while treating patients.

3. Kill germs by disinfecting high-touch areas regularly.

4. Clean and disinfect lobbies, exam rooms, bathrooms and other common areas often.

Lecture six

Infection & its Mode of Transmission

Lecture Six

Infection & its Mode of Transmission

• **Infection**: The invasion and multiplication of microorganisms such as bacteria, viruses, and parasites that are not normally present within the body.

• An infection may cause no symptoms and be subclinical, or it may cause symptoms and be clinically apparent.

• An infection may remain localized, or it may spread through the blood or lymphatic vessels to become systemic (bodywide).

• Microorganisms that live naturally in the body are not considered infections. For example, bacteria that normally live within the mouth and intestine are not infections.

• **INFECTION** *(Synonymous:* ***colonization):***

• **Infection** is not *Synonymous* with **infectious disease**.

• The presence of living infectious agents on exterior surfaces of the body is called *"**infestation**"* (e.g., pediculosis, scabies).

• The presence of living infectious agents upon articles of apparel or soiled articles is not infection, but represents ***CONTAMINATION*** of such articles.

• **Inflammation** is a process by which your body's white blood cells and the things they make protect you from infection from outside invaders, such as bacteria and viruses.

• **Inapparent Infection** ***(Syn: subclinical infection, asymptomatic infection):*** The presence of infection in a host without occurrence of recognizable clinical signs or symptoms.

• - **Asymptomatic infection** may serve as silent or inapparent disseminators of the infectious agent.

DISEASE:

Literally, *dis-ease*, the opposite of *ease*, when something is wrong with a bodily function. (Last, 2001) The words *disease, illness,* and *sickness* are loosely interchangeable, but are better regarded as not synonymous. *Susser1 has suggested that they be used as follows:*

- **Disease:** Is a physiological/psychological dysfunction.
- **Illness:** Is a subjective state of the person who feels aware of not being well.
- **Sickness:** Is a state of social dysfunction, i.e., a role that the individual assumes when ill.

TRANSMISSION OF INFECTION:

Transmission of infectious agents. Any mechanism by which an infectious agent is spread from a source or reservoir to another person.

These mechanisms are defined as follows:

A. Direct transmission.

B. Indirect transmission.

A. Direct Transmission:

1. Person-to-person contact:

Infectious diseases are commonly transmitted through direct person-to-person contact. Transmission occurs through touches or exchanges body fluids with someone else. This can happen before an infected person is aware of the illness. Sexually transmitted diseases (STDs) can be transmitted this way.

• Pregnant women can also transmit infectious diseases to their unborn children via the placenta.

2. Droplet spread

• The spray of droplets during coughing and sneezing can spread an infectious disease. You can even infect another person through droplets created when you speak. Like rubella, Influenza, mumps etc…….

B. Indirect Transmission:

1. Airborne transmission

Some infectious agents can travel long distances and remain suspended in the air for an extended period of time. You can catch a disease like measles by entering a room after someone with measles has departed.

2. Contaminated objects

• Some organisms can live on objects for a short time. If you touch an object, such as a doorknob, Computer keyboards, mice, electronic devices with buttons, Pens, pencils, phones soon after an infected person, you might be exposed to infection. Transmission occurs when you touch your mouth, nose, or eyes before thoroughly washing your hands.

• Germs can also be spread through contaminated blood products and medical supplies.

3. Food and drinking water

Infectious diseases can be transmitted via contaminated food and water. *E. coli* is often transmitted through improperly handled produce or undercooked meat. Improperly canned foods can create an environment ripe for *Clostridium botulinum*, which can lead to botulism.

4. Animal-to-person contact

Some infectious diseases can be transmitted from an animal to a person. This can happen when an infected animal bites or scratches you or when you handle animal waste. The *Toxoplasma gondii* parasite can be found in cat feces.

5. Animal reservoirs

Animal-to-animal disease transmission can sometimes transfer to humans. Zoonosis occurs when diseases are transferred from animals to people. Zoonotic diseases include:

- anthrax (from sheep)
- rabies (from rodents and other mammals)
- West Nile virus (from birds)
- plague (from rodents).

6. Insect bites (vector-borne disease)

Some zoonotic infectious agents are transmitted by insects, especially those that suck blood. These include mosquitos, fleas, and ticks. The insects become infected when they feed on infected hosts, such as birds, animals, and humans. The disease is then transmitted when the insect bites a new host. Malaria.

7. Environmental reservoirs

Soil, water, and vegetation containing infectious organisms can also be transferred to

people. Hookworm, for example, is transmitted through contaminated soil.

Lecture Seven

Prevention and Control of Diseases

Lecture Seven

Prevention and Control of Diseases

With only few exceptions, communicable diseases can be prevented and controlled:

