Lecture:5
Epidemiological model

Prof. Dr. Ridha. M. Lefta

Community health nursing

An epidemiological model

is usually defined as ‘a mathematical and/or logical representation of the epidemiology of disease transmission and its associated processes’. These quantitative models provide a representation of the transmission dynamics of animal diseases among animals, and/or among groups of animal in time and/or space.

An epidemiological model therefore facilitates the evaluation of the efficacy of the potential control measures and provides estimates of the future magnitude, duration and geographical extent of an outbreak given the application of specific control measures.

Epidemiologic Models

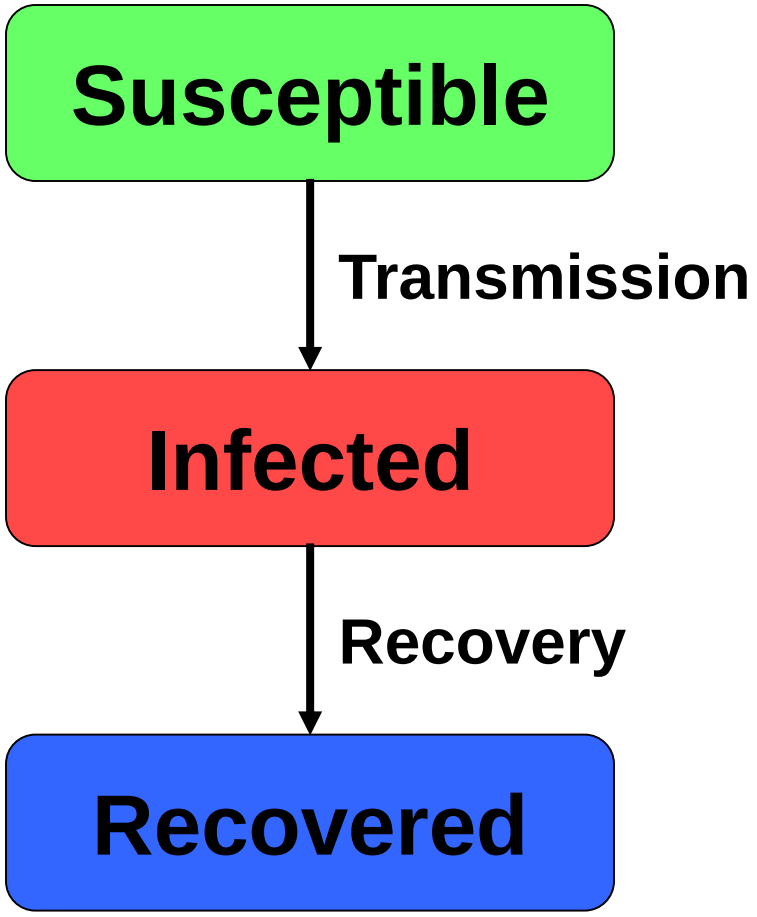
Both nurses and epidemiologists use epidemiologic information to direct interventions to control health-related conditions or event. Determining appropriate control strategies often involves collecting large amounts of data about multiple factors that may be contributing to determine health event.

The modeling of infectious diseases is a tool which has been used to study the mechanisms by which diseases spread, to predict the future course of an outbreak.

Objective of epidemiological model is To understand the system of transmission of infections in population; To help interpret observed epidemiological trends.

Model

Everyone starts here:
not yet infected



These people are unwell
and can infect others

People recover & become
immune to infection

Need to make assumptions about how people mix together.

Modelling can contribute to better disease control through

- retrospective analysis of past outbreaks and evaluation of different control strategies;
- exploration of different strategies in hypothetical outbreaks (contingency planning);
- exploration of the resource requirements of different strategies in hypothetical epidemics (resource planning);
- risk assessment to identify priority areas, those that might be at greater risk to better target preparedness and surveillance activities;

- evaluation of the effectiveness of various surveillance strategies; underpinning economic impact studies;
- provision of realistic scenarios for training exercises and communication of principles of epidemiology and disease control;
- provision of tactical support during epidemics through analysis and hypothesis testing – although with caution

Types of epidemiological model

For this reason, it is helpful to have a model or framework to direct the collection and interpretation of these data.

We explore three

1. **epidemiologic models (tringle)**
2. **the web of causation model,**
3. **determinants-of-health models.**

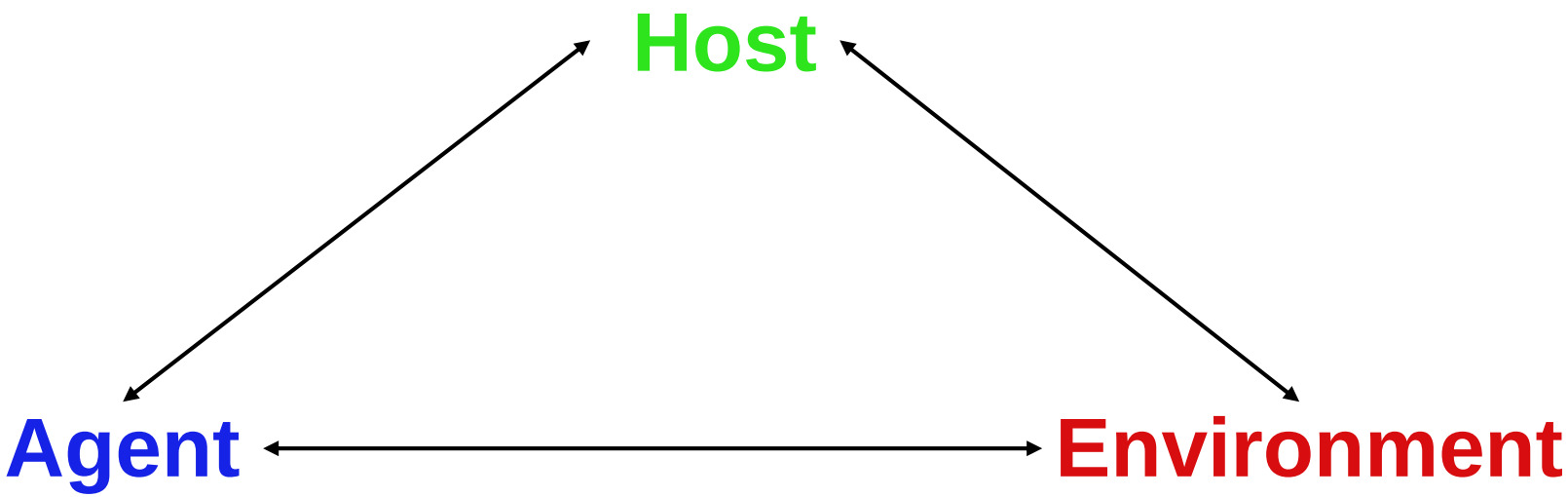
1. the epidemiologic triad or The Epidemic Triangle

- The epidemic or epidemiologic triangle is a conceptual model that we will use to reinforce the idea that infection in an individual or population depends on the interactions of the agent with environmental factors and host factors.

