



# **Natural History of Disease and Concepts of Prevention and Control**

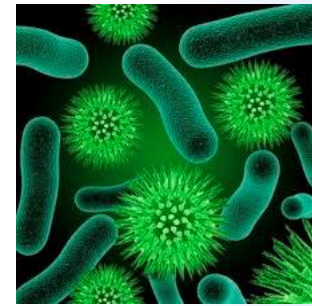
# Session Objectives

1. To describe **theories** postulated for the development of diseases
2. Explain the concepts of **iceberg phenomenon** of diseases
3. Understand the **relationship between host, environment and agent** in disease causation
4. Define the term **prevention**
5. Identify the **level of prevention** in relation to stage of disease development
6. Identify the **measures** applied at each level of prevention.

# Session Overview

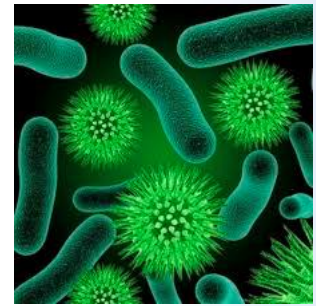
- Theories of Disease Causation.
- Natural History of Disease
- Spectrum of Disease
- Iceberg of Disease
- Concept of Prevention
- Modes of Intervention

# Concepts of Disease Occurrence



- How disease happen in a population?
- Do disease and other health events occur randomly?
- If not how?
- Why some people are more prone to disease than others

# Causation

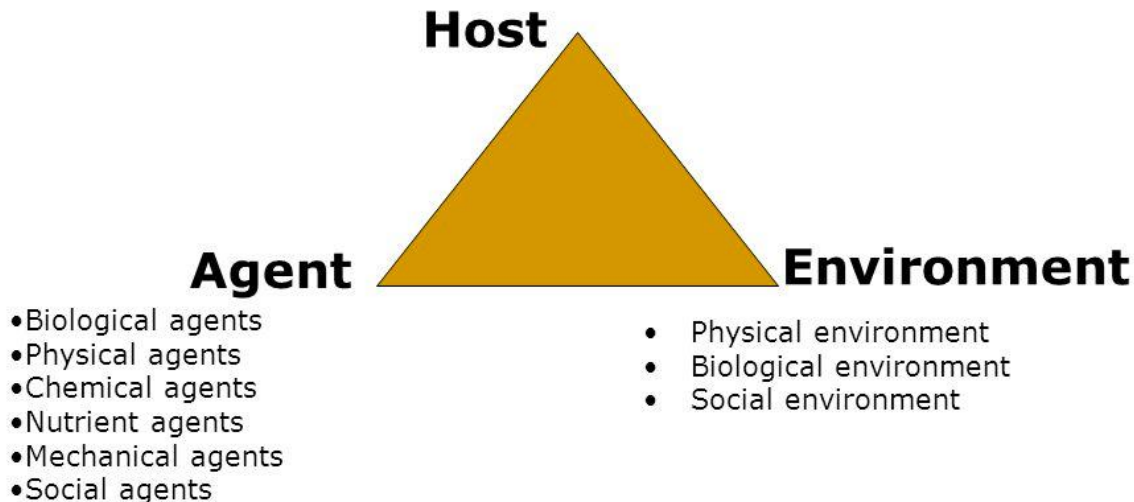


- **Epidemiologic triad or triangle**
- **Rothman's Causal Pies**
- **The Theory of “Web of Causation”**
- **Wheel theory**
- **The “BEINGS” Model of Disease Causation**

# The Epidemiological Triad

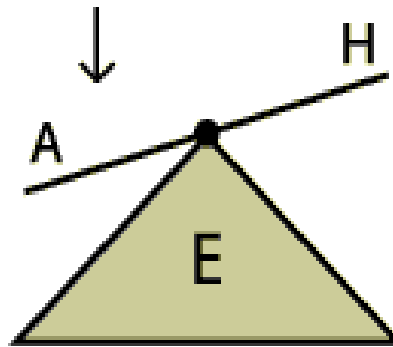
## Epidemiologic triad

- Demographic characteristics
- Biological characteristics
- Socioeconomic characteristics