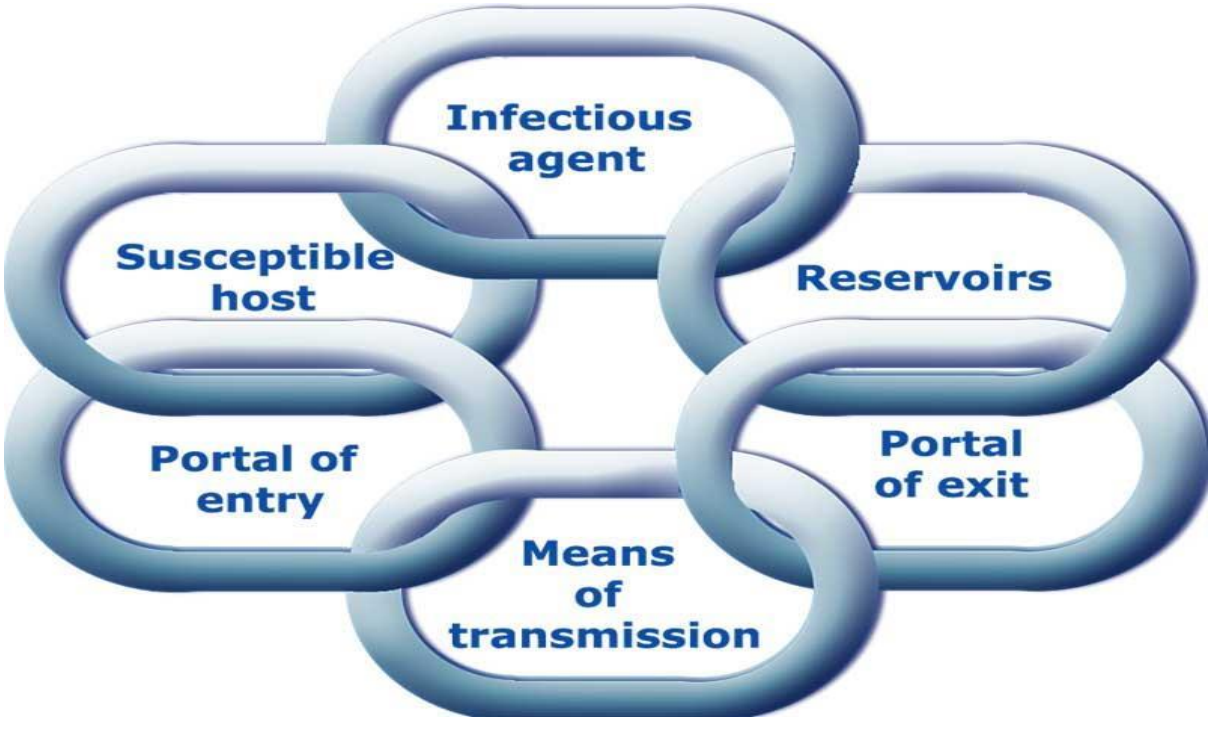
Prevention: Actions aimed at eradicating, eliminating, or minimizing the impact of disease and disability

Controlling: Action aims to reduce the prevalence disease to a level at which no longer poses a major public health problem.

Elimination: Exclusion of a disease from a single country or region or controlling its manifestations so it is no longer a public health problem.

Eradication: Elimination of the causative organism of a disease from nature.

- For successful prevention of diseases or controlling them, the best way to interrupt the infectious cycle as early in natural history of diseases (chain of infection) as possible.



Some definitions are important to emphasize in this context:

A. Primary prevention:

It involves interventions or measures that promote health and prevent diseases processes from developing.

Primary prevention includes health promotion, health protection, and illness prevention.

1- Health promotion: (earliest level of disease prevention)

A behavior directed toward achieving a greater level of health and well-being and promote positive health.

2- Disease prevention: A behavior directed toward reducing the threat of illness, diseases, and complications.

3- Health maintenance: A behavior directed toward keeping a current state of health and well-being.

4- Health protection: is a term used to encompass a set of activities within public health. It is defined as protecting individual, groups and populations from single cases of infectious disease, incidents and outbreaks, and non-infectious environmental hazards such as chemicals and radiation.

These definitions required not to only assess the behavior but makes also basis for one how to make choice for a given behavior.

For example: Exercise: (activity)

1- person: has several factors for C.H.D

2- person: make me more energetic and function at higher level than I do not.

3- person: to maintain weight at good lev**el**

- behavior of (illness: prevention)
- behavior of (health promotion)
- behavior of (health maintenance).

Disease prevention:

Strategy of risk appraisal and risk reduction that can be used by health professionals to helping individual and group maximize their self-care activities.

The goal of risk appraisal and reduction are:

1. to prevent diseases
2. to detect diseases in the earliest stages.

Self-care activities: Activities carried out by individuals, families, and communities, societies are based on many influences (scientific, religious, philosophical, and cultural).

All health workers should provide care to change behavior and believes, in addition; adequate social and personal resources have to develop in community.

*** The knowledge base for this risk is scientific evidence regarding relationship between risk factor and mortality and effectiveness of intervention plan in reducing both (risk and mortality).**

- from clinical approach

- Identification of risk at individual level

- from epidemiological approach:

- Identification of risk to community level.

B. Secondary prevention:

Process of detecting diseases in the early stages before clinical signs and symptoms manifested in order to intervene with early diagnosis and treatment.

**** the goal is:***

To reduce the severity of disease or provide a cure.

For example:

- screening program
- pap smear (cervical disorders)
- B\P checkup (symptom-free person**).**

C. Tertiary prevention

Process directed toward persons with clinically apparent disease.

The goal is:

- to reduce disability
- to rehabilitate the person
- to ameliorate the course of disease.

For example:

- physical therapy for (spinal cord injuries)
- rehabilitate an injured worker to return to work
- rehabilitation job training for juvenile offenders.

