

HARAMBEE UNIVERSITY
FACULTY OF HEALTH
DEPARTMENT OF NURSING

MEASUREMENT OF HEALTH & DISEASE

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MPH)**

Course content

1. Introduction to Epidemiology
2. Natural history of disease and levels of prevention
3. The infectious disease cycle
- 4 . Basic measurement in epidemiology
5. Source of epidemiologic data
6. Public health surveillance
7. Descriptive study designs
8. Analytical epidemiology
9. Measures of strength of association
10. Screening in disease control
11. Investigation of an epidemic/outbreak

Introduction to Epidemiology

- Definition
- History of Epidemiology
- Applications of Epidemiology
- Scope of epidemiology
- Basic assumptions of epidemiology
- Theories of disease causation
- Branches of epidemiology

Learning Outcomes

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At the end of the course, student will be able to:

- Understand the principles of Epidemiology
- Describe basic concepts of disease causation
- Describe natural history of diseases and modes of diseases transmission
- Calculate the measures of disease and death
- Understand types of study design
- Choose appropriate epidemiologic study designs for a specific study objectives
- Investigate and control outbreaks and epidemics
- Describe the purpose and types of surveillance

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Introduction

- The word epidemiology comes from the Greek words
 - ***epi***, meaning “***on or upon***,”
 - ***demos*** , meaning “***people***,” and
 - ***logos***, meaning “***the study of***.”

Definition

- **Epidemiology** is the ***study*** of the ***frequency***, ***distribution*** and ***determinants*** of ***health-related states*** or events in ***specified populations***, and the ***application*** of this study to the prevention and control of health problems.

Major components of the definition

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- ***Population***: The main focus of epidemiology is on the effects of disease on the population rather than individuals.
- ***Frequency***: epidemiology is mainly quantitative science
- ***Health related conditions***: the concern is not only with disease but also with other related conditions
- ***Distribution***: in terms of place, time and person.
- ***Determinants***: factors which determine whether or not a person will get a disease
- ***Application***: it is an applied science to identify effective prevention and control strategies.

History of Epidemiology

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- Epidemiology originates from Hippocrates' observation (460 B.C)
 - Environmental factors influence the occurrence of disease than supernatural power
 - Displayed an extraordinary awareness of the impact of environmental and behavioral well-being.
 - He identified forces that epidemiologists today recognizes as major determinates of human health
 - Though epidemiological thinking has been traced to the time of Hippocrates, the discipline did not flourished until 1940s

History of Epidemiology

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John Graunt (1620 - 1674).

- He noted that biological phenomena, such as births and deaths, varied in predictable and regular ways
- He observed that male births consistently outnumbered female births.
- Also noted a relatively higher urban than rural death rate and seasonal variation in mortality rates.
- His work is summarized in the “*Natural and Political Observations.... Upon the Bills of Mortality*”, which was first published in England in 1662.

History of Epidemiology

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- **William Farr(1807-1883)**
 - Systematically collect and analyze Britain's mortality statistics
 - Considered father of modern vital statistics and surveillance
 - Extends epidemiologic analysis of morbidity and mortality data looking at the effects of marital status, occupation and altitude
 - He also developed many epidemiologic concepts and techniques still used today.

History of Epidemiology

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John Snow

- He was conducting a series of investigations in London that later earned him the title *“the father of field epidemiology.”*
- In 1849, ***John Snow formulated and tested a*** hypothesis concerning the origin of an epidemic of cholera in London.
- Snow postulated that cholera was transmitted by specific contaminated water pump.
- He then used this information to map the distribution of cases on what epidemiologists call a spot map.
- **1950's-1970's** , major epidemiology successes in the area of – fluoride, tobacco, blood pressure and stroke, CHD risk factors, toxic shock syndrome, and etc.

Scope of epidemiology

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- At the beginning epidemiology was limited to understanding epidemics.
- Now it is advanced to all kinds of diseases whether they belong to
 - communicable,
 - non-communicable or injury category.
- It is used in laboratory sciences, clinical medicine and public health.

Uses of epidemiology in public health practice

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1. Elucidate the natural history of disease.
2. Describe the health status of the population.
3. Establish causation of disease.
4. Provide understanding of what causes or sustains disease in populations.
5. Define standards and ranges for normal values of biological and social measures.
6. Guide health and healthcare policy and planning.
7. Assist in the management and care of health and disease in individuals.
8. Evaluate the effectiveness of intervention.

Basic Epidemiologic Assumptions

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1. Human disease does not occur at random: eg. behavioural and environmental factors increase the risk of acquiring particular disease.
 2. Human disease has causal and preventive factors that identified through systematic investigation of populations.
- Thus, identifying these factors creates opportunity for prevention and control of diseases in human population either by
- ❖ eliminating the cause or
 - ❖ introducing appropriate treatment.