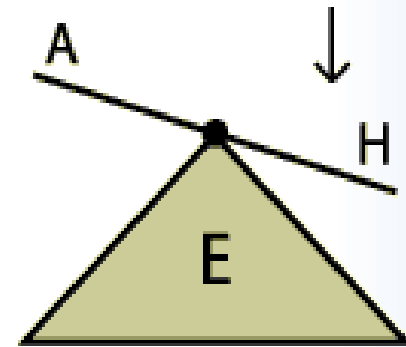


# The Epidemiological Triad

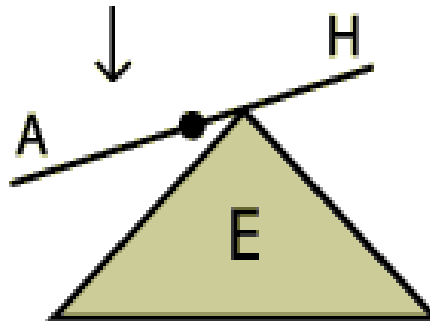
A = Agent  
H = Host  
E = Environment



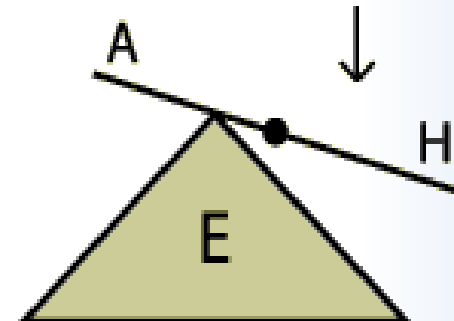
Increase in the ability of an agent to infect and cause disease in man



The proportion of susceptibles in the human host population is increased



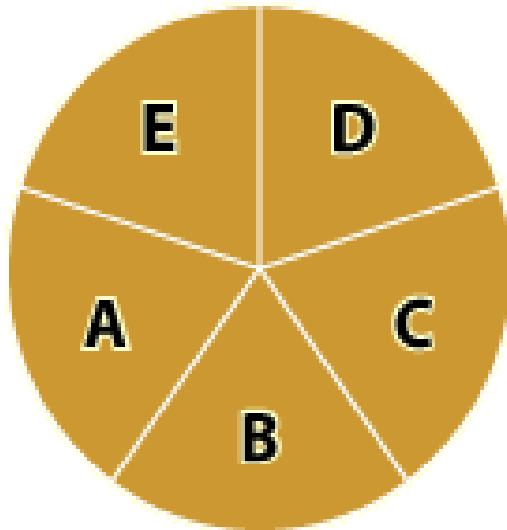
Environmental change facilitates agent spread



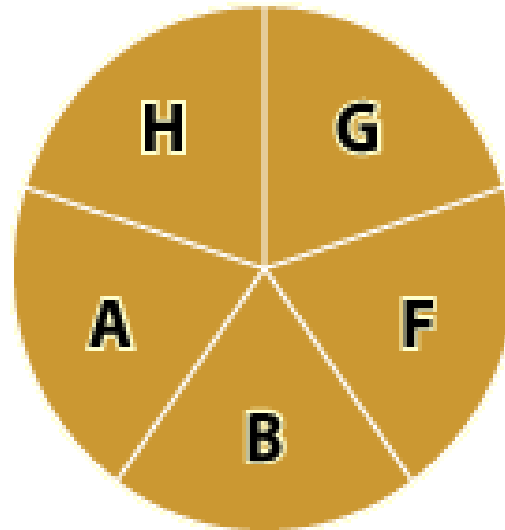
Environmental change alters host susceptibility

