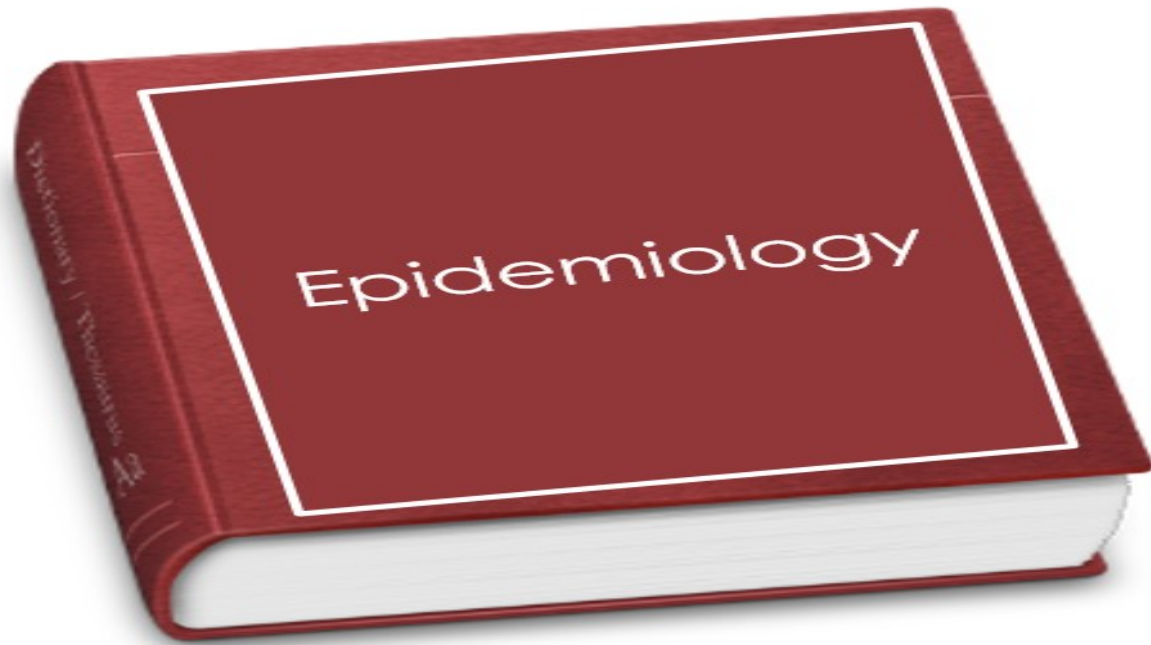




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Ethiopia, 2022*

Epidemiology Topics

Session 1:

Unit 1: Introduction of Epidemiology

Unit 2: Epidemiological concepts of disease causation

Unit 3: Infectious diseases Epidemiology

Session 2:

Unit 4: Basic Measurements of health and diseases and Measures of Association

Unit 5: Epidemiological study designs

Unit 6: Evidence of causality-**Reading assignment**

Unit 7: Sources of epidemiologic data-**Reading assignment**

Session 4:(Presentation topics)

Unit 8: Public health surveillance-**Grpup2**

Unit 9: Screening in disease control-**group1**

Unit 10: Epidemic investigation-**group3**

Session 1:

Unit 1: Introduction of Epidemiology

Definition of Epidemiology

Epidemiology:

- The study of the ***distribution*** and ***determinants*** of ***health and health related events*** in ***human populations***, and the ***application*** of this knowledge for the promotion of health, prevention and control of diseases.

Brief hx of Epidemiology and its contributions

- Some key dates and contributions to the development of epidemiologic thinking and methods;
 - ✓ env'tal factors effects on the disease....by **Hippocrates**(460 B.C)
 - ✓ Quantification of deaths and births ..by **J. Graunt** (1662)
 - ✓ Cholera epidemic controlled before vibrio was identified..by **John Snow** (1854)
- The uses of quantitative methods to study diseases in human populations (modern form);
 - r/ship b/n smoking and lung cancer in 1950 by Doll and Hill(case control study)

Scope of Epidemiology

- ❖ The use of epidemiology in advancing health sciences and improving public health practices has been greatly expanded in the last few decades.