- We often focus on the infectious organism, or agent, as the cause of infectious disease. However, for most infections factors specific to the host and environment are equally necessary.

The Epidemic Triangle

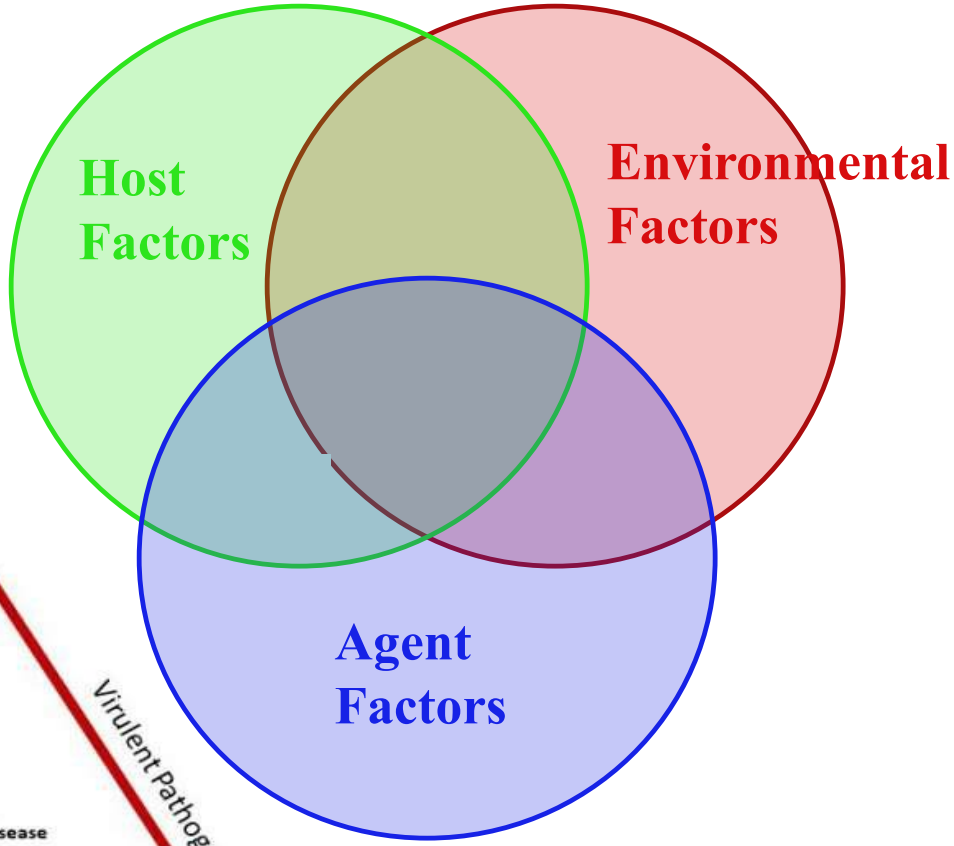
A helpful conceptual model to frame our thoughts about infectious diseases

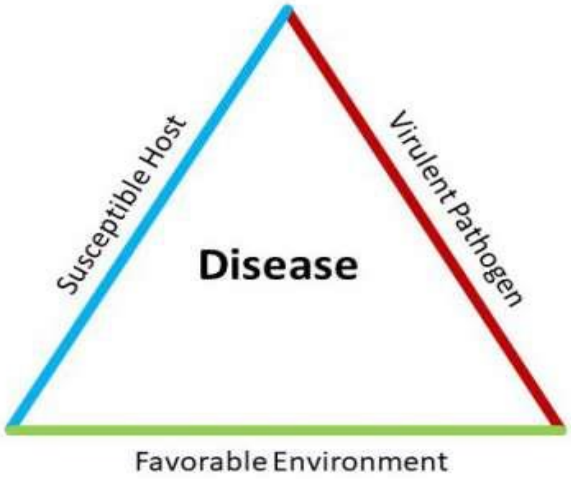


The Epidemiologic Triangle

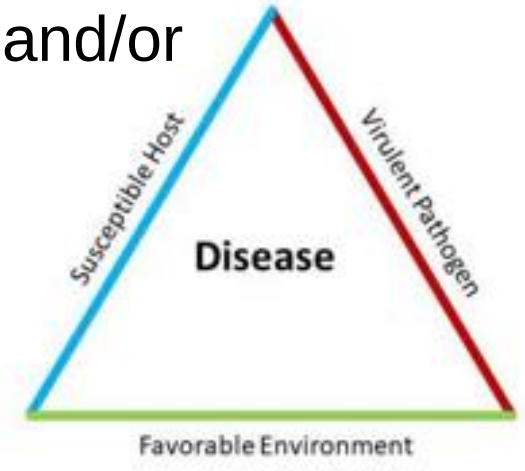
A Multi-Causal Model

- Agent, Host, and Environment interact
- This interaction is a necessary cause for infection to occur





Infectious diseases host factors : are factors that may determine how likely it is a given host will get an infection and/or how severe disease will be in the host.



- Overall health
- Immune status
- Age
- Comorbidities and underlying health conditions
- Nutrition
- Genetics

others Host Factors

- Genetic

- Personal characteristics
- Personal behavior
- Definitive versus intermediate (in vector-borne diseases)

Main Infectious Disease Agents (types of pathogen)

- **Viruses**: smaller than bacteria. They aren't even a full cell. They are simply genetic material (DNA or RNA) packaged inside of a protein coating
- **Bacteria**: are tiny, single-celled organisms that get nutrients from their environments.
- **Protozoans**: are one-celled organisms, like bacteria. But they are bigger than bacteria and contain a nucleus and other cell structures, making them more similar to plant and animal cells.
- **Fungi**: are multicelled, plant-like organisms. A fungus gets nutrition from plants, food, and animals in damp, warm environments

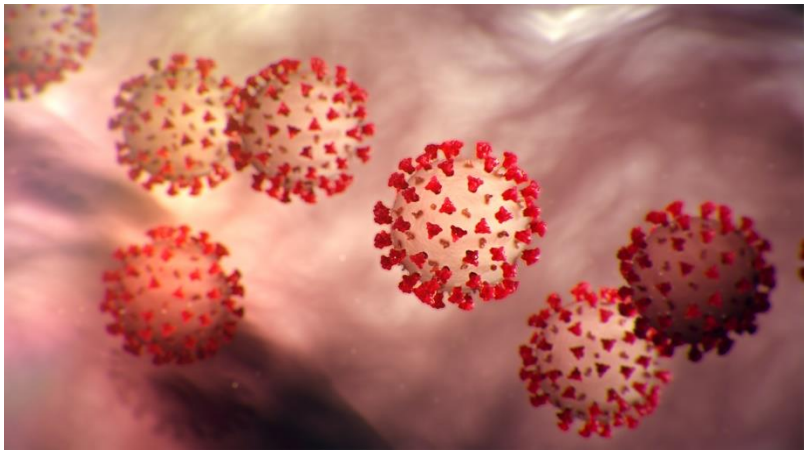
parasite: is an organism that lives on or in a host and gets its food from or at the expense ... Some parasitic diseases are easily treated and some are not

Infectious Disease Basics

- **Infection** - The invasion of a susceptible host by an infectious agent. Usually implies a relationship where the agent's benefit comes at the expense of the host

- **Infectious** - Usually refers to an infected host who is capable of *transmitting infection* to other susceptible hosts

- **Infectious Disease** - A set of physical and clinical symptoms present in an infectious host. These symptoms can result from direct pathology caused by the agent.