# Rothman's Causal Pies

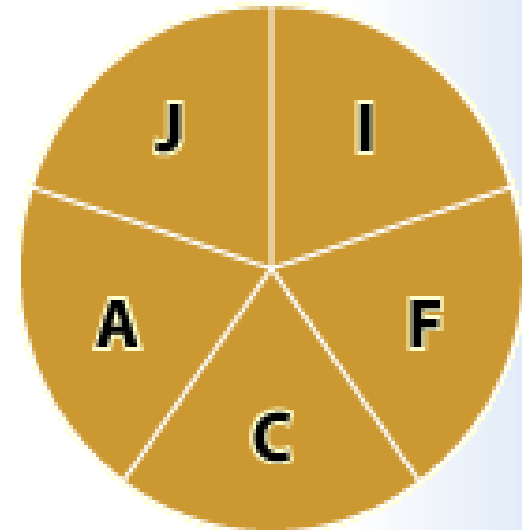
**Sufficient Cause I**



**Sufficient Cause II**



**Sufficient Cause III**





# The “BEINGS” Model of Disease Causation

## A complex interplay of nine different factors

- **B**iological factors innate in a human being,
- **B**ehavioural factors concerned with individual lifestyles,
- **E**nvironmental factors as physical, chemical and biological aspects of environment,
- **I**mmunological factors,
- **N**utritional factors,
- **G**enetic factors,
- **S**ocial factors,
- **S**piritual factors and
- **S**ervices factors, related to the various aspects of health care services.

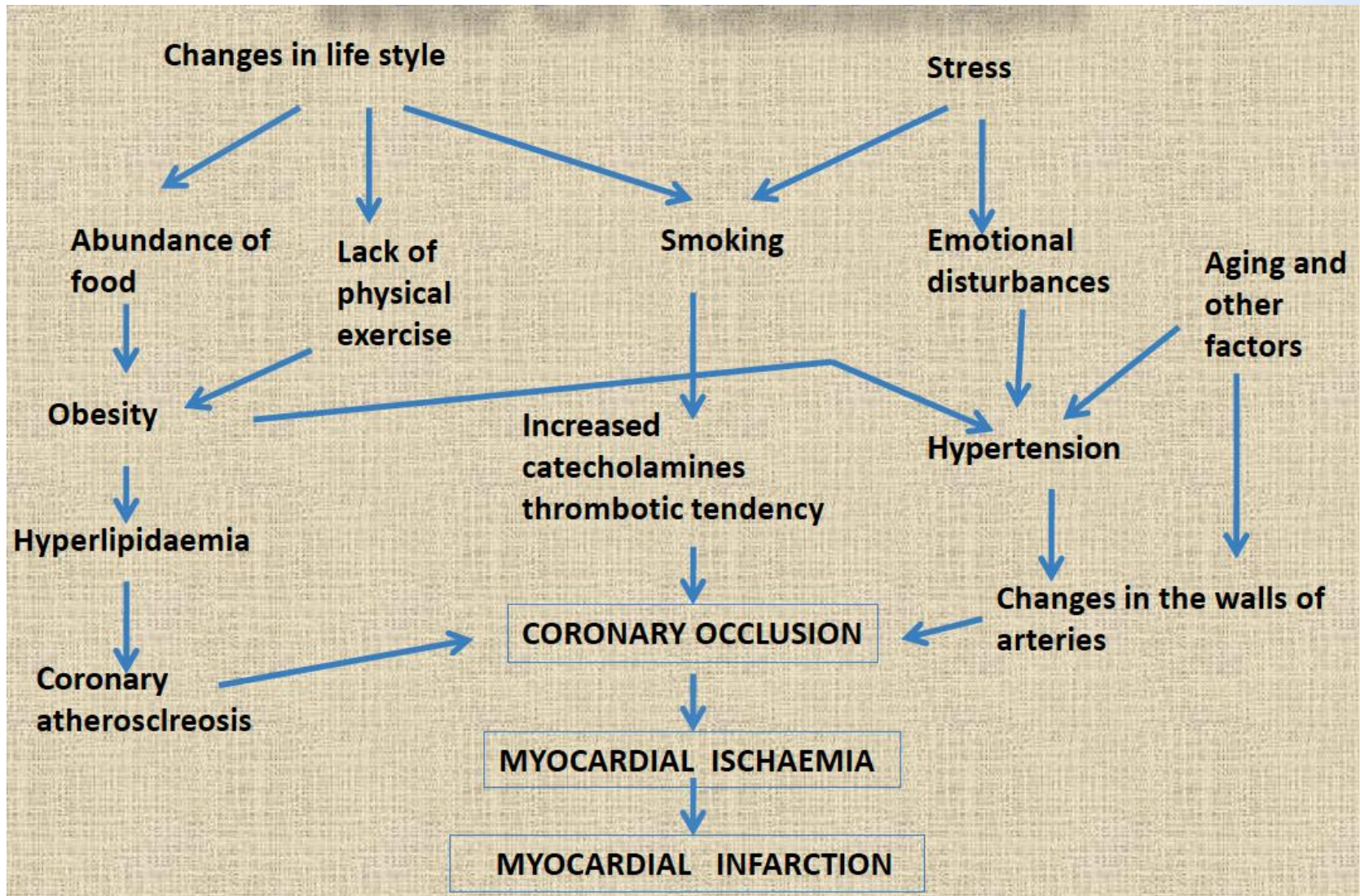
# The Theory of “Web of Causation”