Lecture Eight

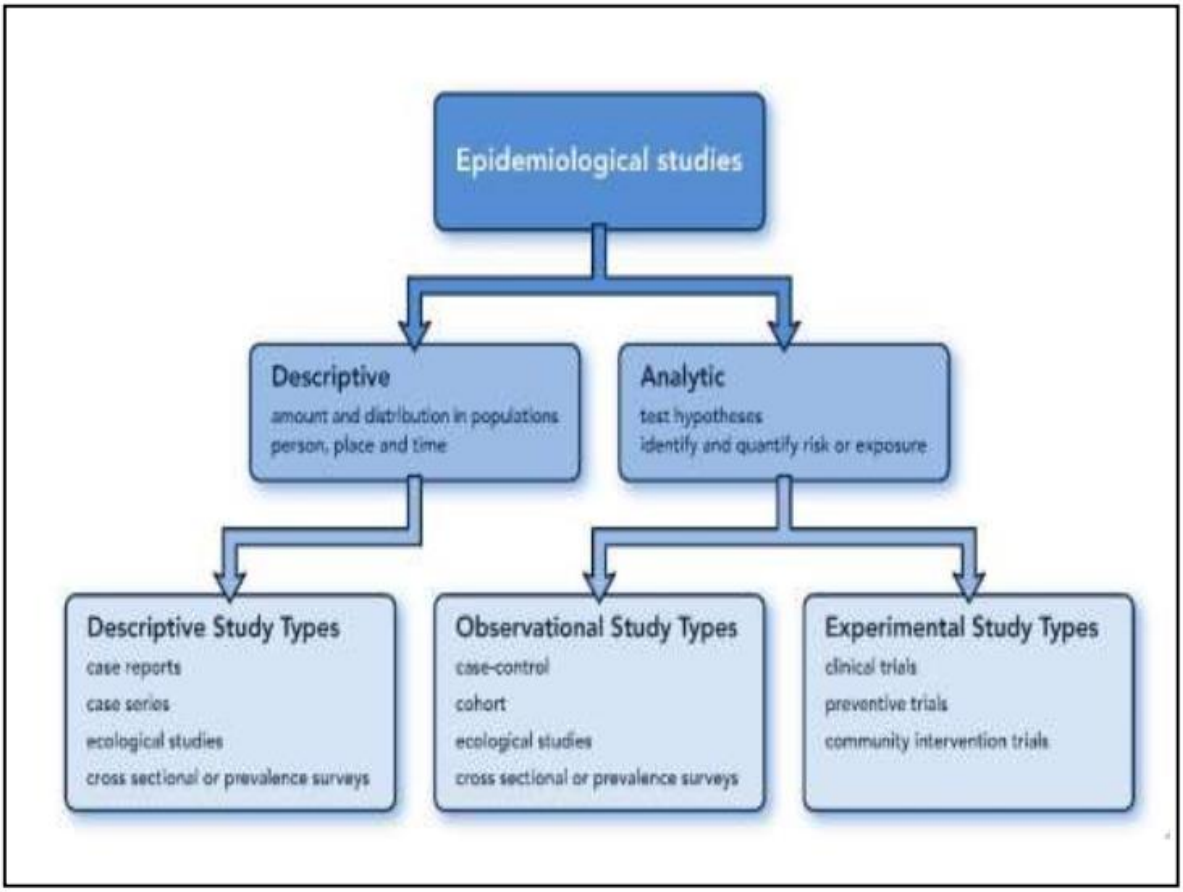
Epidemiological Study

Lecture Eight

Epidemiological Study

Two major categories of epidemiology studies:

1. **Descriptive epidemiology**
2. **Analytic epidemiology**



Descriptive studies:

• Describe the pattern of diseases entity or occurrence according to some variables such as "person, place, and time"

• Descriptive studies deal with distribution of health outcomes.

Analytic studies:

• Is directed toward understanding the etiology of diseases and caused factors of disease in term of origins.

• Seek to discover the determinants of outcomes.

• How & why factors influence pattern of diseases.

Types of descriptive studies :

1. **Case –report.**
2. **Case- series.**
3. **Correlational (ecological).**
4. **Cross – sectional.**

1. A Case Report

¬ Consists of a careful, detailed report on the profile of a single patient

¬ Most *basic type of descriptive study* design of individuals

¬ Ex: Patient, i.v. drug abuser; weight loss, etc.

2. A Case Series

¬ Consists of a compilation of case reports describing the characteristics of a number of individual patients with a particular health-related outcome

¬ Ex: Aids

3. An Ecological Study

¬ Study of whole populations or groups of persons rather than individual persons

¬ Unit of analysis = populations

¬ Ex: County death rates by per capita cigarette consumption

4. Cross – Sectional survey or study:

¬ It describes the exposure of disease status among individuals in well–defined population.

¬ It provides information concerning: Frequency and characteristics of disease at specified time.

¬ Also known as (Prevalence study)

¬ Considered descriptive & analytical

¬ Most common study design used

Types of analytic studies:

1. Case control study

2. Cohort study.

3. Randomized Controlled Trials.

4. Quasi experimental design

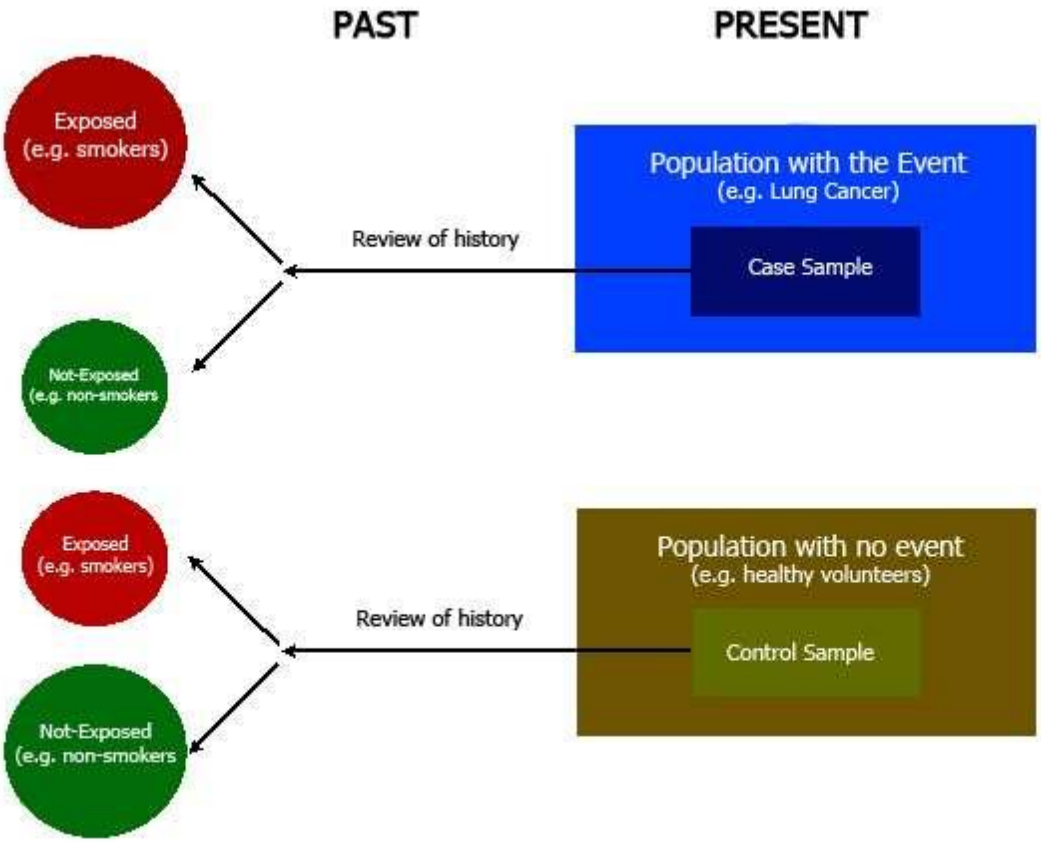
1. Case-control study:

¬ Is the type of observational analytic epidemiologic investigation in which the subjects (people) are selected on basis they are cases (do have disease) and controls (people do not have disease), have particular or special disorder under study.

¬ These two groups (cases & controls) are then compared with respect to proportion of having history of an exposure to some risks or special characteristics.

¬ *Also known as (Retrospective study)*

¬ Provides strength of association.



2. A Cohort Study

¬ Study subjects are selected based on whether or not they have an exposure of interest and are then followed over time to assess the occurrence of outcome(s)

¬ *Also known as (Prospective study or Follow-up study)*

¬ Provides measures of relative risk of incidence

Examples:

o smoking & lung cancer

o forceps delivery & mental retardation

o diet pattern & MI.

Comparison of case-control & cohort studies

Case-control	Cohort studies
- Both evaluate risks.	
- Both evaluate causes of disease	
- Starts with risk factors or exposure and looks at consequences.	- It takes the outcome as the starting point of the inquiry and look for precursors or risk factors.
- Results carry more weight in determining a cause.	- Results carry less weight in determining a cause.
- There are many biases.	- There are few biases.
- More frequently used.	- Less frequently used.
- Takes short time.	- Takes long time.
- Less expensive	- More expensive

3. A randomized controlled trial (RCT)

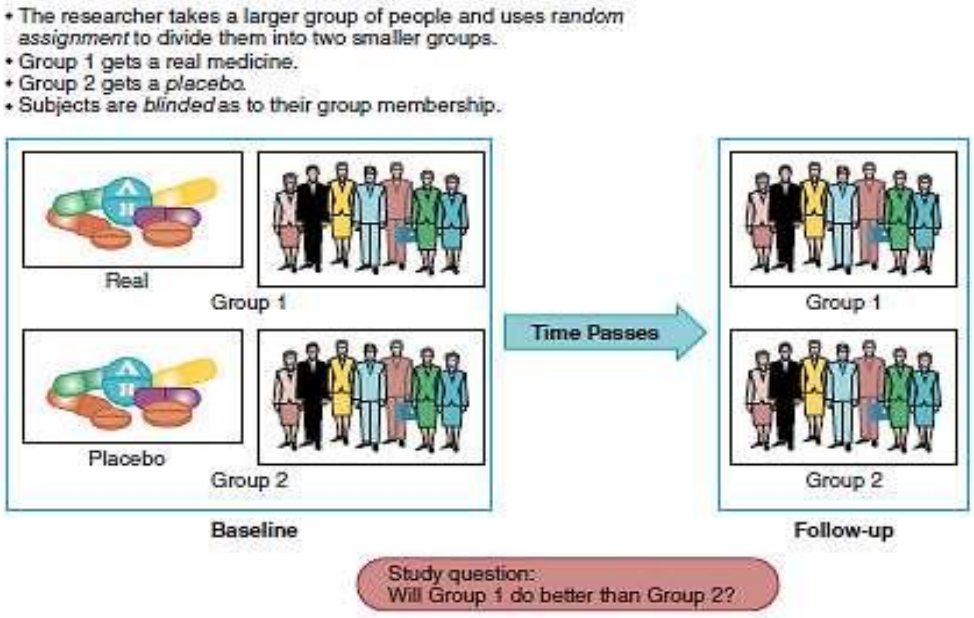
♣ Is a clinical-epidemiological experiment in which subjects are randomly allocated into groups, usually called test and control groups, to receive or not to receive a preventive or a therapeutic procedure or intervention.

♣ The results are assessed by comparison of rates of disease, death, recovery, or other appropriate outcome in the study control groups."

♣ **Blinding or masking to prevent biases:**

♣ Single-blind study: The subjects are unaware of whether they are participating in the treatment or control conditions.

♣ Double-blind study: Neither the participants nor the investigators are aware of who has been assigned to the treatment or control conditions**.**



4. Quasi-Experimental Designs

¬ A quasi-experimental study is a type of research in which the investigator manipulates the study factor but does not assign individual subjects randomly to the exposed and non-exposed groups.

¬ some quasi-experimental designs may not use a control group. An important component of community interventions is program evaluation, the determination of whether the program meets stated goals and is justified economically.

Difference between Descriptive and Analytical Study

Descriptive	Analytical
Only one group is studied	At least 2 groups are studied for making comparisons.
At the start of the study, there is no explicit hypothesis regarding cause – effect relationship	At the start of the study there is a definite hypothesis regarding an exposure possibly causing an outcome
The study ends with development of possible hypotheses regarding cause and effect relationship but does not confirm or reject such hypothesis.	At the end of the study, it confirms or rejects the hypothesis with which it started.

Lecture Nine

Measures in Epidemiology

Lecture Nine

Measures in Epidemiology

• Epidemiologic measurements aid in describing the occurrence of morbidity and mortality in populations.

• Epidemiology is mainly a quantitative science.

• The most basic measure of disease frequency is a simple count of affected individuals.

• One of the central concerns of epidemiology is to find and enumerate appropriate denominators in order to describe and compare groups in a meaningful and useful way.