Coronavirus is an infectious agent (pathogen)

Another example: Infected, infectious and diseased= a rabid dog

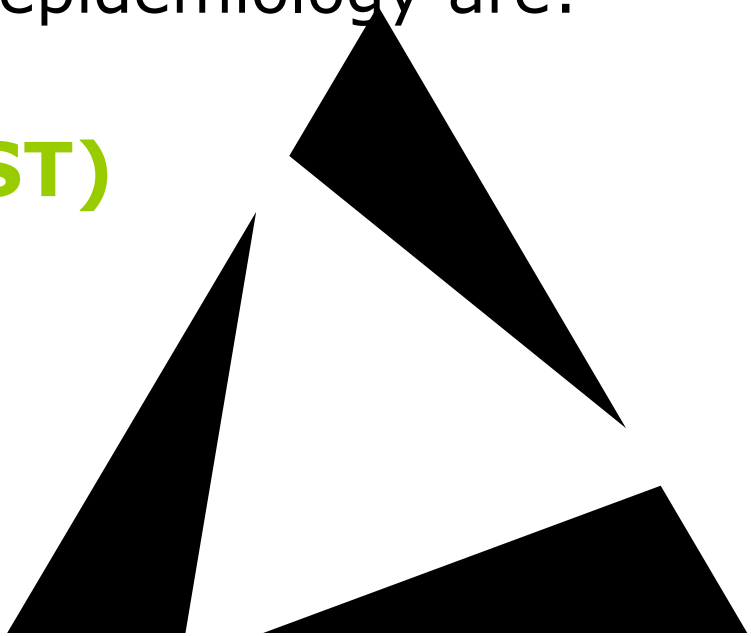
classification of Agents

- Biological (micro-organisms)
- Physical (temperature, radiation, trauma, others)
- Chemical (acids, alkalis, poisons, tobacco, others)
- Environmental (nutrients in diet, allergens, others)
- Psychological experiences

Basic Triad of Descriptive Epidemiology

the three essential characteristics of disease we look for in descriptive epidemiology are:

- **PERSON (HOST)**
- **PLACE**
- **TIME**



Personal Characteristics (whom)

- Age
- Gender
- Socio-economic status (education, occupation, income)
- Marital status
- Ethnicity/race/genetic profile
- Behavior / habits

Place (where ?)

- Geographically restricted or widespread (outbreak, epidemic, pandemic)?
- Climate effects (temperature, humidity, combined effects..)
- Urban / sub-urban-squatter / rural
- Relation to environmental exposure

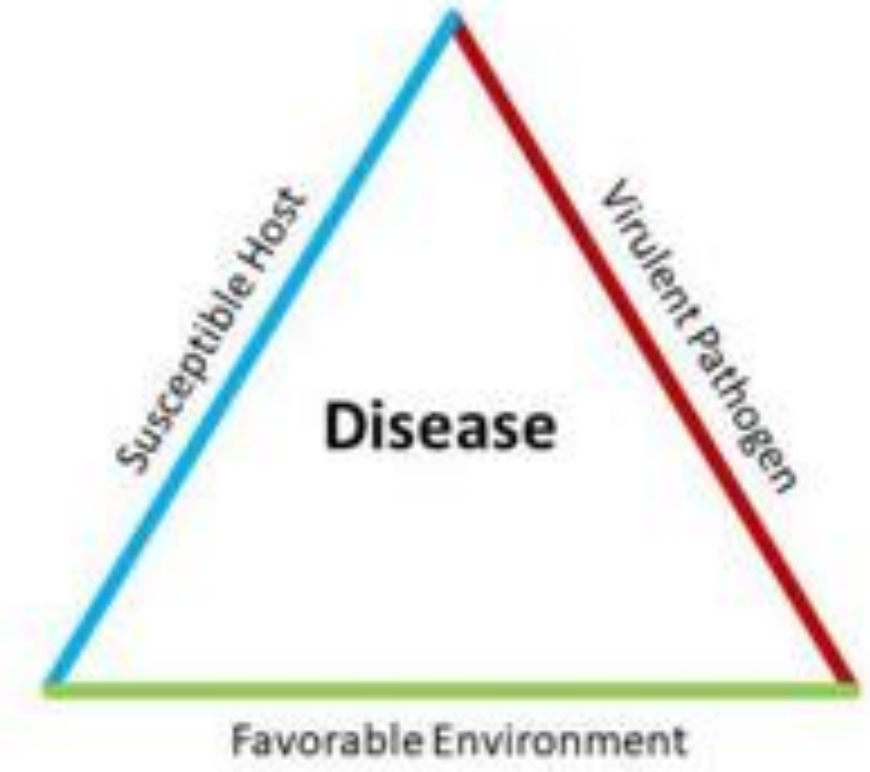
(water, food supply, etc)

Time (when ?)

- Changing or stable?
- Clustered (epidemic) or evenly distributed (endemic)?
- Time-trends: Point source, propagated, seasonal

The Environment

- Physical environment
- Climactic conditions
- Ecology
- Geography
- Social environment
  - Poverty
  - Demographics
  - Urban Crowding
- Agent environment
  - Changes in microflora can tip the competitive balance and cause once harmless organisms to flourish and cause disease



Environment

- Modes of communication: phenomena in the environment that *bring host and agent together*, such as: vector, vehicle, reservoir, etc)

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. In this model, factors are explored in terms of their interplay, and both direct and indirect causes of the problem are identified.

The web of causation approach allows the epidemiologist to map the interrelationships among factors contributing to the development (or prevention) of a particular health condition.

3. Determinants of health model

determinants of health are categories of factors that influence health and illness. Emphasis on broad determinants of health and illness marks a change from individually focused explanations of disease to a focus on social and environmental contributions to health and illness.