- Suggested by MacMohan and Pugh.
- The various factors (e.g. hypercholesterolemia, smoking, hypertension) are like an **interacting** web of a spider.
- **Each factor** has its own relative importance in **causing** the final departure from the state of health, as well as **interacts** with others, **modifying** the effect of each other.

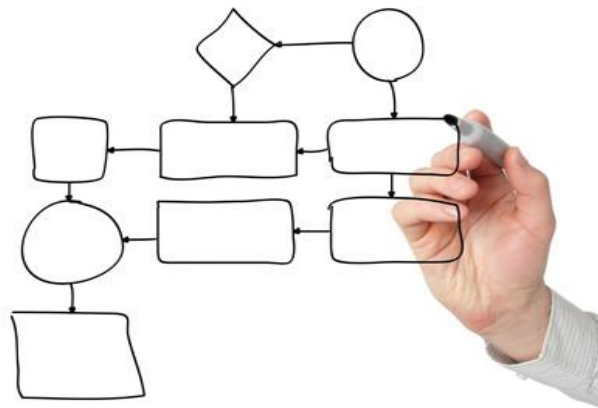
# The Theory of “Web of Causation”

- Ideally suited in the study of **chronic disease**, where the **agent is often not known** and disease is the outcome of **interaction of multiple factors**.
- This model of disease causation considers **all predisposing factors** of any type and **their complex interrelationship** with each other.