1- Frequency measures:

• Frequency measures compare one part of the distribution to another part of the distribution, or to the entire distribution.

• Common frequency measures are:

1. Ratios

2. Proportions

3. Rates.

• All three frequency measures have the same basic form:

$$\frac{numerator}{denominator} \times 10^n$$

1. Ratio

¬ A ratio is defined as the value obtained by dividing one quantity by another.

¬ It consists of a numerator and a denominator.

¬ It Does not necessarily have any specified relationship between the numerator

and denominator.

¬ A ratio is expressed as follows: ratio = X/Y.

Method for calculating a ratio

$$\frac{\text{Number or rate of events, items, persons, etc. in one group}}{\text{Number or rate of events, items, persons, etc. in another group}}$$

Calculation example of a ratio:

Example l: With respect to AIDS mortality, the sex ratio of deaths (male to female deaths) = X/Y, **where:**

X = 450,451 and Y = 89,895.

The sex ratio = 450,451/89,895 = 5.01

= 5 to 1 (approximately).

Calculation example of a ratio:

Example 2: In the result of a study, number of intravenous drug users (IDU) = 19, and number of persons who did not use = 1. Calculate the ratio of users of intravenous drugs to Nonusers?

IDU to nonusers = X/Y, where:

X = 19 (users) and Y = 1 (nonusers).

The ratio of users of intravenous drugs to Nonusers = 19/1

The ratio of users of intravenous drugs to nonusers is 19 to 1.

2- Proportion:

¬ A **proportion** is a type of ratio in which the numerator is part of the denominator.

¬ Proportions may be expressed as percentages.

¬ A proportion is expressed as follows: proportion = A/A + B

Method for calculating a proportion

$$\frac{\text{Number of persons or events with a particular characteristic}}{\text{Total number of persons or events, of which the numerator is a subset}} \times 10^n$$

For a proportion, 10^n is usually 100 (or n=2) and is often expressed as a percentage.

Example 1: Proportion of AIDS deaths

Suppose that A = the number of male deaths from AIDS

A = 450,451

B = the number of female deaths from AIDS

B = 89,895

The proportion of deaths that occurred among males =

= A/A + B

450,451 / (450,451 + 89,895) = 0.83

(0.83 × 100) = 83%.

Example 2: Proportion of IDU users

A = 19 (users)

B = 1 (nonuser)

The proportion of IDU users =

= A/A + B

19/(19 + 1) = 0.95

(0.95 × 100) = 95%.

3- Rate

¬ Rate is the most important epidemiological tool used for measuring diseases.

¬ Rate is a special form of proportion that includes time.

¬ It is the measure that most clearly expresses probability or risk of disease in a defined population over a specified period of time

$$Rate = \frac{number\ of\ cases\ or\ events\ occurring\ during\ a\ given\ time\ period}{population\ at\ risk\ during\ the\ same\ time\ period} \times 10^n$$

• The rate is always reported per some unit of time. For these epidemiologists, a rate describes how quickly disease occurs in a population,

- for example, 70 cases of breast cancer per 1,000 women

in year.

= 70 / 1000

70/1000 per year.

2- Morbidity Frequency Measures:

• Morbidity has been defined as any departure, subjective or objective, from a state of physiological or psychological wellbeing. In practice, morbidity encompasses disease, injury, and disability.

• Measures of morbidity frequency characterize the number of persons in a population who become ill (incidence) or are ill at a given time (prevalence).

1- Incidence

• Incidence refers to the occurrence of new cases of disease or injury in a population over a specified period of time.

Although some epidemiologists use incidence to mean the number of new cases in a community, others use incidence to mean the number of new cases per unit of population.

• Two types of incidence are commonly used :

1- Incidence proportion.

2- Incidence rate.

Incidence proportion or risk (Attack rate):

Incidence proportion is the proportion of an initially disease-free population that develops disease, becomes injured, or dies during a specified (usually limited) period of time.

$$\frac{\text{Number of new cases of disease or injury during specified period}}{\text{Size of population at start of period}}$$

EXAMPLES: Calculating Incidence Proportion (Risk)

Example A: In the study of diabetics, 100 of the 189 diabetic men died during the 13-year follow-up period. Calculate the risk of death for these men.

Numerator = 100 deaths among the diabetic men

Denominator = 189 diabetic men

$10^n = 10^2 = 100$

$$\text{Risk} = (100/189) \times 100 = 52.9\%$$

Example B: In an outbreak of gastroenteritis among attendees of a corporate picnic, 99 persons ate potato salad, 30 of whom developed gastroenteritis. Calculate the risk of illness among persons who ate potato salad.

Numerator = 30 persons who ate potato salad and developed gastroenteritis

Denominator = 99 persons who ate potato salad

$10^n = 10^2 = 100$

$$\text{Risk} = \text{“Food-specific attack rate”} = (30/99) \times 100 = 0.303 \times 100 = 30.3\%$$

Incidence rate:

¬ Incidence rate or person-time rate is a measure of incidence that incorporates time directly into the denominator.

¬ A person-time rate is generally calculated from a long-term cohort follow-up study, wherein enrollees are followed over time and the occurrence of new cases of disease is documented. Typically, each person is observed from an established starting time until one of four “end points” is reached: onset of disease, death, migration out of the study (“lost to follow-up”), or the end of the study.

$$\text{Incidence rate} = \frac{\text{Number of new cases over a time period}}{\text{Average population at risk during the same time period}} \times \text{multiplier (e.g., 100,000)}$$

The choice of the multiplier is arbitrary; any convenient multiplier can be chosen.

Population at risk: those members of the population who are capable of developing a disease, e.g., nonimmune persons.

Time period: various time periods can be chosen, e.g., a week, month, year, or other time period; annual incidence rates are often reported in government statistics.