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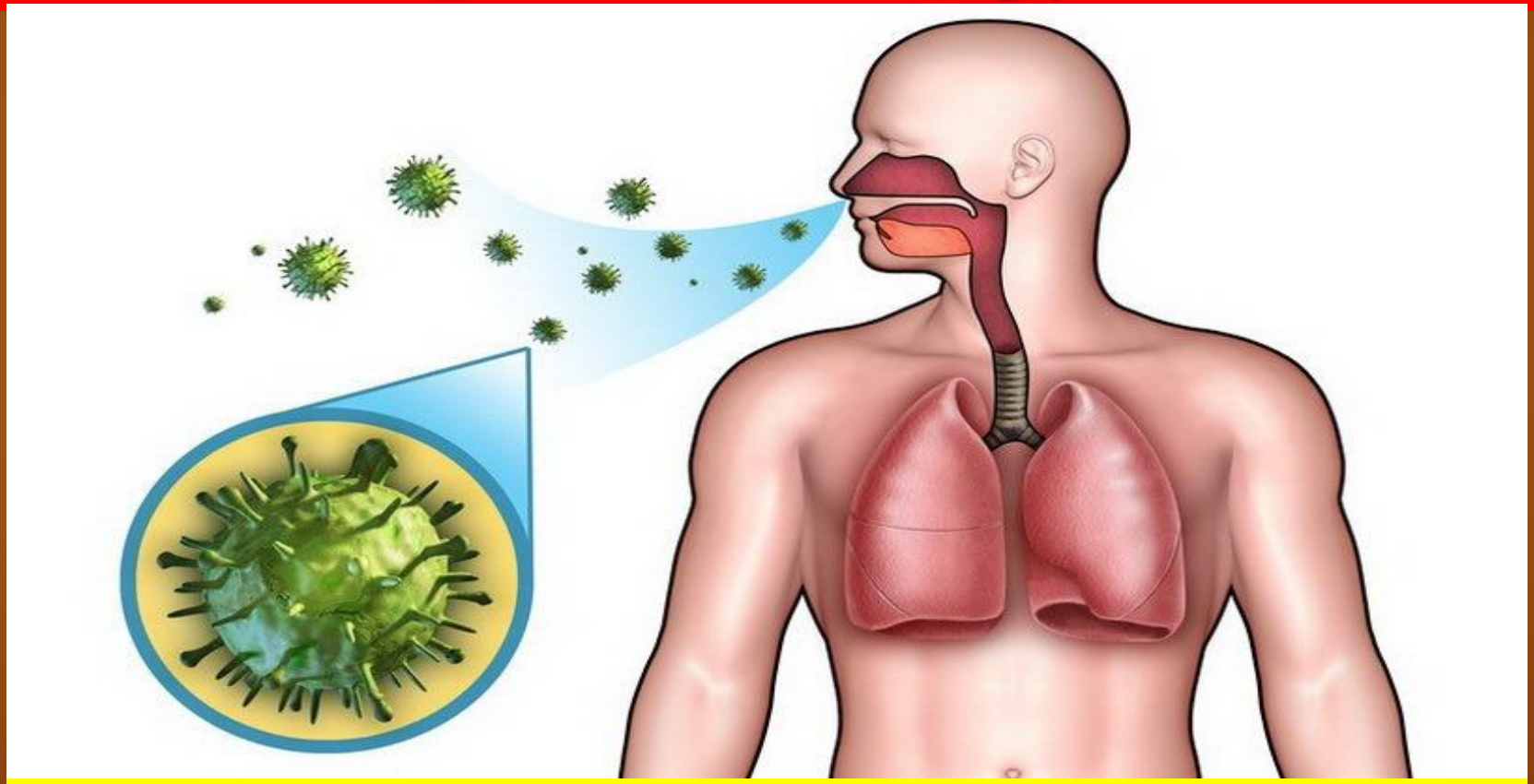
Social determinants of health (SDOH) have a major impact on people's health, well-being, and quality of life. Examples of SDOH include:

Safe housing,
transportation,
and neighborhoods.
Racism,
discrimination,
and violence.

lecture: 6 Infection process Epidemiology



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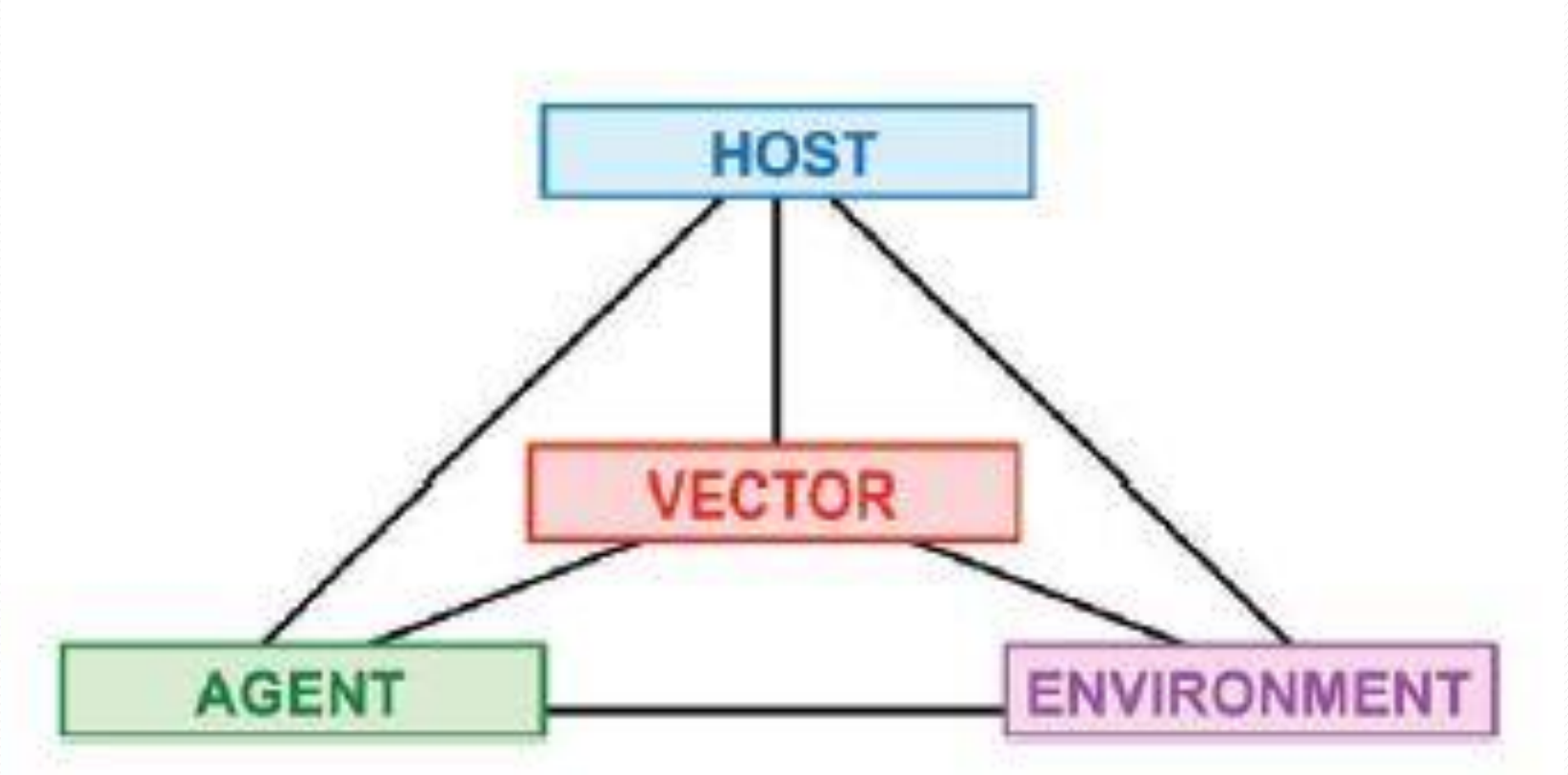
Learning Objectives