Theories of disease causation

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- **Causal theory** assume that some events or states of nature are causes of specific effects.
- **Cause of disease**
 - a factor (characteristic, behavior, event, etc.) that influences the occurrence of disease.
 - An increase in the factor leads to an increase in disease.
 - Reduction in the factor leads to a reduction in disease.

Causes of a disease can be classified into two:

- **Primary cause:** factors which are necessary for a disease to occur, in which absence the disease will not occur. Also called etiologic agent for infectious disease
- **Risk factors:**(contributing, predisposing, or aggravating factors) are not necessary factors but important
 - If disease does not develop without the factor being present, then we term the causative factor “ **necessary.**”
 - If the disease always results from the factor, then we term the causative factor “**sufficient** .

- Exposure to *Mycobacterium tuberculosis* is necessary for tuberculosis to develop, but it is not sufficient, because not everyone infected develops disease.
- Exposure to a large inoculum of rabies virus is a sufficient cause in a susceptible person, since clinical rabies and death will almost inevitably occur
- There are different models to deal with disease causation

Models of disease causation

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- ❑ Epidemiologic triad
- ❑ Wheel model
- ❑ Web of causation
- ❑ Component cause and casual pies

The Epidemiologic Triad:

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Agent, Host, and Environment

- The epidemiologic triangle or triad is the traditional model of infectious disease causation.
- It has three components:
 - an external agent,
 - a susceptible host, and
 - an environment that brings the host and agent together.
- In this model, the environment influences the agent, the host, and the route of transmission of the agent from a source to the host.

The Epidemiologic Triad

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Agent factors

- referred to an infectious microorganism—virus, bacterium, parasite, or other microbe.
- Generally, these agents must be present for disease to occur. That is, they are necessary but not always sufficient to cause disease.
- As epidemiology has been applied to noninfectious conditions, the concept of agent in this model has been broadened to include chemical and physical causes of disease.
- This model does not work well for some noninfectious diseases, because it is not always clear whether a particular factor should be classified as an agent or as an environmental factor.

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The Epidemiologic Triad

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Host factors

- Are intrinsic factors that influence an individual's exposure, susceptibility, or response to a causative agent.
- Age, race, sex, socioeconomic status, and behaviors (smoking, drug abuse, lifestyle, sexual practices and contraception, eating habits)
 - Affect likelihood of Exposure
- Age, genetic composition, nutritional and immunologic status, anatomic structure, presence of disease or medications, and psychological makeup
 - Affect Susceptibility and response to an agent.