Genetic markers of disease risks

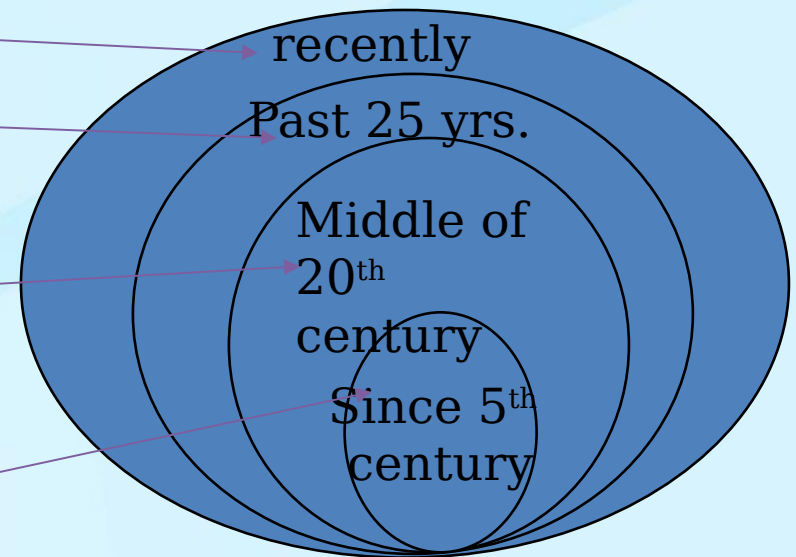
Health related behavior

Chronic diseases, injuries, birth defects

MCH, Env'tal and Occupational health

Endemic communicable diseases & Non communicable diseases

epidemic of communicable diseases



Branches of Epidemiology

1. Descriptive Epidemiology

- concerned with describing the frequency and distribution of diseases and other health related conditions by time, place, and person.
- It asks the questions: **who? Where? When?**

2. Analytical Epidemiology

- deals with the causes or determinants of diseases
- It asks the questions: **How? Why?**

Purposes/use of Epidemiology:

- ✓ Community health diagnosis/describe health status
- ✓ Completing the clinical picture (elucidation of the natural hx of diseases)
- ✓ Search for and identify causes or determinants of diseases
- ✓ Classification of diseases
- ✓ Guide health and healthcare policy, planning and Monitoring of health programs

Basic Epidemiologic Assumptions

A. Human disease does not occur at random:

- Disease is not randomly distributed throughout a population
- Epidemiology uses systematic approach to study the differences in disease distribution in subgroup
- Why certain individuals/group acquire disease and others not?

B. Human disease has causal and preventive factors:

- Identifying/developing a particular disease among group of individuals or group of individuals within a population in different places or times.
- Allows for study of causal and preventive factors

Unit 2: Concepts of Disease Causation

Objectives of learning this section

After successfully completion of this session the students will be able to:

- Define health, disease and causes
- Describe theories and models in disease causation
- Explain causal r/ships and classification of risk factors

What is a cause?

Definition:

- The cause of a disease is **an event, condition or a characteristic** that **precedes the disease event** and without which the disease event either would not occurred at all or would not have

occurred until some later time.

What does cause disease? or how disease is caused?

There are different theories :

- Supernatural
- Hippocratic
- Single germ
- Classic epidemiologic
- Multifactorial causation

Supernatural theory :

- the disease was mainly due to either the curse of God or evil force of the demons (early thought)
- At least 10% of the people in developed countries and 30% in developing countries still believe in this view
- This view might be obstacles in disease control
- Most of the literates view that disease is the result of microbes

Hippocratic theory :

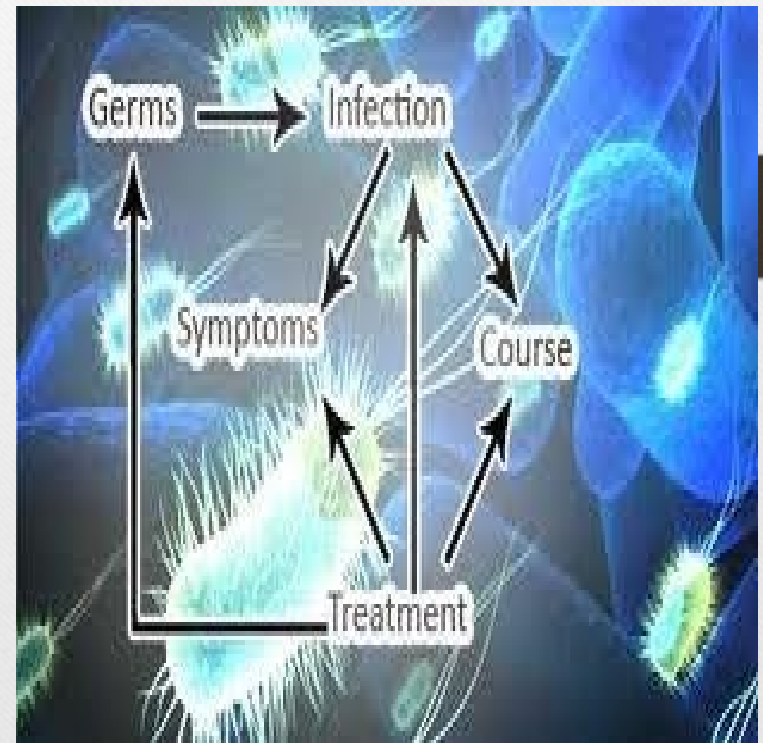
- Stated by Hippocrates
- Rejected superstitions and beliefs that credited supernatural or divine forces with causing illness.
- The discipline of medicine was separated from religion
- The disease was the product of environmental factors, diet and living habits