Calculation example (incidence rate of pertussis [whooping cough], 2013):

Number of new cases of pertussis, 2013 = 28,639

Average population of the U.S. (estimated population, July 1, 2013) = 316,128,839

$$\text{Incidence rate} = \left(\frac{28{,}639}{316{,}128{,}839}\right) \times 100{,}000 = 9.1 \text{ per } 100{,}000 \text{ (rounded)}$$

Example

In 1989, 733,151 new cases of gonorrhea were reported among the United States civilian population (2). The 1989 mid-year U.S. civilian population was estimated to be 246,552,000. For these data we will use a value of 10^5 for 10^n. We will calculate the 1989 gonorrhea incidence rate for the U.S. civilian population using these data.

1. Define x and y: x = new cases of gonorrhea in U.S. civilians during 1989
   y = U.S. civilian population in 1989

2. Identify x, y, and 10^n: $x = 733{,}151$
   $y = 246{,}552{,}000$
   $10^n = 10^5 = 100{,}000$

3. Calculate $(x/y) \times 10^n$:

$$\frac{733{,}151}{246{,}552{,}000} \times 10^5 = .002974 \times 100{,}000 = 297.4 \text{ per } 100{,}000$$

or approximately 3 reported cases per 1,000 population in 1989.

2- Prevalence:

• Prevalence, sometimes referred to as **prevalence rate,** is the proportion of persons in a population who have a particular disease or attribute at a specified point in time or over a specified period of time.

• Prevalence differs from incidence in that prevalence includes all cases, both new and preexisting, in the population at the specified time, whereas incidence is limited to new cases only.

Method for calculating prevalence of disease

$$\frac{\text{All new and pre-existing cases during a given time period}}{\text{Population during the same time period}} \times 10^n$$

EXAMPLE: Calculating Prevalence:

In a survey of 1,150 women who gave birth in Maine in 2000, a total of 468 reported taking a multivitamin at least 4 times a week during the month before becoming pregnant. Calculate the prevalence of frequent multivitamin use in this group.

Numerator = 468 multivitamin users

Denominator = 1,150 women

Prevalence = (468 » 1,150) × 100 = 0.407 × 100 = 40.7%.

The two forms of prevalence are:

1- Point prevalence refers to the prevalence measured at a particular point in time. It is the proportion of persons with a particular disease or attribute on a particular date.

2- Period prevalence refers to prevalence measured over an interval of time. It

is the proportion of persons with a particular disease or attribute at any time during the interval.

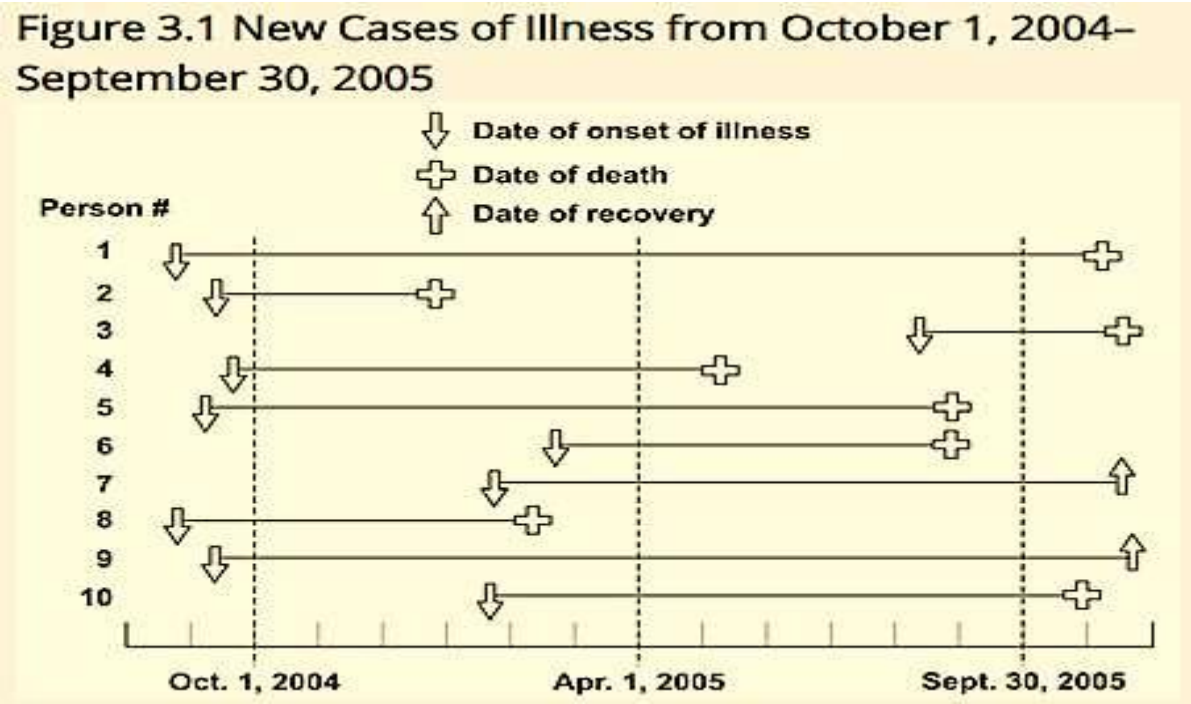


Figure 3.1 Represents 10 new cases of illness over about 15 months in a population of 20 persons.

Example A: Calculate the incidence rate from October 1, 2004, to September 30, 2005, using the midpoint population (population alive on April 1, 2005) as the denominator. Express the rate per 100 population?

Incidence rate numerator = number of new cases between October 1 and September 30 = 4 (the other 6 all had onsets before October 1, and are not included) Incidence rate denominator = April 1 population = 18 (persons 2 and 8 died before April 1)

Incidence rate = (4 » 18) × 100

= 22 new cases per 100 population.

Example B: Calculate the point prevalence on April 1, 2005?

Point prevalence is the number of persons ill on the date divided by the population on that date. On April 1, seven persons (persons 1, 4, 5, 6, 7, 9, and 10) were ill.