The Epidemiologic Triad

Environmental factors

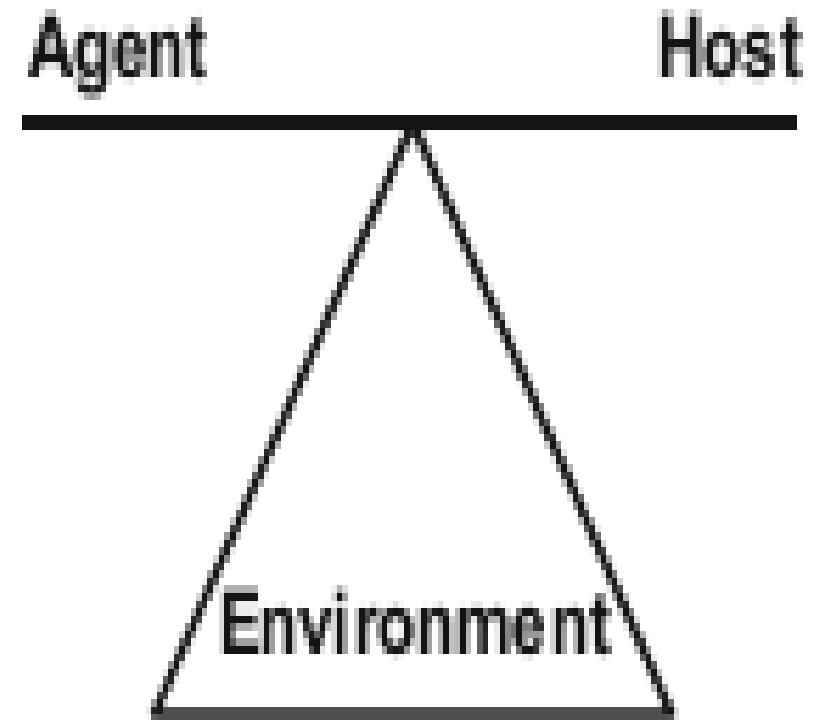
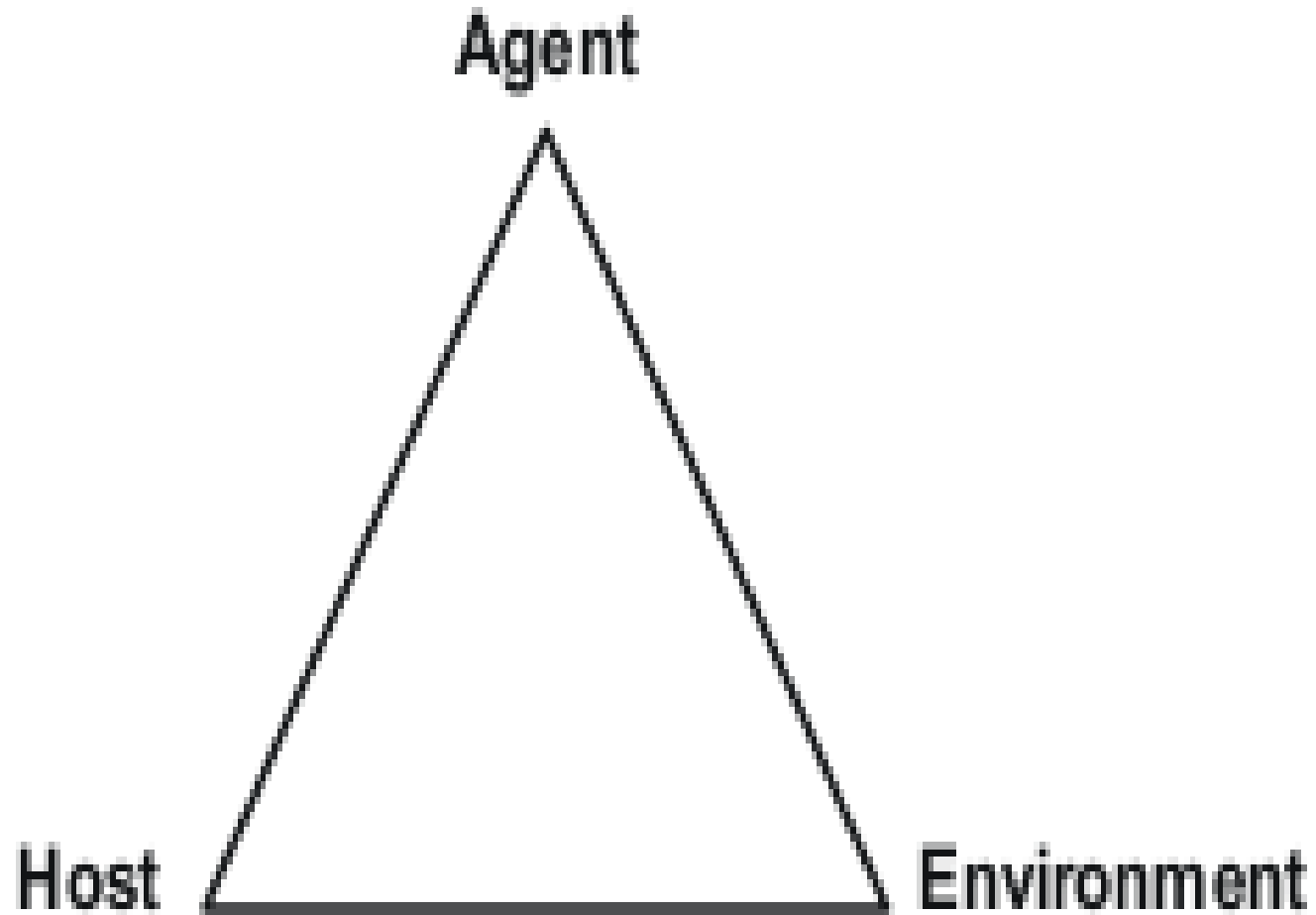
- Are extrinsic factors which affect the agent and the opportunity for exposure.
- Include physical factors such as geology, climate, and physical surroundings (e.g., a nursing home, hospital); biologic factors such as insects that transmit the agent; and socioeconomic factors such as crowding, sanitation, and the availability of health services.
- Agent, host, and environmental factors interrelate in a variety of complex ways to produce disease in humans.
- Their balance and interactions are different for different diseases.
- When we search for causal relationships, we must look at all three components and analyze their interactions to find practical and effective prevention and control measures

Epidemiologic Triad....