THE SINGLE GERM THEORY:

- Each disease will be caused by a germ and Without that germ that disease will not be caused
- The mere existence of microorganism in an individual is sufficient for the development of the Ds
- Also called HENLE-KOCH POSTULATES or pure determinism

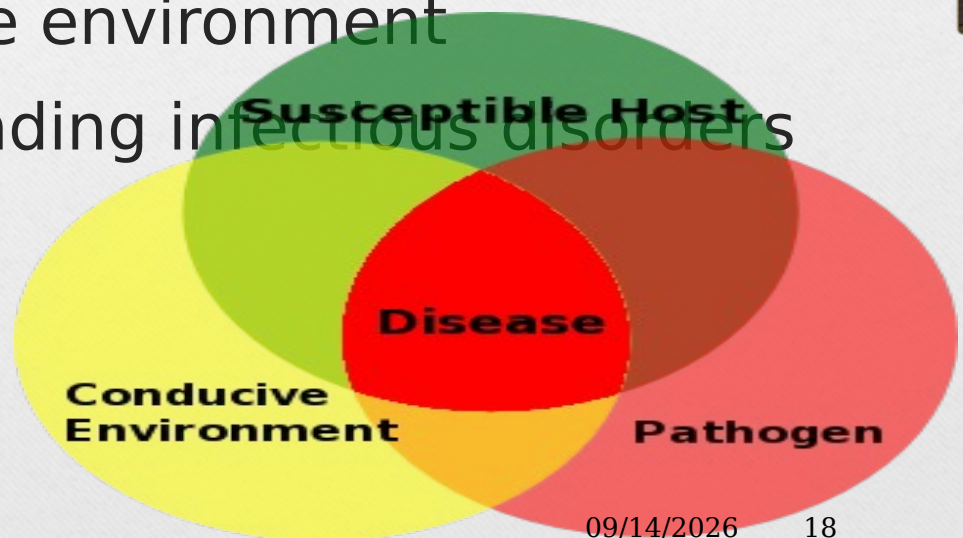
Germ theory...

- Health problems were believed to be the product of living organisms which entered the body through food, water, air or the bites of insects or animals.
- It was believed that each disease has a single and a specific cause (mono-causal approach or unifactorial theory)



Classic Epidemiologic Theory:

- Exposure to an agent does not necessarily lead to disease
- Disease is the result of an interaction between agent, host and the environment
- useful in understanding infectious disorders



Multifactorial causation theory:

- Pettenkoffer contradicted the unifactorial theory of disease causation and emphasized that disease is Multifactorial in causation
- Several causes or factors acting jointly, cumulatively, by complementing or in an unexplained manner will lead to the disease
- These factors may promote or inhibit the disease at more than one point in the causal process.
- prevention offers a better prospects for health than cure

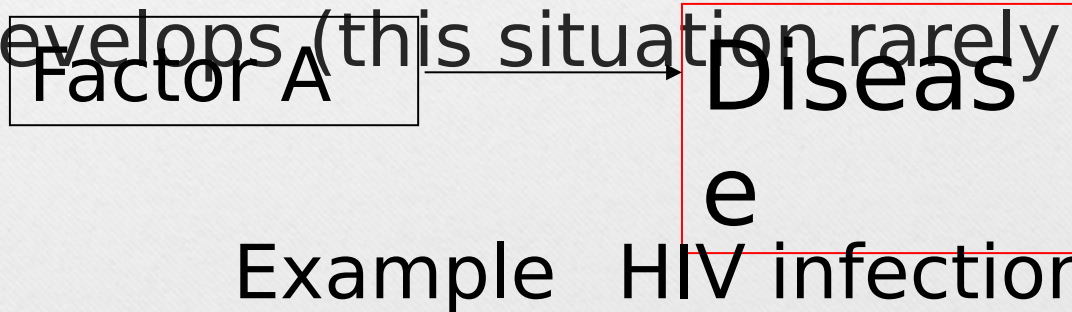
Causal Relationships:

- A causal pathway may be direct or indirect with or without intermediate effect
- There are **four** types of causal relationship in disease causation;
 1. Necessary and sufficient cause
 2. Necessary but not sufficient cause
 3. Sufficient but not necessary cause
 4. Neither sufficient nor necessary cause

Types of Causal Relationships

1. Necessary and sufficient cause:

– without the factor, disease never develops; with the factor, disease always develops (this situation rarely occurs).



Types...

2. Necessary but not sufficient cause

- The factor in itself is not enough to cause disease
- Multiple factors including main factor are required, usually in a specific temporal sequence

E.g.: development of tuberculosis required M. tuberculosis, other factors, malnutrition, genetic factors, crowded housing poverty and so on.