Point prevalence = (7 » 18) × 100

= 38 %

Example C: Calculate the period prevalence from October 1, 2004, to September 30, 2005?

The numerator of period prevalence includes anyone who was ill any time during the period. In Figure 3.1, the first 10 persons were all ill at some time during the period.

Period prevalence = (10 » 20) × 100

= 50.0%.

3- Mortality Frequency Measures:

Mortality rate:

A mortality rate is a measure of the frequency of occurrence of death in a defined population during a specified interval. Morbidity and mortality measures are often the same mathematically; it's just a matter of what you choose to measure, illness or death.

$$\frac{\text{Deaths occurring during a given time period}}{\text{Size of the population among which the deaths occurred}} \times 10^n$$

Table 3.4 Frequently Used Measures of Mortality

Measure	Numerator	Denominator	10^n
Crude death rate	Total number of deaths during a given time interval	Mid-interval population	1,000 or 100,000
Cause-specific death rate	Number of deaths assigned to a specific cause during a given time interval	Mid-interval population	100,000
Proportionate mortality	Number of deaths assigned to a specific cause during a given time interval	Total number of deaths from all causes during the same time interval	100 or 1,000
Death-to-case ratio	Number of deaths assigned to a specific cause during a given time interval	Number of new cases of same disease reported during the same time interval	100
Neonatal mortality rate	Number of deaths among children < 28 days of age during a given time interval	Number of live births during the same time interval	1,000
Postneonatal mortality rate	Number of deaths among children 28–364 days of age during a given time interval	Number of live births during the same time interval	1,000
Infant mortality rate	Number of deaths among children < 1 year of age during a given time interval	Number of live births during the same time interval	1,000
Maternal mortality rate	Number of deaths assigned to pregnancy-related causes during a given time interval	Number of live births during the same time interval	100,000

4- Natality (Birth) Measures:

Natality measures are population-based measures of birth. These measures are used primarily by persons working in the field of maternal and child health.

Lecture Ten

Methods of Epidemiology

Lecture Ten

Methods of Epidemiology

- Public Health Surveillance
- Disease Investigation
- Analytic Studies
- Program Evaluation.

Epidemiology and Prevention

- Identify high risk populations
- Modify risks
- Prevent exposures.

Disease and levels of prevention:

- The goal of epidemiology is to understand causal factors well enough to devise interventions to prevent adverse events before they start (prevent initiation of the disease process or prevent injury).
- Also the goal of epidemiology is to describe disease pattern, identify etiological factors in disease development and taking the most effective preventive measures.
- Nurses need to understand the levels of prevention because disease occurs over time.
- There are many potential points at which intervention may prevent , or reverse the pathological change.
- A three-levels model developed by (Leavell and Clark, 1965) based on the idea that disease evolves over time continues to be used in the conceptualization and structure of health programs :

1. **Primary prevention** :

- **Primary Involves halting any occurrence of a disease or disorder before it happens.**
- The major thrust of community health in controlling communicable diseases is primary prevention.
- Community health nurses play a vital role in eliminating or reducing the spread of disease.
- There are two approaches that useful :

a. Education: by using mass media for health education, and targeting meaningful
health massage to aggregates .These occur before disease development called primary prevention that involved two types:

1. Health promotion:

- Those actions that are general health promotion in nature and designed to foster healthful and safe environment. e.g. regular exercise lead to positive effect on general , physical and mental health.

2. Specific protection (prevent disease):

- Those measures in the prepathogenesis stage that are designed to improve the health and we; being of the population, aimed at preventing certain risk conditions or disease.
- Community health nurses often play an important role primary prevention programs, such as immunizations general health education, removal of harmful environmental substance, protection from UV rays.
- (Physical activity).
- Health education in primary prevention is directed both at helping at –risk individuals **understand** their risk status and at promoting behaviors that decrease exposure and susceptibility.

b. Immunization: Immunization is the process of introducing some form of disease-causing organism into a person's system to cause the development of antibodies that well resist that disease, this process makes person immune to that particular infectious disease. This is prophylactic measures which aimed at reducing the risk of illness to persons who are already exposed to communicable disease .

2. Secondary prevention.

There are two approaches to secondary prevention of communicable disease (**Health screening and detection activities)**:

a. Screening programs.

- **Screening** is used in community health and disease prevention to describe program that deliver a testing to detect disease in groups of asymptomatic, apparently healthy individuals'. For examples tests such as Venereal Disease Research Laboratory (VDRL), Rapid Plasma Reagent (RPR) and Treponemal test.
- It is important to identify those persons with positive or suspicious who require further medical evaluation or treatment. The screening test must be valid and reliable.
- These measures designs to detect disease at its earliest namely screening and physical examination that are aimed to early diagnosis, early treatment and cure of a disease are secondary prevention e.g. dental caries, mammography general fecal examination secondary prevention is aimed at early detection and prompt treatment either to cure a disease as early as possible or to slow it's progression or complication.

b. Contact investigation, partner notification and case-finding.

- Another secondary prevention approach is known investigation, partner notification and case-finding those how have had contact with

- a person with a communicable disease such as TB and partners in case of STDs.
- Contact investigation is most commonly practice in STDs and TB.
- The community health nurse seeks to discover notify those who have had contact with a person with communicable disease such as with TB and partners in are the case of STDs.
- It is also used in types of foodborne illness outbreak-control efforts.