At the end of this lecture the student is expected to:

A. Discuss the components of infectious process
B. Describe different modes of disease transmission

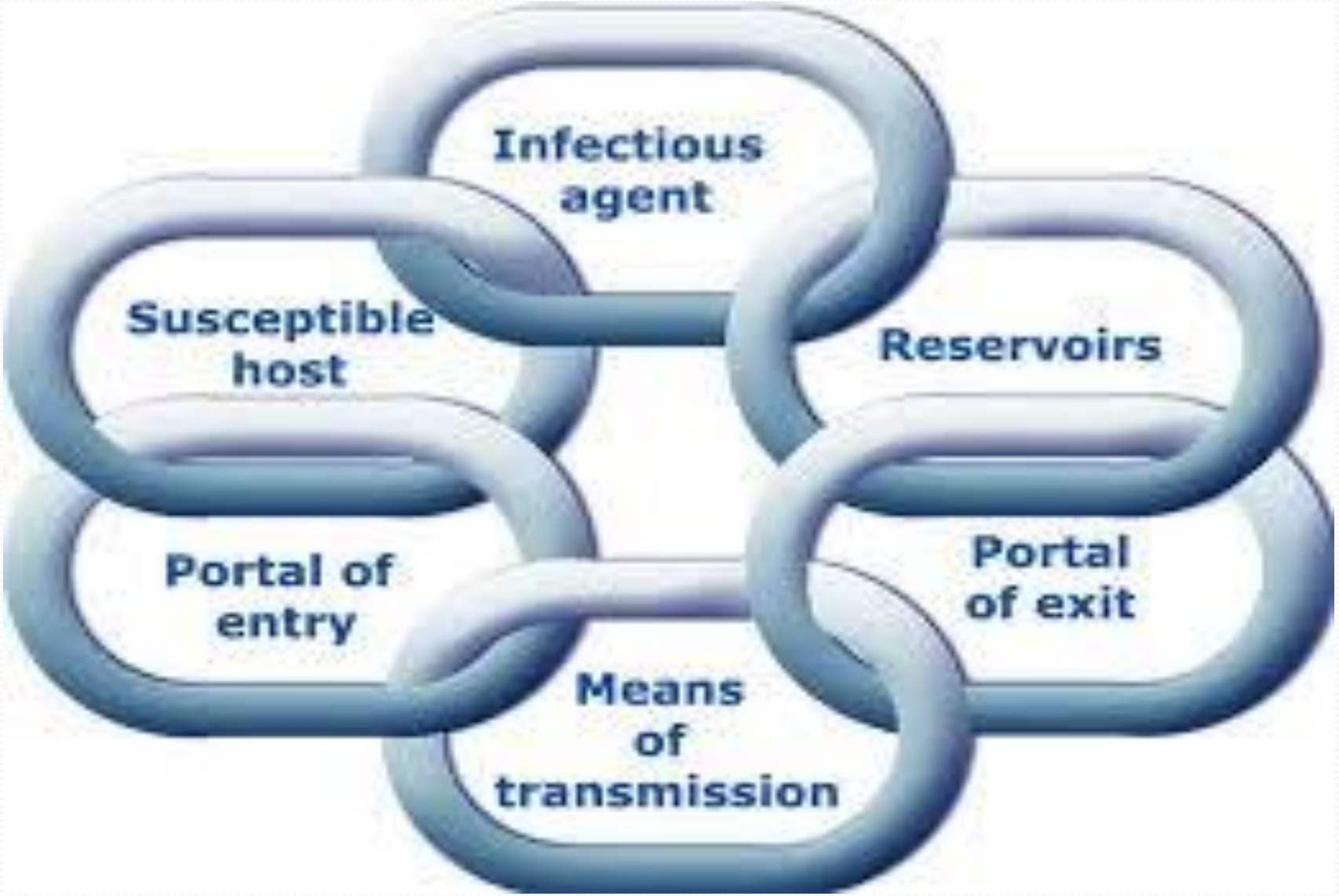
The epidemiologic triad of a disease.



Definition

- **Communicable disease (infectious disease)** – is an illness due to a specific infectious agent or its toxic products that arises through transmission of that agent or its products from an infected person, animal, or reservoir to a susceptible host, either directly or indirectly through an intermediate plant or animal host, vector, or the inanimate environment.

Components of the infectious process



The Agents

- a substance or organism which causes a disease or condition

Reservoir

- A reservoir is an organism or habitat, in which an infectious agent normally lives, transforms, develops and multiplies. Reservoirs for infectious agents may be humans, animals, plants.

Con…

All infected humans, whether showing signs and symptoms of the disease or not, are potential sources of infection to others. A person who does not have apparent clinical disease, but is a potential source of infection to other people is called a Carrier. An example of carrier is a person infected with HIV.

Con…

A person infected with HIV might not have the signs and symptoms but he/she is capable of transmitting the infection to others.

Some diseases are transmitted to human beings from animals. These diseases are called zoonosis.

- Examples: Rabies, anthrax, etc.

Portal of Exit

- Portal of exit is the way the infectious agent leaves the reservoir. Possible portals of exit include all body secretions and discharges: Mucus, saliva, tears, breast milk, vaginal and cervical discharges, excretions (feces and urine), blood, and tissues. For example feces is the portal of exit for the eggs of hook worm.

Mode of Transmission

- Modes of transmission include the various mechanisms by which agents are conveyed to other susceptible hosts. Transmission may be direct or indirect.

1. Direct Transmission

- ***1.1 Direct contact*:** Occurs when there is contact of skin, mucosa, or conjunctiva with infectious agents directly from person or vertebrate animal, touching, kissing, biting, passage through the birth canal, or during sexual intercourse.
- Example: HIV/AIDS/STIs,

1. Direct Transmission

- ***1.2 Direct Projection*:** is transmission by projection of saliva droplets during coughing, sneezing, singing, spitting or talking.
- Example: common cold

1. Direct Transmission

- **1.3 Transplacental:** is transmission from mother to fetus through the placenta.
- Example: syphilis, HIV/AIDS

2. Indirect transmission

- The following are the different types of indirect transmission.
- ***2.1 Vehicle-borne*:** Transmission occurs through indirect contact with inanimate objects fomites: bed sheets, towels, toys, or surgical instruments; as well as through contaminated food, water, IV fluids etc.

2. Indirect transmission

- ***2.2 Vector-borne***: The infectious agent is conveyed by an arthropod to a host. Vectors may be biological or mechanical.