Factor A +
Factor B +
Factor C

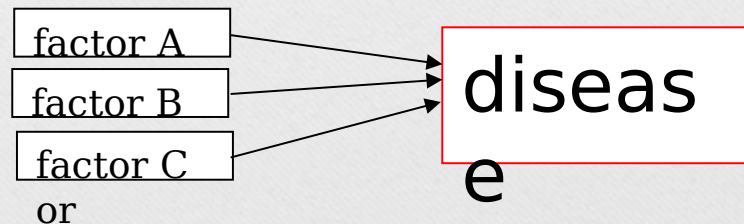
Disease

Types

3. Sufficient but not necessary cause

- the factor alone can cause disease, but so can other factors in its absence.

E.g.: sun can cause burn without the presence of the other factor such as fire



Types...

4. Neither sufficient nor necessary cause:

- the factor cannot cause disease on its own, nor it is the only factor that can cause that disease.
- This is the probable model for chronic disease relationships.

- *E.g.:* High fat diet and heart disease, hypertension, diabetes and so

Risk Factors in causation of diseases

Four types of risk factors

- *not the necessary causes of disease
- *associated with increased or decreased occurrence of a disease for the exposed/non group
- *related to the agent, the host and the environment.

Types of risk factors in causation of diseases...

1. Predisposing factors:

- create a state of susceptibility to the disease agent.

E.g; age, sex and previous illness

2. Enabling factors: favor the development of disease or an out come of illness/circumstances that assist in recovery from illness.

Examples: low income, health insurance coverage...

Factors in causation of diseases...

3. Precipitating factors:

- are those associated with the definitive onset of a disease.
- *E.g:* exposure to specific disease, amount or level of an infections organism,

4. Reinforcing factors:

- are those tending to perpetuate or aggravate the presence of a disease, disability, impairment, attitude, pattern of behavior, or course of action.

E.G; repeated exposure to the same noxious stimulus

DISEASE MODELS:

- Models are purposely simplified representations and used is to facilitate the understanding of nature, which is complex.
- There are different disease causation models:
 1. The epidemiologic triangle- suitable for Infectious disease
 2. The web of causation model-for chronic disease
 3. The wheel model- depend upon the specific disease under consideration

1. Epidemiologic triangle / TRIAD (Balance beam)



- ✓ The epidemiologic triangle consists of three components -host, environment, and agent.
- ✓ A change in any of the components will alter an existing equilibrium to increase or decrease the frequency of the disease.