# The Theory of “Web of Causation”



# Natural History of Disease



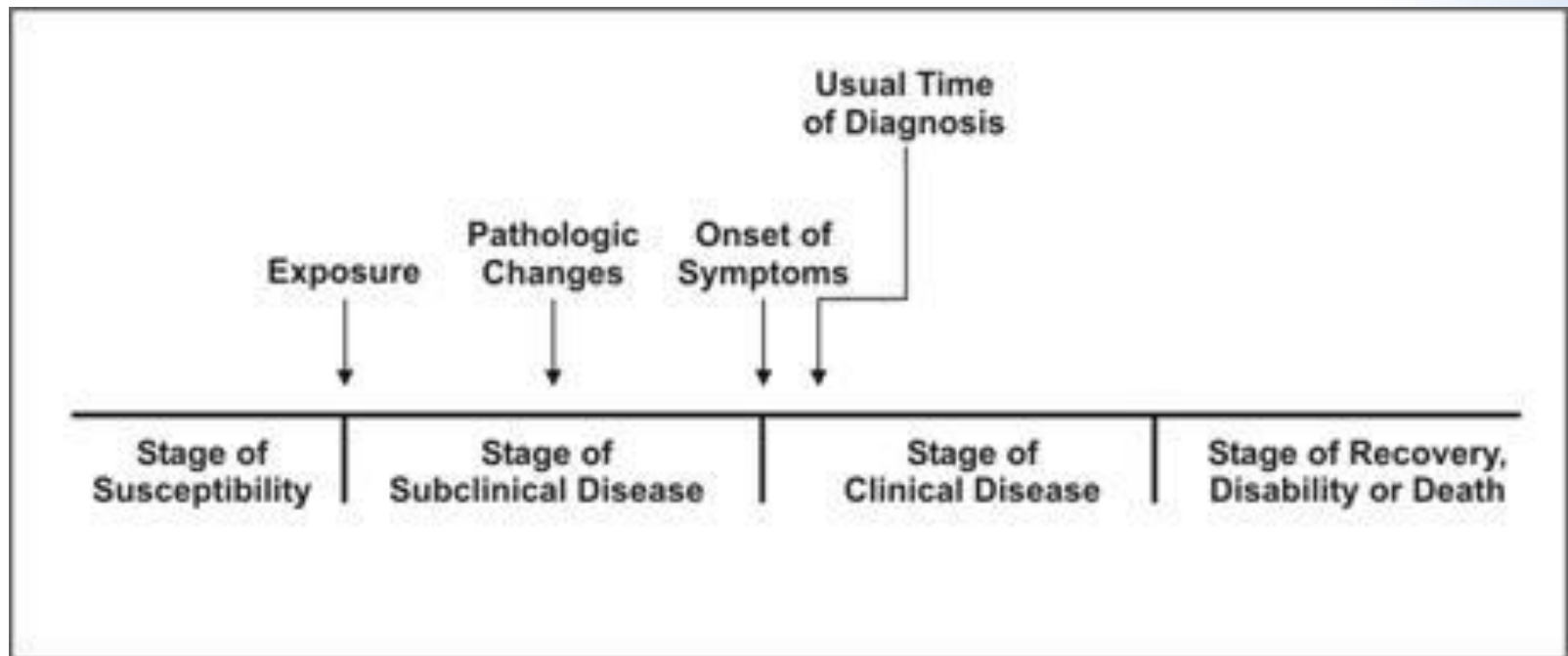
# Definition

- Natural history of disease refers to the **progress** of a **disease process** in an individual **over time**, in the **absence** of intervention.
- The process begins with ***exposure to*** or accumulation of **factors** capable of causing disease

# Natural History of Disease

- Pre-pathogenesis phase
- Pathogenesis phase

# Natural History of Disease





# Why it is important?

- It is one of the major elements of **descriptive epidemiology**.
- Understanding the progress of disease process and its pathogenetic chain of events is must for the **application of preventive measures**.

# Which Design is the Best

- The natural history of disease is best established by **prospective cohort studies**.
- As these studies are costly, understanding of the natural history of disease is largely based on other epidemiological studies, such as **cross-sectional**, **case-control** and **retrospective cohort studies**, undertaken in different population settings.



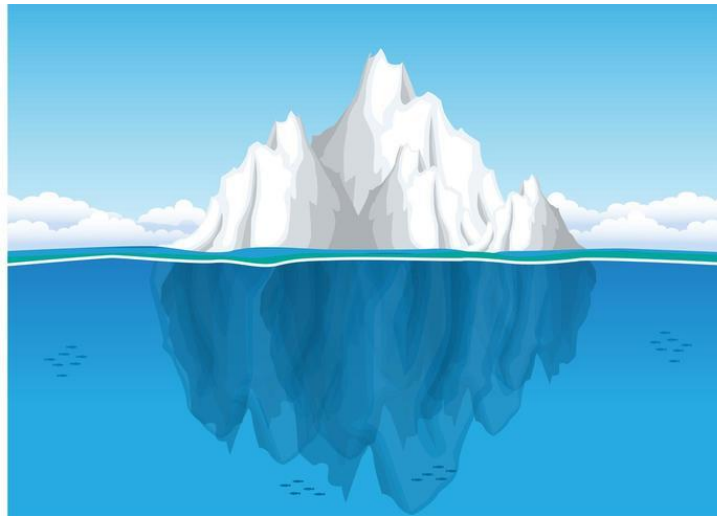
- What the **physician** sees in the hospital is just an "**episode**" in the natural history of disease.