***A. Biological vector*:** A vector is called biological vector if the agent multiplies in the vector before transmission.

- • Example: anopheles mosquito is a biological vector for malaria.

2. Indirect transmission

- ***B. Mechanical vector***: A vector is called mechanical vector if the agent is directly infective to other hosts, without having to go through a period of multiplication or development in the vector. The vector simply carries the agent by its body parts(leg, proboscis etc) to convey it to susceptible hosts.
- Example: Flies are mechanical vectors for the transmission of trachoma.

2. Indirect transmission

- ***2.3 Airborne:*** which may occur by dust or droplet nuclei .
- Example: Tuberculosis. When pulmonary tuberculosis patients cough, they emit many aerosols which consists the agents of tuberculosis.

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Susceptible human host:

- **Susceptible human host:** The susceptible human host is the final link in the infectious process. Host susceptibility or resistance can be seen at the *individual* and at the *community* level.

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Host resistance at the community (population) level is called ***herd immunity***. Herd immunity can be defined as *the resistance of a population to the introduction and spread of an infectious agent, based on the immunity of a high proportion of individual members of the population, thereby lessening the likelihood of a person with a disease coming into contact with susceptible*.

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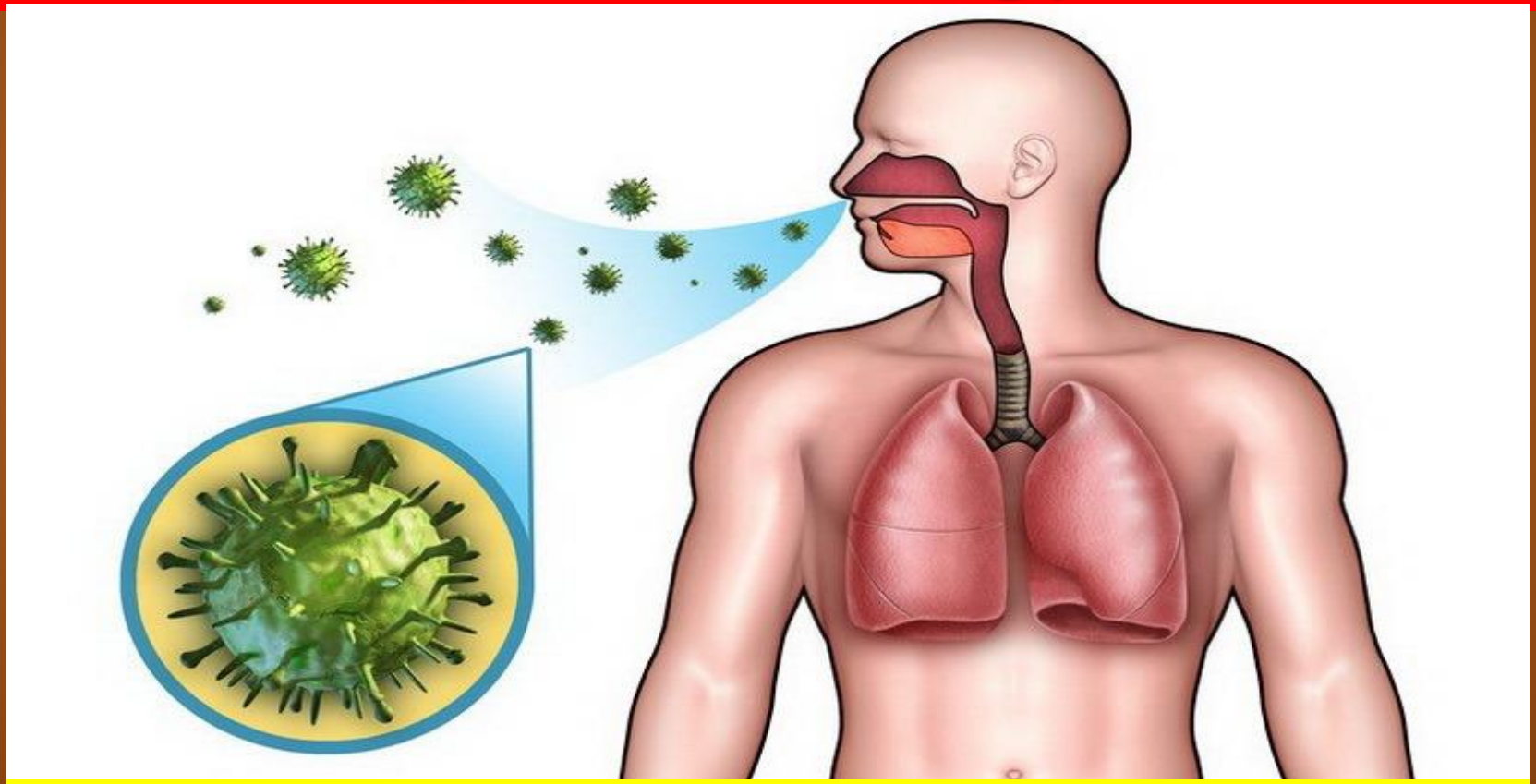
- Example - If 90 % of the children are vaccinated for measles, the remaining 10 % of the children who are not vaccinated might not become infected with measles because most of the children (90 %) are vaccinated. That means transmission from infected person to other susceptible children will not be easier.