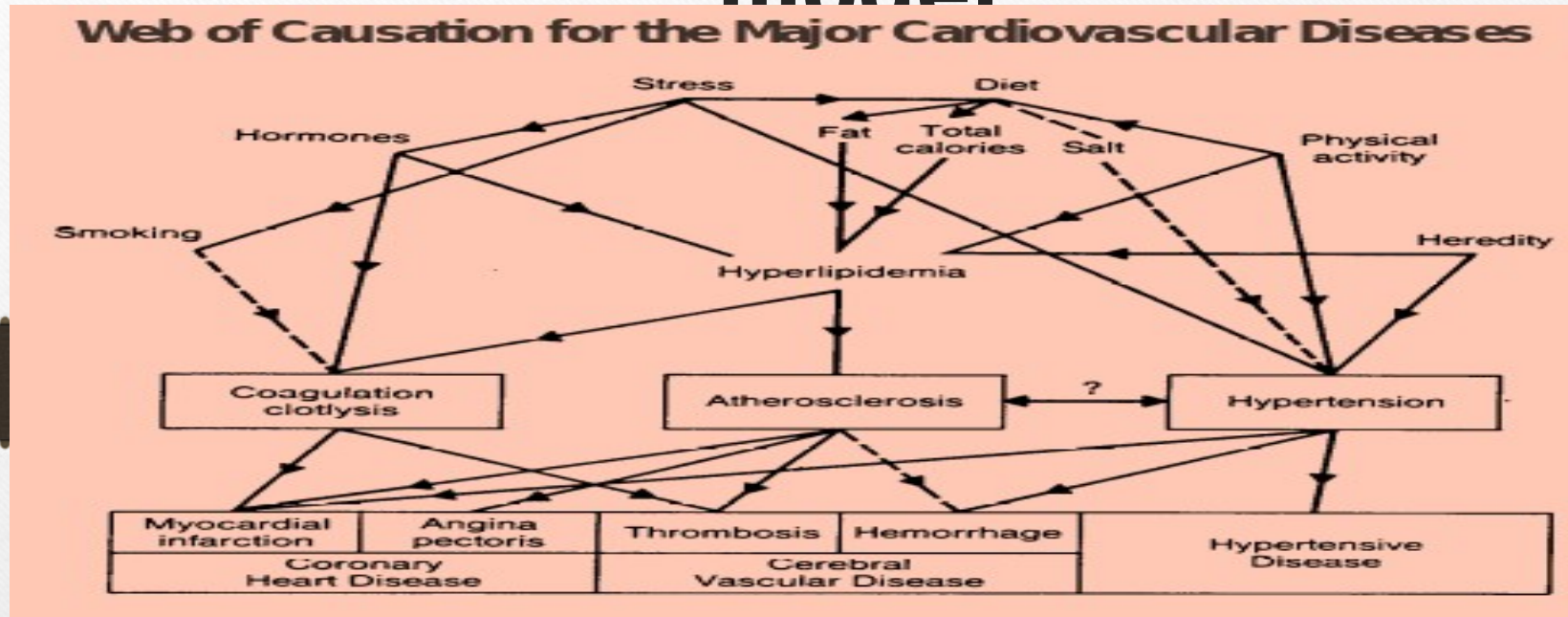
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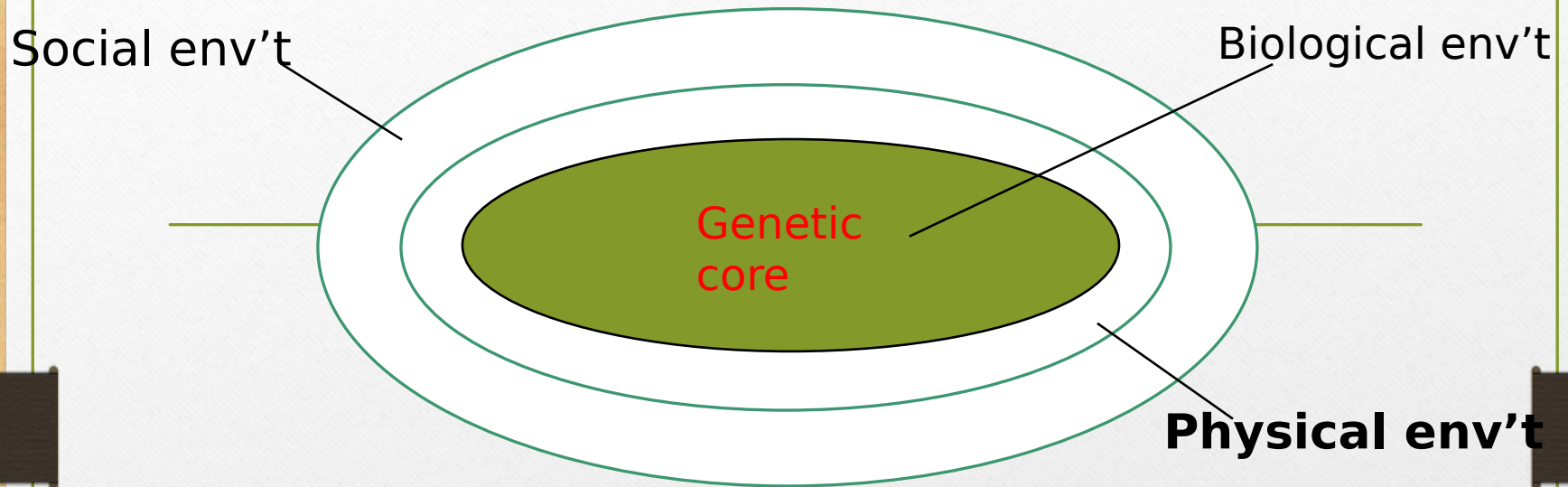
- ✓ This model holds true for infectious disease which has specific agent as

2. The web of causation model:



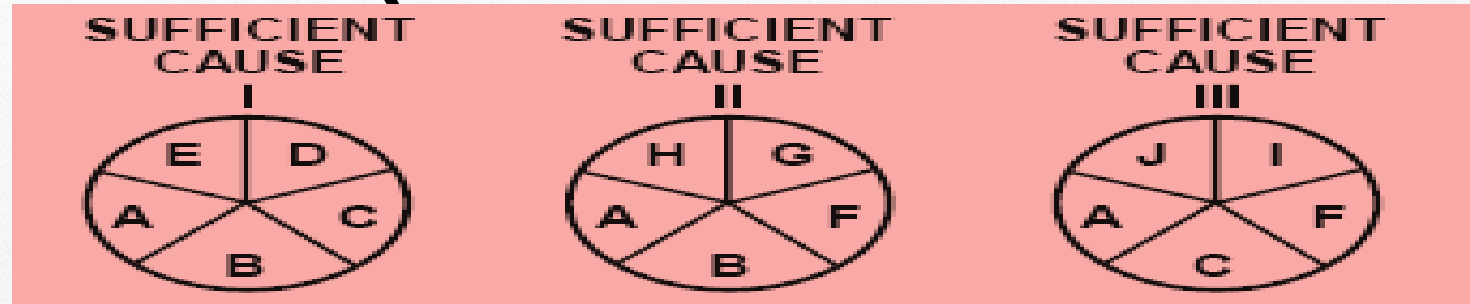
- This complexity that generates disease or leads to injury is better portrayed in this model
- It was especially developed to enhance understanding of *chronic diseases*

3. THE WHEEL MODEL:



- The wheel consists of a hub (the host or human), which has genetic make-up as its core.
- The relative sizes of the different components of the wheel depend upon the specific disease under consideration.
- For hereditary disease, the genetic core would be relatively large.