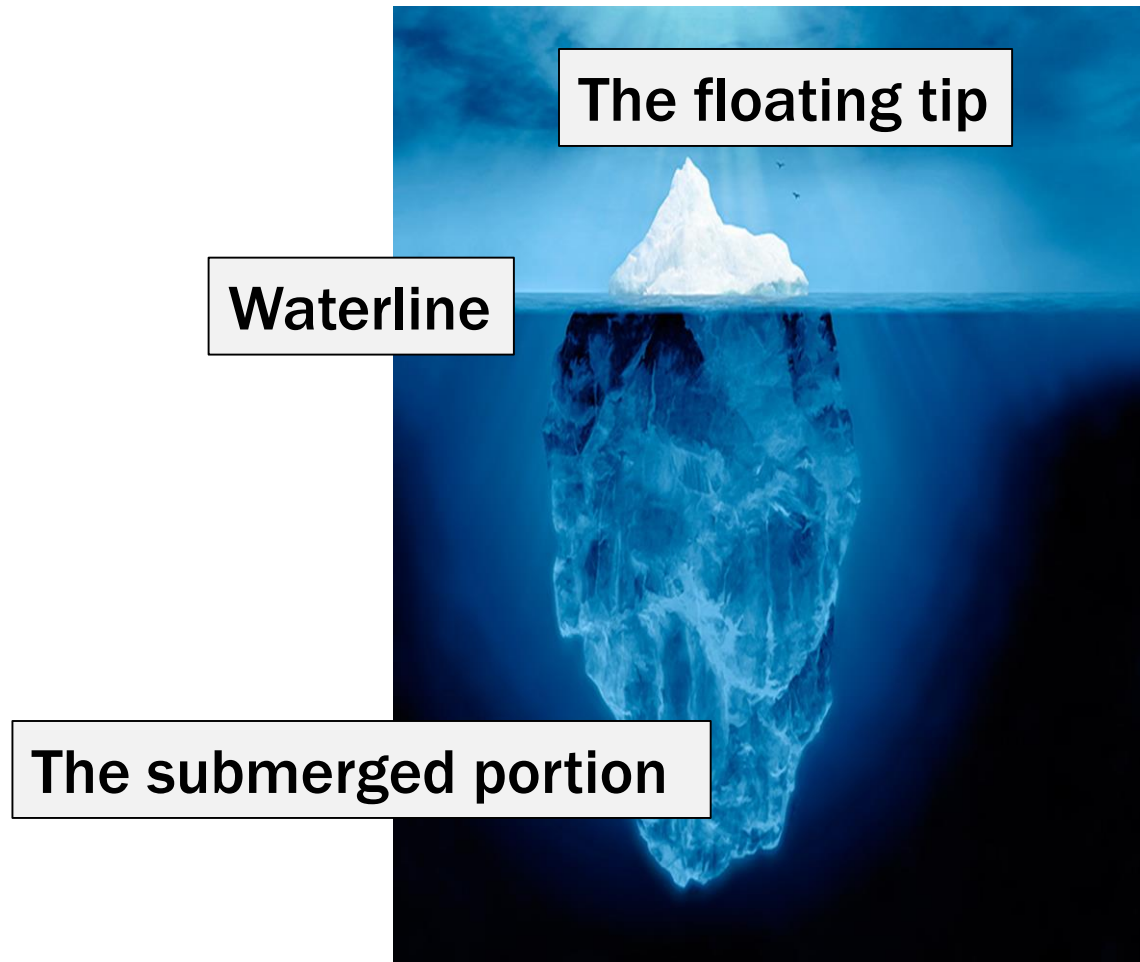
- The **epidemiologist**, by studying the natural history of disease in the **community setting** is in a unique position to fill the gaps in the knowledge about the natural history of disease.