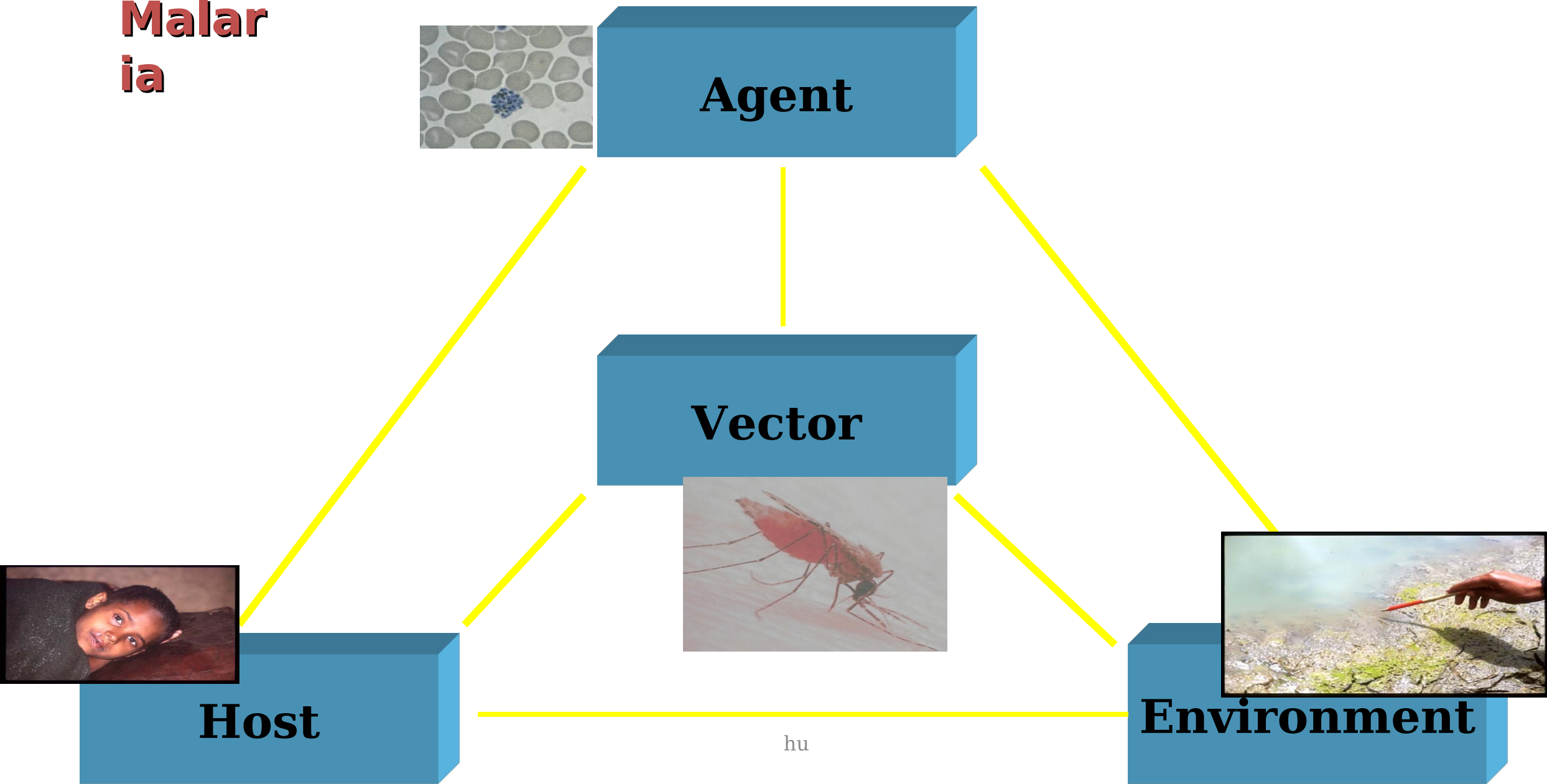
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- The environmental factors are further classified according to whether they belong in the social, physical or biological environments
- **Social environment** encompasses a broad range of factors, including education, unemployment, culture regarding diet; and many other factors pertaining to political, legal, economic, communications, transportation, and health care systems.
- **Physical environment:** factors such as climate, terrain and pollution
- **Biological environmental influences:** include vectors, humans and plants serving as reservoirs of infection

Epidemiologic triangle and triad (balance beam)



Malaria



Component causes and causal pies

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Necessary and sufficient causes

- ❖ A necessary cause is a causal factor whose presence is required for the occurrence of the effect.
- ❖ If a disease does not develop without the factor being present, then we term the causative factor “necessary”.
- ❖ Sufficient cause is a “minimum set of conditions, factors or events needed to produce a given outcome.”
 - o Exposure to *Mycobacterium tuberculosis* is necessary for tuberculosis to develop, but it is not sufficient, because not everyone infected develops disease.
 - o Exposure to a large inoculum of rabies virus is a sufficient cause in a susceptible person, since clinical rabies and death will almost inevitably occur

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Component causes and causal pies

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- The individual factors in pies are called **component causes**. The complete pie, which might be considered a causal pathway, is called a **sufficient cause**.
- A disease may have more than one sufficient cause, with each sufficient cause being composed of several component causes that may or may not overlap.
- A component that appears in every pie or pathway is called a **necessary cause**, because without it, disease does not occur.
- Each single component cause is rarely a sufficient cause by itself, but may be necessary for causation of the disease.

Component...