4. The causal pie model (Rothman's causal Pie model)



- Take into account multiple factors which are important in causation of disease
- Illustrates the factors that act to cause disease as pieces of a pie, the whole pie making up the sufficient for a disease.
- factors are represented by pieces of the pie called component causes
- **All factors** (component causes) together form the sufficient cause while component cause **A** constitutes the necessary cause

Unit 3: Infectious disease Epidemiology

Objectives of learning this section

After successfully completion of this session the students will be able to:

- ✓ Define communicable/infectious disease and some common terms in communicable disease
- ✓ Explain the Natural hx of disease
- ✓ Discuss the components of infectious process
- ✓ Discuss the level of disease prevention

Infectious diseases/communicable disease

Infectious diseases;

- ✓ is an illness due to a specific infectious agent or its toxic products
- ✓ continue to account for a major proportion of acute illnesses
- ✓ characterized by the presence of the infectious agent in addition to susceptible human population
- ✓ arises via transmission of that agent or its products from an infected person, animal, or reservoir to a susceptible host, either directly or indirectly

Natural history of disease:

- ✓ It refers to the progression of disease process, in the absence of intervention.
- ✓ It begins with exposure to causative agent capable of producing disease.
- ✓ Without intervention, the process ends with recovery, disability or death
- ✓ Halted at any time in the progression by intervention, host factors, other influences

Natural history of disease...

There are four stages in the natural history of a disease.

- 1. Stage of Susceptibility**
- 2. Presymptomatic disease stage**
- 3. Clinical disease stage**
- 4. Stage of Disability or death**

Natural hx ...

1. Stage of Susceptibility:

- disease has not yet developed, but the groundwork has been laid by the presence of factors that favor its occurrence.
- Susceptible person is lacking sufficient resistance to particular pathogenic agent to prevent disease if or when exposed.
- *E.g.:* unvaccinated child is susceptible to measles.

Natural hx...

2. Presymptomatic disease stage:

- ✓ no manifestations of the disease but pathologic changes (damages) have started to occur in the body
- ✓ extending from the time of exposure to onset of disease symptoms, is usually called the **incubation period** for infectious diseases,
- ✓ Most screening programs attempt to identify the disease process during this phase
- ✓ The disease can only be detected through lab or special tests

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Eg. Ova of intestinal parasite in the stool of apparently healthy

Natural hx...

3. Clinical disease stage:

- the person has developed signs and symptoms of the disease.
- Marked with the onset of symptoms and most diagnoses are made during the stage
- The clinical stage of different diseases differs in duration, severity and outcome.
- The outcomes of this stage may be recovery, disability or death.

- E.g. Common cold has a *short* and *mild* clinical stage and almost everyone *recovers* quickly

Natural hx...

4. Stage of Disability or death:

- Disability is limitation of a person's activities including his role as a parent, , etc
- Some diseases run their course and then resolve completely either spontaneously or by treatment.
- In others, the disease may result in a residual defect(disabled). Still, other diseases will end in death.

Eg. Trachoma may cause blindness

Natural hx...