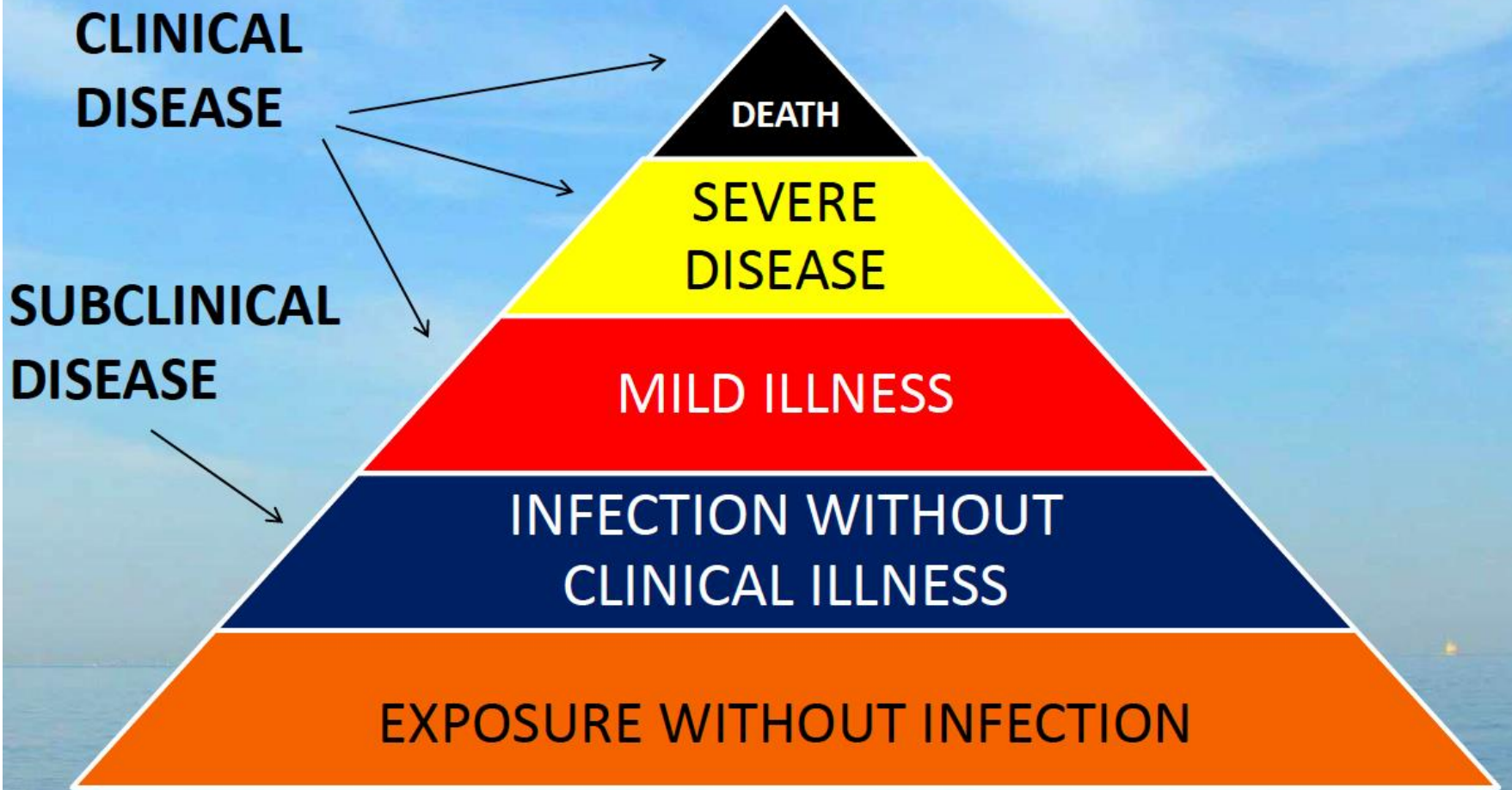
# Spectrum of Disease and Iceberg Phenomenon