THANK YOU

lecture: 6 Infection process Epidemiology



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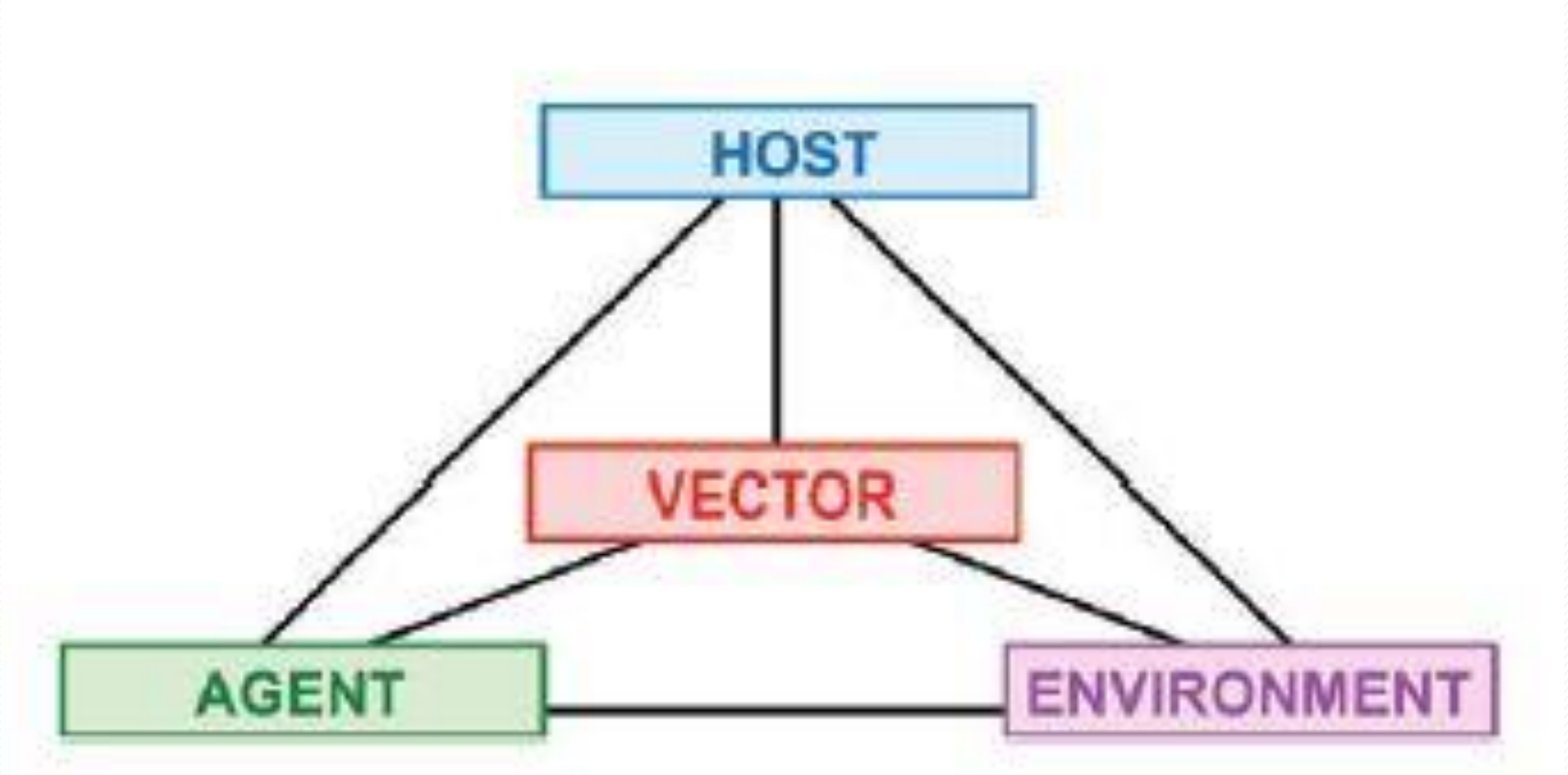

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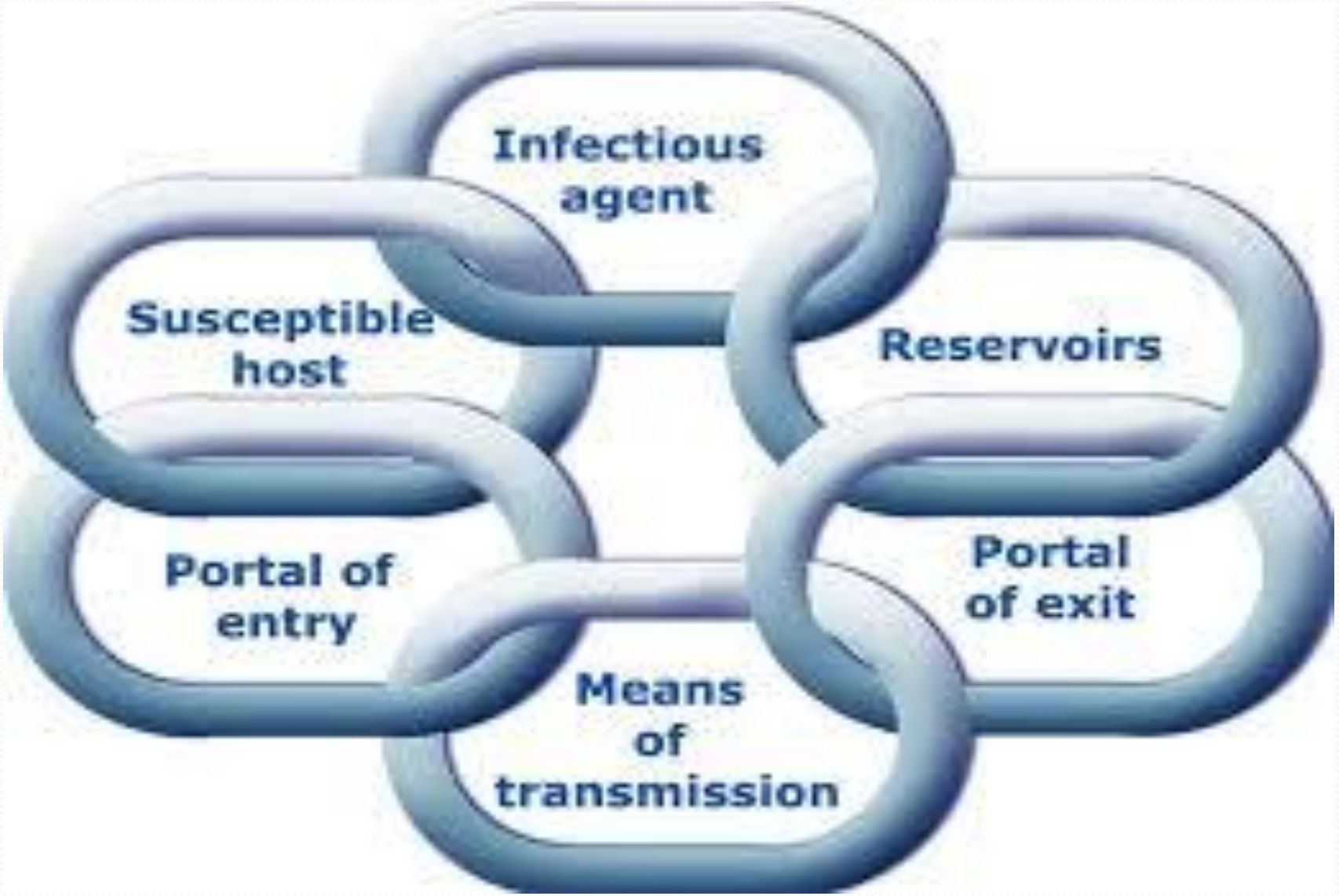

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THANK YOU

Epidemiology

lecture one: History of Epidemiology

by: Assistance. Prof. Dr. :
Ridha M Lefta

Dr. Radha.m@alameed.edu.iq.