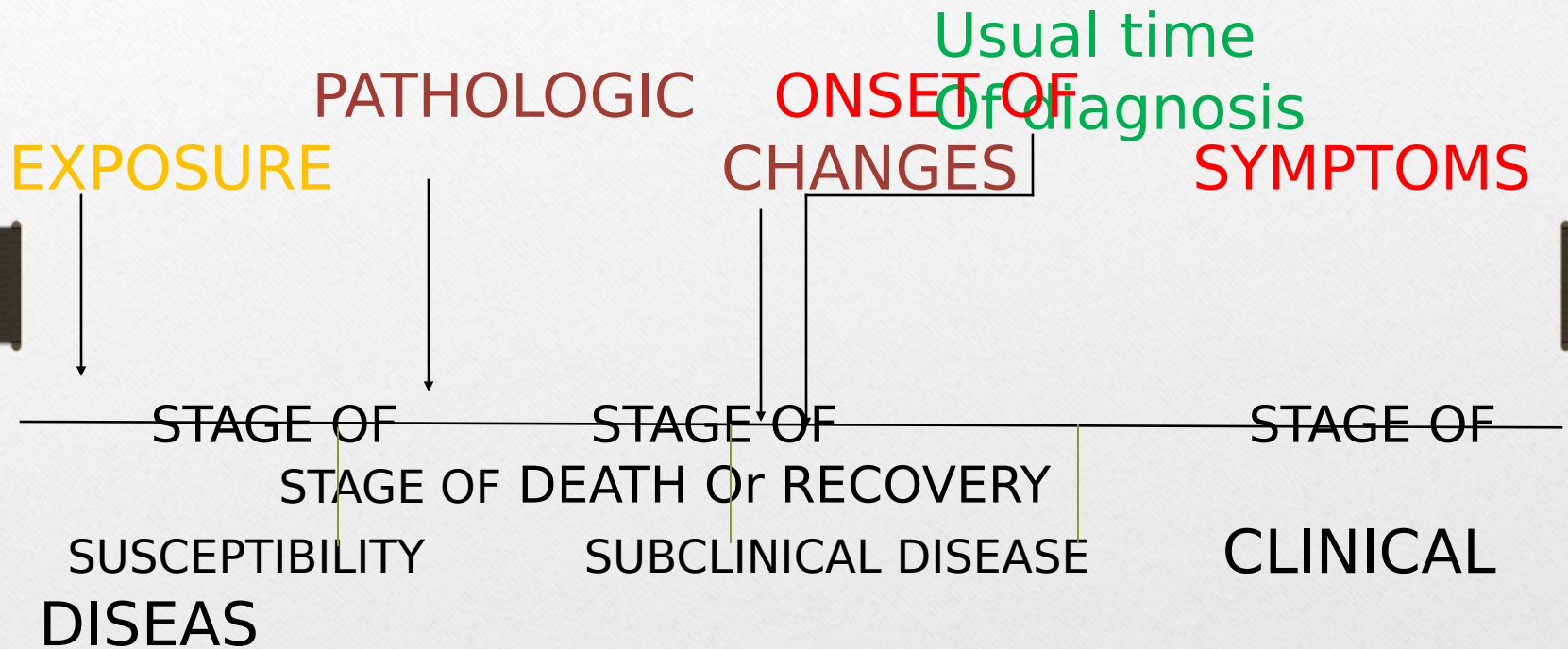


Fig. NATURAL HISTORY OF DISEASE_Source: Centers for Disease Control and Prevention. Principles of epidemiology, 2nd ed. Atlanta: U.S. Department of Health and Human Services;1992

Components of the infectious process

- Infection is the entry and development or multiplication of an infectious agent in the host.
- Infection is not equivalent to disease, as some infections do not produce clinical disease.
- A model used to understand the infection process is called **the chain of infection or transmission cycle**
- Understanding the characteristics of each link provides with methods to prevent the spread of infection.

Components...

Six components:

1. Causative Agent
2. Its reservoirs
3. Its portal of exits
4. Its mode of transmission
5. Its portals of entry
6. The susceptible host

1. Infectious agent/etiology

- originally referred to an infectious microorganism or pathogen: a virus, bacterium, parasite, or other microbe.
- Also include chemical and physical causes of disease or injury
- In order to survive the agent must be able to:
 - **Multiply**
 - **Emerge from the host**
 - **Reach the new host**
 - **Infect the new host**

Infectious agent/etiology...

- Generally, the agent must be present for disease to occur; however, presence of that agent alone is not always sufficient to cause disease.
- A variety of factors(eg. agent, host and env'tal) influence whether exposure to an organism will result in disease,
- The specific characteristics of each agent are important in determining the nature of the infection, which is determined by such factors as:

Infectious agent/etiology...

- **The pathogenicity of the agent:** its ability to produce disease, measured by the ratio of the number of persons developing clinical illness to the number exposed.
- **Virulence:** a measure of the severity of disease, which can vary from very low to very high which is measured by the proportion of clinically apparent cases that are severe or fatal.
- **Infective dose:** the amount required to cause infection in susceptible subjects measured by the proportion of exposed persons who become infected.

2. **Reservoir**

- is the person or animal, arthropod, plant, soil or substance which is the habitat in which the agent normally lives, grows, and multiplies
- may or may not be the source from which an agent is transferred to a host.
- Agents with a human reservoir include measles, mumps, and most respiratory pathogens.
- Human reservoirs may be persons with symptomatic illness, or carriers.

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- A carrier is a person without apparent disease who is nonetheless capable of transmitting the

Reservoir...