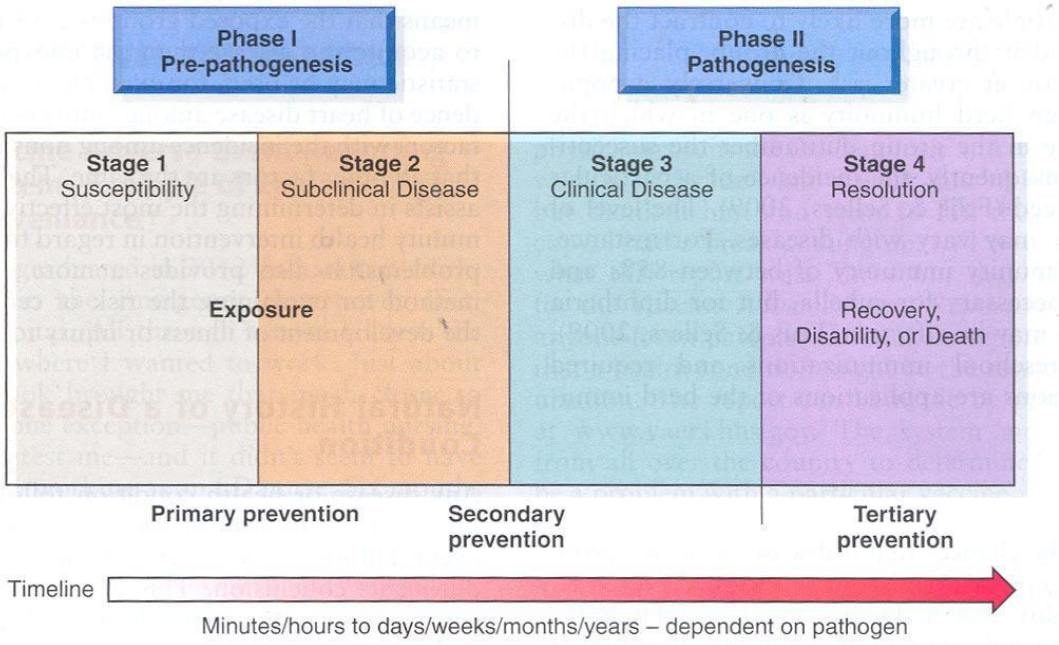
3. Tertiary prevention:

Retard or block the progression of condition

- The approaches to tertiary prevention of communicable disease include isolation and quarantine of the infected and safe handling and control of wastes.

- Tertiary is aimed and includes the limitation of disability in persons in the early stages of disease and at performing rehabilitation for persons of those with irreversible disease or who have experienced a loss of function due to disease process injury.

- Nursing activities include education to prevent deterioration of a person's condition, direct nursing care and referrals to resource that can help patients minimize the loss of function.



Communicable disease control:

• Communicable disease control includes many methods for keeping infected persons and non-infected persons apart to prevent the spread of disease. There are kinds of control measures :

1. Directed toward reducing or eliminating the sources or reservoir of infection.

a. Quarantine and isolation of cases and carriers.

b. Destruction of an animal reservoir of infection.

c. Treatment of sewage to reduce water contamination.

d. Therapy that reduces or eliminates infectivity of the individual.

2. Designed to break the connection between the sources of infection and susceptible individuals. (e.g. include general sanitation measures:

a. Chlorination of water supplies.

b. Pasteurization of milk.

c. Supervision and inspection of food and people who handle food.

d. Destruction of vectors by spraying with insecticides

3. Reduce the number of susceptible individual and raises the general level to herd- immunity by immunization (e.g.) include the following:

a. **Passive immunization** to give a temporary immunity following exposure to pathogen or when a disease threatens to take an epidemic form.

b. **Active immunization** to protect the individual from the pathogen and the host population from the epidemic.

Also other methods to the control of epidemic disease or infectious disease in community:

1. Increasing host resistance as vaccination against (e.g HBV, polio, TB, (passive immune).

2. Reduction of reservoirs and vectors (e.g. ***plasmodium malaria***).

3. Segregation, isolation, and Quarantine. (e.g. nosocomial disease or infected by TB.

4. Health care workers , safe handling and control of infectious wastes

5. Control of infection disease in hospital by using antiseptic disinfection substance.

6. The public health network (e.g. organizations, public health services by WHO.

Table: hospital infection: sources, spread, and control

sources	Routes of spread	Prevention	
Cases and carriers among patients and staff	contact	Washing of hand Not touch technique	No admit once of staff with infection
Ancilling and domestic staff	Droplets	Bed spacing Barrier nursing	
	Airborne dust	Room isolation	Reduce Activity of personal measure to reduce dust certified supplies
		Air filtration unidirectional airflow	
visitors	Food, milk	Sterilization and disinfection	
Other	Apparatus		

Standard precautions: are the infection control actions used for all people receiving care, regardless of their condition or diagnosis. Standard precautions apply to situations in which care providers may contact:

a. Blood, body fluid (except sweat), secretion, and excretions.

b. Mucous membrane

c. Non intact skin

Some examples of secretion and excretion are:

d. Respiratory mucus (phlegm)

e. Cerebrospinal fluid

f. Urine.

g. Feces

h. Vaginal secretion

i. Semen

j. Vomitus.

• This means that all health care workers follow specific procedures, called work practice controls, to prevent the spread of infection. Standard precautious stress hand washing and the use of personal protective equipment (PPF): glove, gown, mask, and goggles or face shield.

Nursing in the control of communicable diseases:

Community health nurses may focus their energies on population groups or on individuals and family members to protecting them from the spreading of communicable diseases. Nurses may be having basic information about communicable diseases, including causative organisms, incubation period, and mode of transmission, symptoms protective measures and the necessary treatments. Immunization is the most effective primary prevention method for controlling communicable diseases. Vaccines and immunization is important not only for children, but also for older adults, the chronically ill, and who are at

increased risk such as nursing or health care workers. It is very imported to received lists of recommended immunization or vaccines administration types as:

1. Hepatitis B vaccine (HBV).
2. Diphtheria and tetanus Toxoids and a cellular Pertusis.
3. Haemophilus influenza type b (HIb) conjugates vaccine.
4. Measles, mumps, and rubella vaccine (MMR).
5. Varicella vaccine.
6. Pneumococcal vaccine.
7. Hepatitis A vaccine.
8. Influenza vaccine.
9. Tetanus and diphtheria vaccine (TD).