Causal *pies* representing all sufficient causes of a particular disease

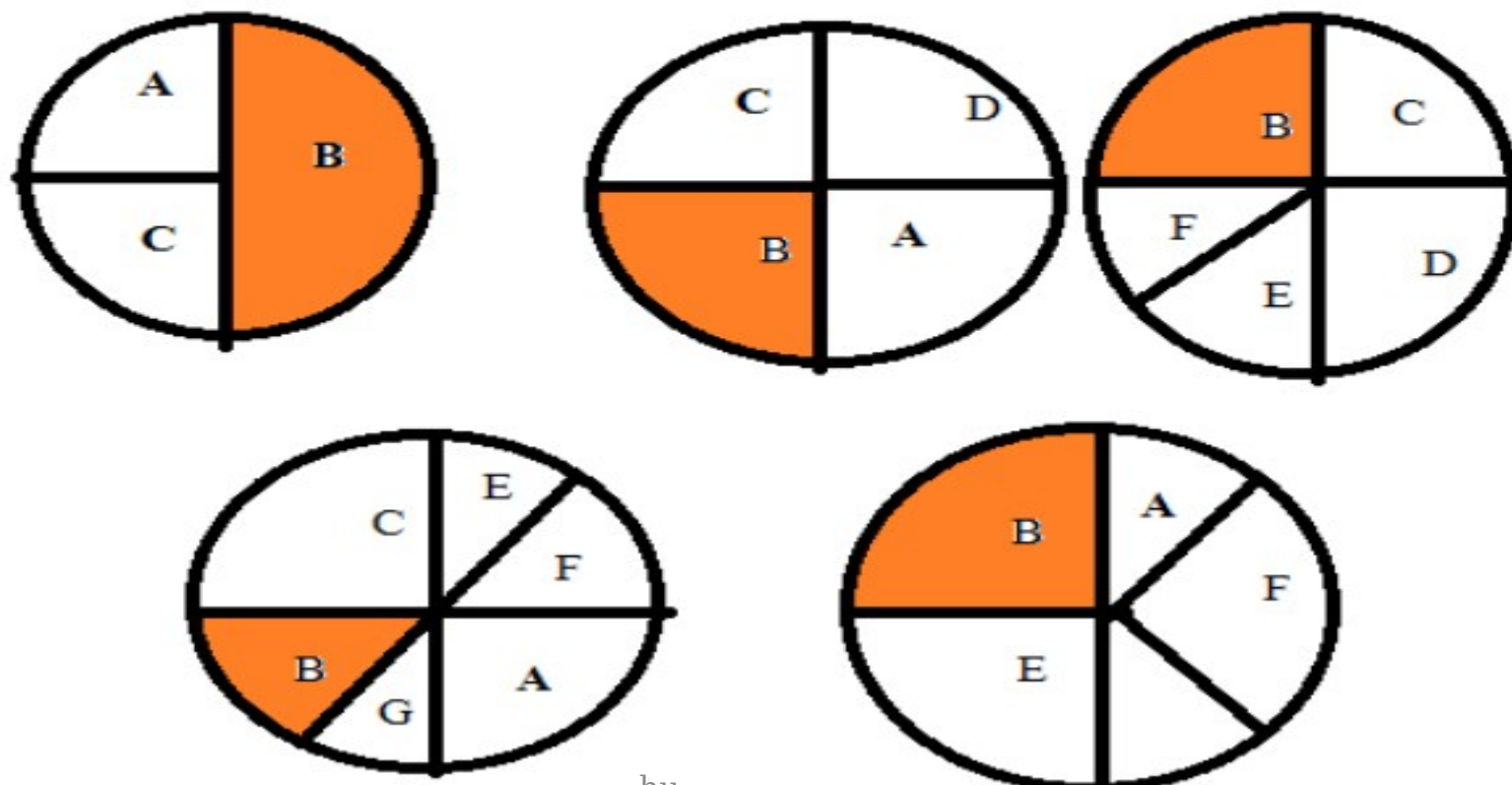
Necessary cause =

found in all cases (B)

Contributing cause =

needed in some cases (A, C, D, E, F) but not in all cases.

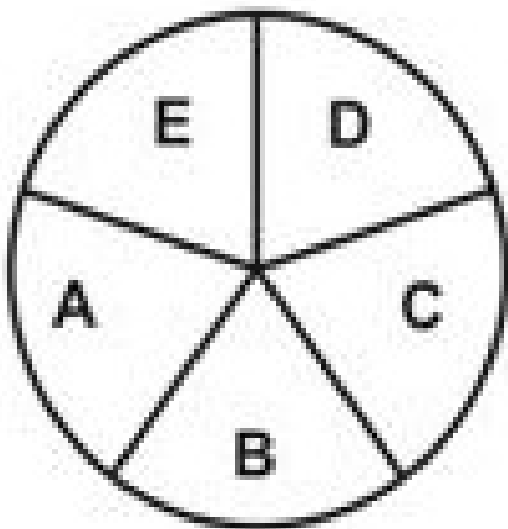
Sufficient cause = the set of necessary & contributing causes that make disease inevitable in an individual