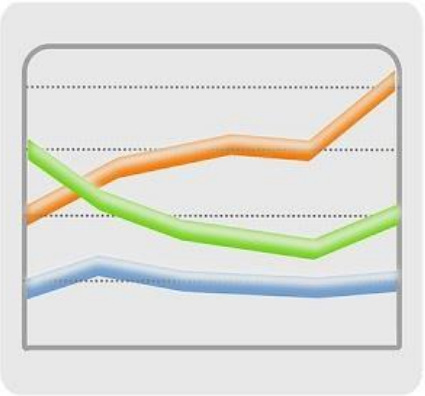
Epidemiology

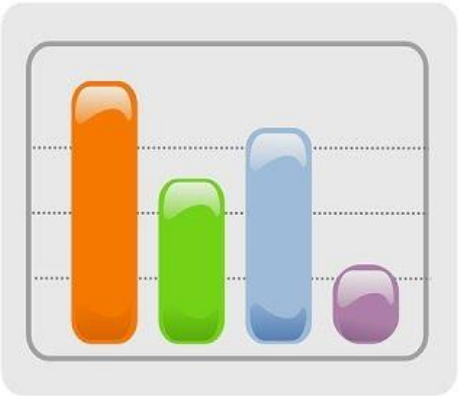
- Learning Objectives:
- At the end of this unit the student is expected to:

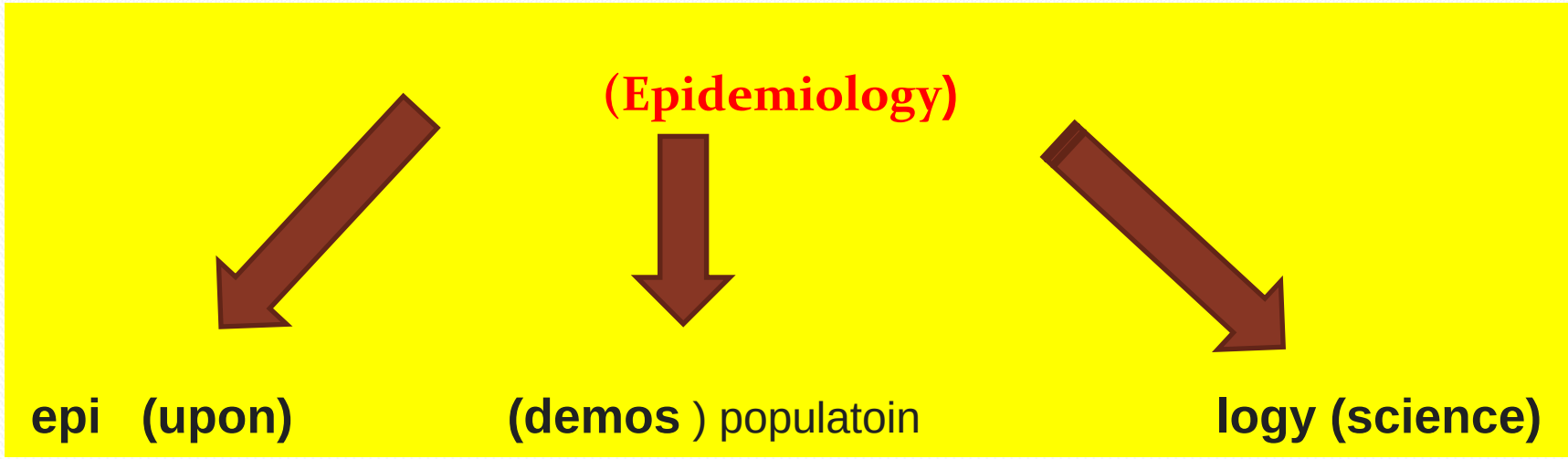
1. Define Epidemiology
2. Identify the main issues in the definition
3. Discuss the uses of Epidemiology

KEY TO PUBLIC HEALTH:

EPIDEMIOLOGY






(Epidemiology)
epi (upon)
(demos) populatoin
logy (science)

WHAT IS EPIDEMIOLOGY?

Epidemiology is the study of how disease is distributed in populations and the factors that influence or determine this distribution.

Why does a disease develop in some people and not in others?

The premise underlying epidemiology is that disease, illness, and ill health are not randomly distributed in human populations.

Define

- **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.

Con…

- It defines epidemiology as “the study of the distribution and determinants of health-related states or events in specified populations and the application of this study to control of health problems.”1

Con…

These characteristics may be primarily genetic in origin or may be the result of exposure to certain environmental hazards.

we are dealing with an interaction of genetic and environmental factors in the development of disease.

What are the relationship between veterinary and public health?

One of the many fields that falls within veterinary public health, veterinary epidemiology focuses specifically on disease surveillance, response, and prevention.

This allows veterinary epidemiologists to better understand risks and how to prevent widespread illness.

Veterinary epidemiology is an important field, because there’s a considerable amount of overlap between human and animal health. Many of the conditions threatening other species also have implications for people. According to the Centers for Disease Control and Prevention (CDC), more than 60 percent of infectious human diseases have an animal source..

History of Epidemiology

- Although epidemiological thinking has been traced to the time of Hippocrates, who lived around 5th century B.C., the discipline did not flourish until 1940s. Hippocrates displayed an extraordinary awareness of the impact of environment and behavior on personal well–being. Hippocrates therefore identified forces that epidemiologists today recognize as major determinants of human health.

THE OBJECTIVES OF EPIDEMIOLOGY

1. To identify the ***etiology*** or ***cause*** of a disease and the relevant **risk factors** —that is, factors that increase a person's risk for a disease.
2. To reduce morbidity and mortality from the disease.
3. to determine the extent of disease found in the community.
4. to study the natural history and prognosis of disease.

Con…

5. To evaluate both existing and newly developed preventive and therapeutic measures and modes of health care delivery.

6. To provide the foundation for developing public policy relating to environmental problems, genetic issues, and other considerations regarding disease prevention and health promotion.

Major components which deals with Epidemiology

- 1. Population.

The main focus of epidemiology is on the effect of disease on the population rather than individuals. For example malaria affects many people in Ethiopia but lung cancer is rare. Also Breast cancer affects many people in Iraq but AIDS is rare. If an individual develops lung cancer, it is more likely that he/she will die

- 2. Frequency. This shows that epidemiology is mainly a quantitative science. Epidemiology is focus with the frequency of diseases and other health related conditions. Frequency of diseases is measured by morbidity and mortality rates.

- 3. **Health related conditions. :**

Epidemiology is focus not only with disease but also with other health related conditions because every thing around us and what we do also affects our health. Health related conditions are conditions which directly or indirectly affect or influence health. These may be injuries, births, health related behaviors like smoking, unemployment, poverty etc.

- 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.

- 6. Application of the studies to the promotion of health and to the prevention and control of health problems. This means the whole aim in studying the frequency, distribution, and determinants of disease is to identify effective disease prevention and control strategies

What is benifit of Epidemiology

- To make a community diagnosis. Epidemiology helps to identify and describe health problems in a community (for example, the prevalence of anemia, or the nutrition status of children).

- To monitor continuously over a period of time the change of health in a community. (for example, the effect of a vaccination program, health education, nutritional supplementation).

- To practice surveillance for a specific disease in order to be able to act quickly and so cut short any outbreak (example cholera).

- To investigate an outbreak of a communicable disease, analyze the reasons for it, plan a feasible remedy and carry it out, and monitor the effects of the remedy on the outbreak.

Thank you my dears