❖ Carriers may be:

- ✓ **Asymptomatic carriers** (transmitting infection without ever showing signs of the disease), E.g. Polio
- ✓ **Incubatory carriers** (transmitting infection by shedding the agent before the onset of clinical manifestations), E.g. Measles
- ✓ **Convalescent carriers** (transmitting infection after the time of recovery from the disease). E.g. Typhoid fever
- ✓ **Chronic carriers** shed the agent for a long period of time or even indefinitely E.g. Viral

3. Portal of exit

- is the path by which a pathogen leaves its host.
- usually corresponds to the site where the pathogen is localized.
- Through respiratory tract(tubercle bacilli and influenza viruses), feces(cholera vibrio), placenta(syphilis) ,way of the skin through cuts or needles (hepatitis B) or blood-sucking arthropods (malaria)...etc

4. Mode of Transmission

After an agent exits its natural reservoir, it may be transmitted to a susceptible host in numerous ways.

1. Direct transmission; an infectious agent is transferred from a reservoir to a susceptible host by direct contact or droplet spread.

2. Indirect transmission; refers to the transfer of an infectious agent from a reservoir to a host by suspended air particles (air born; dust and droplet nuclei), inanimate objects (vehicle born), or animate intermediaries (vector born; Biological and mechanical).

5. Portal of entry

- It refers to the manner in which a pathogen enters a susceptible host.
- It must provide access to tissues in which the pathogen can multiply or a toxin can act.
- Often, infectious agents use the same portal to enter a new host that they used to exit the source host
- fecal-oral” route, skin (hookworm), mucous membranes (syphilis), and blood (hepatitis B, human immunodeficiency virus)

6. Susceptible host

- Host- a person or animal that harbors an infectious agent under natural conditions.
- The final link in the chain of infection
- Susceptibility of a host depends on genetic or constitutional factors, specific immunity and nonspecific factors that affect an individual's ability to resist infection or to limit pathogenicity.

Susceptible host...

- The chain of infection may be interrupted if the agent does not find a susceptible host.
- Host resistance at the community (population) level is called ***herd immunity***
- The concept of **herd immunity** suggests that if a high enough proportion of individuals in a population are resistant to an agent, then those few who are susceptible will be protected by the resistant majority, since the pathogen will be unlikely to “find” those few susceptible individuals.

Susceptible host...

Immunity may be;

1. Active immunity

- requires stimulation of Antibody production
- response to many infections
- induced by most vaccine
- Long lasting

2. Passive immunity

- presence of antibody without stimulation of production
- maternal antibodies
- Immunoglobulins injections
- Transient

Spread of Disease in community

➤ Person to person transmission is one of the main methods of disease spread in a community and is dependent on:

1. Generation time: the period between exposure/infection and the maximum communicability of the exposed host regardless of whether the disease is apparent or inapparent.
2. Herd immunity: refers to a community resistance to spread of an infectious agent as a result of immunity gained by high proportion of individual members of the

Spread of Disease...

- Secondary AR = New cases among contacts of index cases during the period over total number of contacts with the index cases
 - * The index cases are excluded from both numerator and denominator.
 - * Index case: The case that brings a household or any other group (community) to the attention of the

LEVELS OF DISEASE PREVENTION:

- The major purpose in investigating the epidemiology of diseases is to learn how to prevent and control them.
- Disease prevention means to interrupt or slow the progression of disease.
- Epidemiology plays a central role in disease prevention by identifying those modifiable causes

level...

There are three levels of prevention

1. Primary prevention

➤ is defined as those measures provided to individuals to prevent the onset of a targeted condition.

- Objective is to:
 - promote health,
 - prevent exposure and
 - prevent disease.

➤ has 3 components

Primary...

- **Health promotion:** non-specific interventions that enhance health and the body's ability to resist disease;
- **Prevention of exposure:** provision of safe and adequate water supply, proper excreta disposal, of vector control, of safe environment, etc.
- **Prevention of disease:** during incubation/latency period, b/n exposure and biological onset, such as immunization.

2. Secondary Prevention:

- Secondary Prevention:

- is described as measures as those that “identify and treat asymptomatic persons who have already developed risk factors or preclinical disease but in whom the condition is not clinically apparent.

Objective:

- is either to stop or to slow the progression of disease so that to prevent or to limit permanent damage, through the early detection and treatment of disease.

Secondary...

Examples;

- Prevention of blindness from Trachoma
- Early detection and treatment of breast cancer to prevent its progression to the invasive stage, which is the severe form of the disease.

3. Tertiary Prevention:

It is limitation of disability and rehabilitation.

Objective:

- Treatment to prevent further disability or death
- to limit the physical, psychological, social and economical impact of disability.
- ❖ activities involve:
 - ✓ the care of established disease, with attempts made to restore to highest function,
 - ✓ minimize the negative effects of disease, and prevent disease-related complications.

Tertiary...

Eg1:

- When a person becomes blind due to vitamin A deficiency, tertiary prevention (*rehabilitation*) can help the blind or partly blind person learn to do gainful work and be economically self supporting.

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Eg2. Leprosy

Thank you!!!