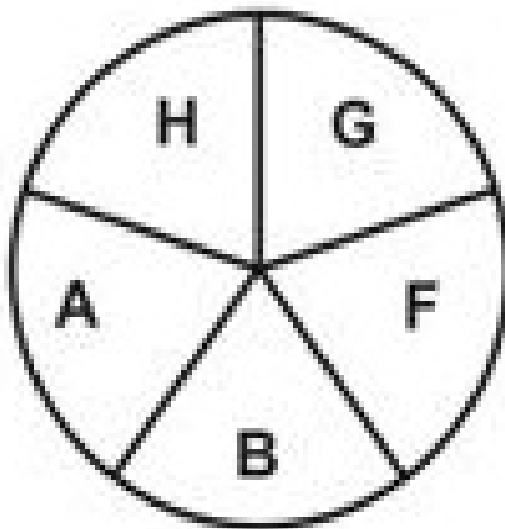
Which piece of a pathway is a necessary cause from below pies?

Rothman's Causal Pies

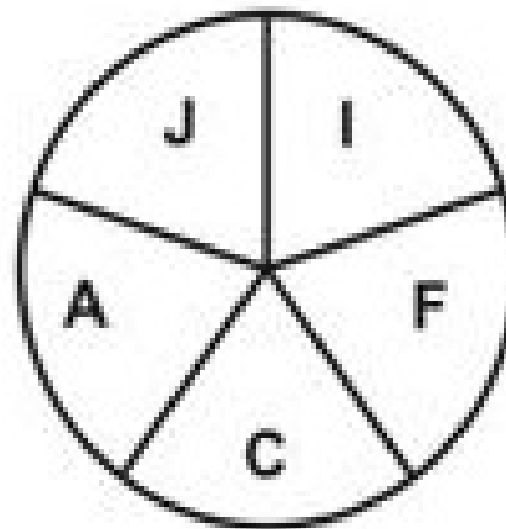
Sufficient Cause I



Sufficient Cause II



Sufficient Cause III

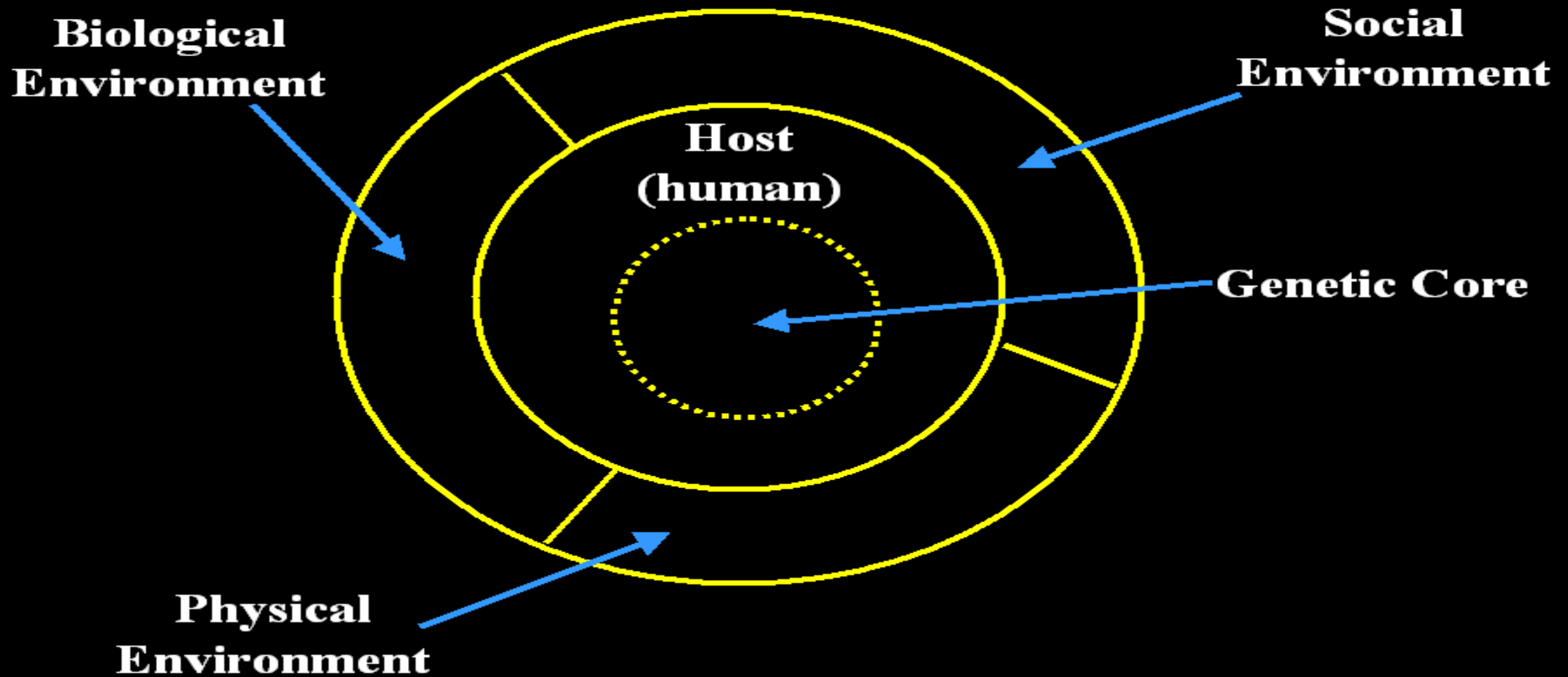


Wheel causation Model

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- Biological environment
- Social environment
- Physical environment
- Genetic core

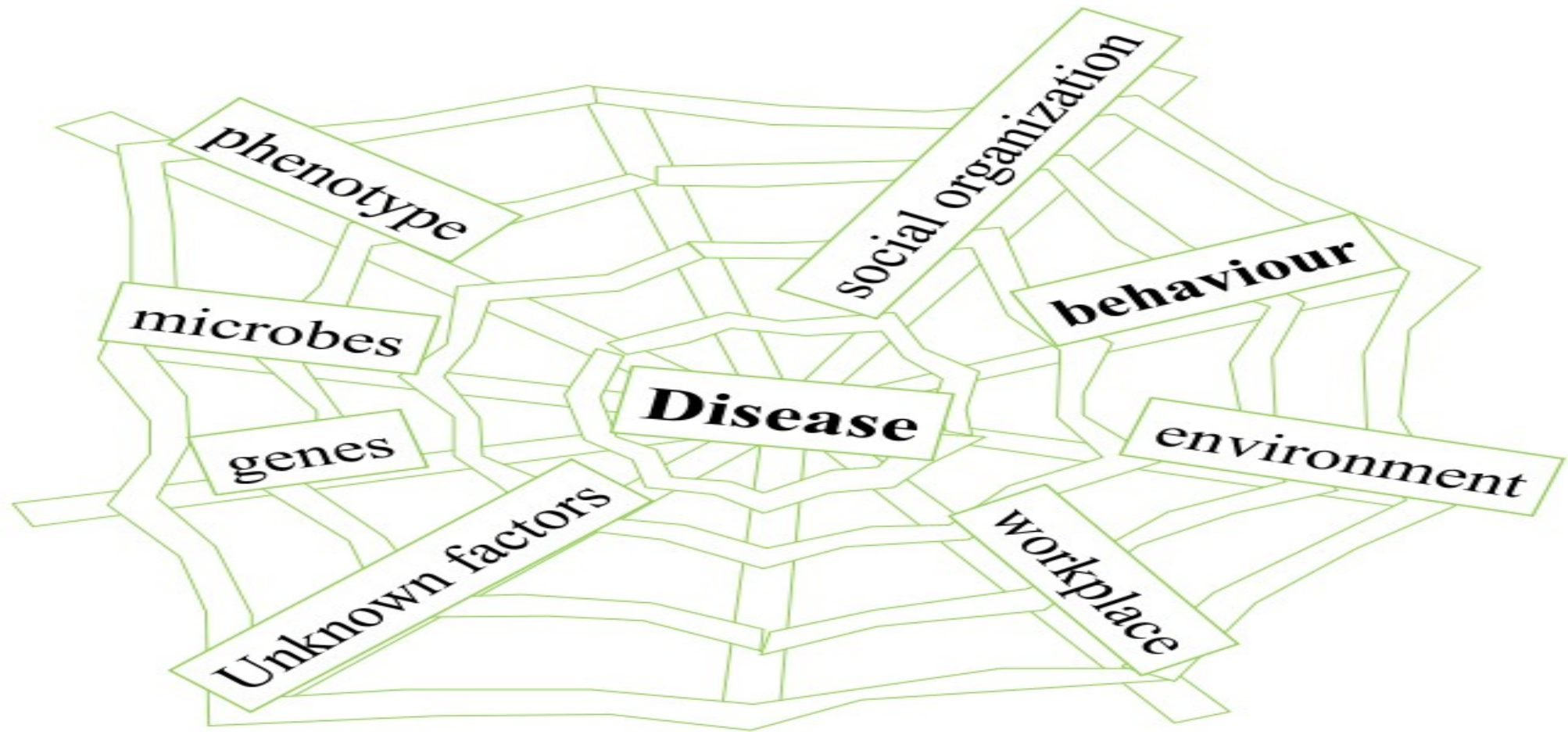
The Wheel of Causation



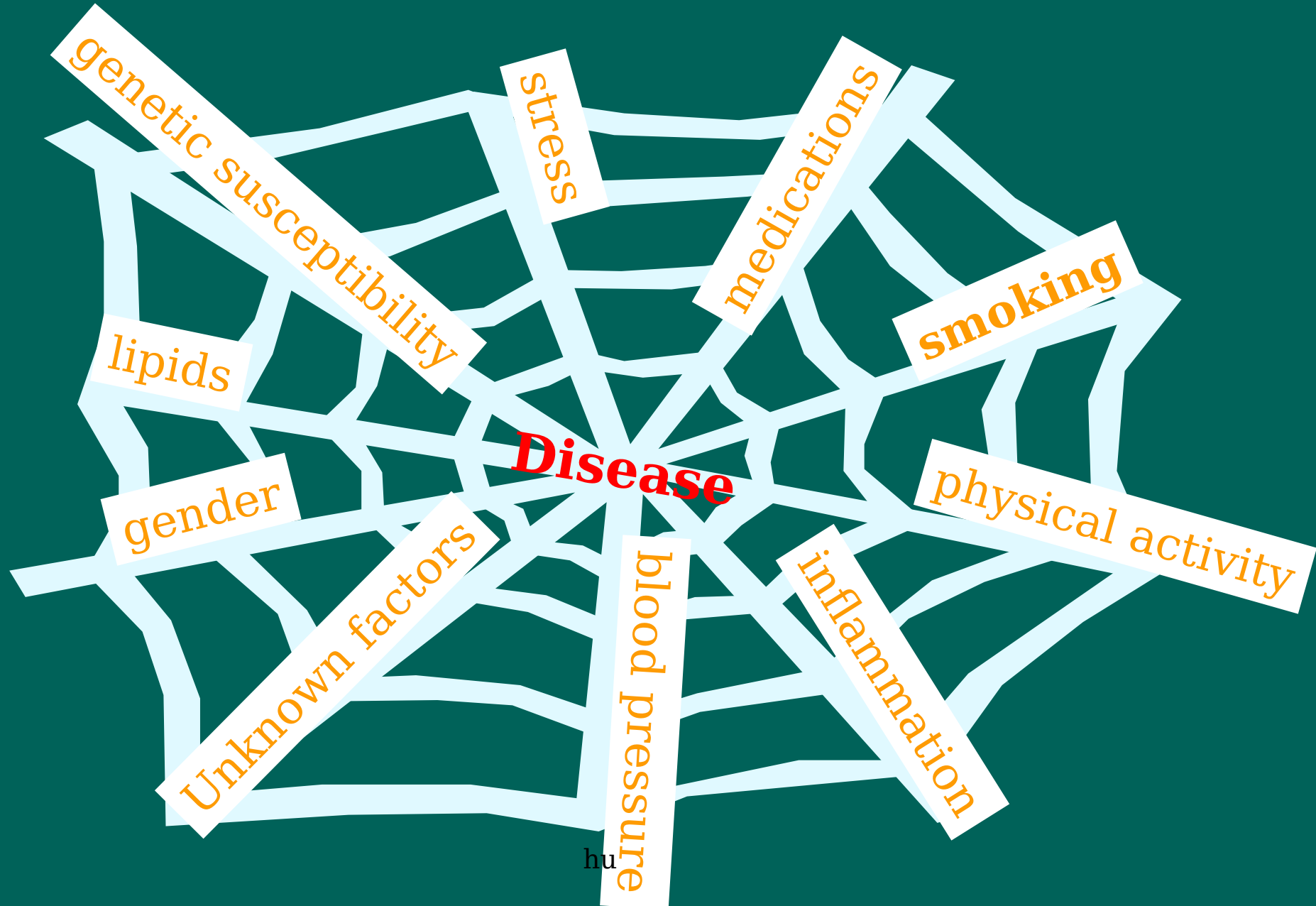
Web of causation

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- Devised to address chronic disease
- Can also applied to communicable disease due to multi-factorial causation of many disease
- No single cause
- Causes of disease are interacting in various pathways



Web of Causation - CHD



Major categories of epidemiology

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Epidemiology can be categorized into two:

1. Descriptive Epidemiology - Defines the amount and distribution of health problems in relation to person, place and time.
 - It answers the questions ***who, where and when.***
2. Analytic Epidemiology – involves explicit comparison of groups of individuals to identify determinants of health and diseases.
 - It answers the questions ***why and how.***

Applications

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- ❖ Control of disease could be achieved by removing one of the components in each “pie” and if there were a factor common to all “pies” the disease would be eliminated by removing that alone.
- ❖ For example, elimination of smoking (component B) would prevent lung cancer from sufficient causes I and II, although some lung cancer would still occur through sufficient cause III.
- ❖ Web of causation: devised to address chronic disease and can also be applied to communicable disease.

Applications....

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- Studying cause and effect in epidemiology is used to generate knowledge to prevent and control disease.
- Distinguishing natural from other causes of death and loss or reduced production/utility.
- Establishing modes of transmission and spread.

Thank You!