# Iceberg of disease



# ICEBERG CONCEPT OF DISEASE



# How do we evaluate evidence on a cause?

- Strength
- Dose-response
- Consistency
- Temporality
- Specificity
- Plausibility

# Concept of Prevention





# LEVELS OF PREVENTION

Whole population through public health policy

Whole population selected groups and healthy individuals

Selected individuals with high risk patients

Patients

**PRIMORDIAL PREVENTION**  
establish or maintain conditions to minimize hazards to health

**PRIMARY PREVENTION**  
prevent disease well before it develops  
Reduce risk factors

**SECONDARY PREVENTION**  
early detection of disease  
(e.g. Screening & Intervention for Pre diabetes)

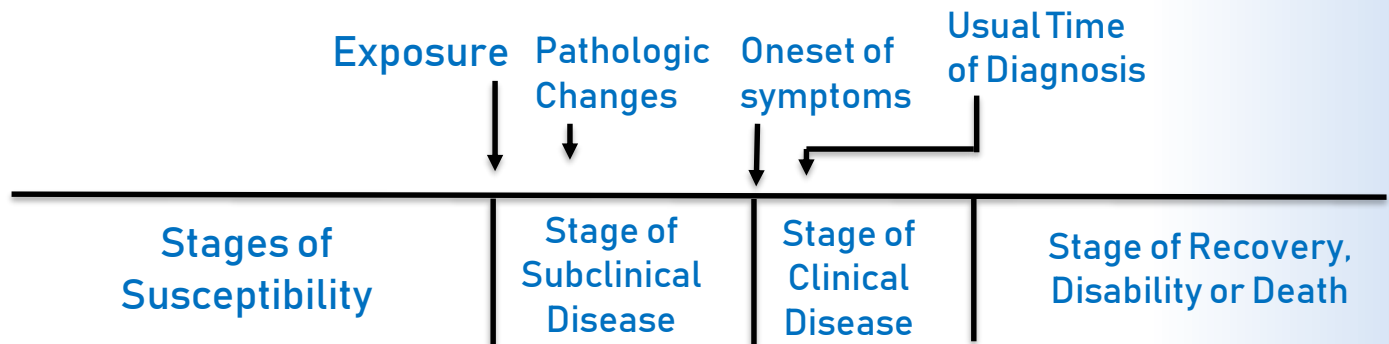
**TERTIARY PREVENTION**  
treat established disease to prevent deterioration

Advocacy for social change to make physical activity easier

Primary care advice as part of routine consultation

e.g. primary care risk factor reduction for those at risk of chronic disease, falls, injury

e.g. exercise advice as part of cardiac rehabilitation



A decorative border of watercolor flowers and leaves in shades of green, yellow, and pink surrounds the central text. The flowers include large pink peonies and smaller yellow blossoms, with various green leaves interspersed throughout.

thank  
you

# Prevention of disease

*Prevention is the process of intercepting or opposing the “cause” of a disease and thereby the disease process.*

## **Successful prevention depends on:**

- Knowledge of causation
- Dynamics of transmission
- Identification of risk factors and risk groups
- Availability of prophylactic or early detection and treatment measures
- Organization to apply these measures
- Continuous evaluation

# Prevention of disease

## Levels Of Prevention

- Primordial prevention
- Primary prevention
- Secondary prevention
- Tertiary prevention

# Primordial prevention

- It is the prevention of the emergence or **development of risk factors in population groups** in which they **HAVE NOT** yet appeared.
- *For example*, many adult health problems (e.g., obesity and hypertension) have their **early origin in childhood**, so efforts are directed towards **encouraging children to adopt healthy lifestyles** ( e.g, physical exercise, healthy dietary habits etc.)
- The main intervention in primordial prevention is through **individual and mass education**.

# Primary Prevention

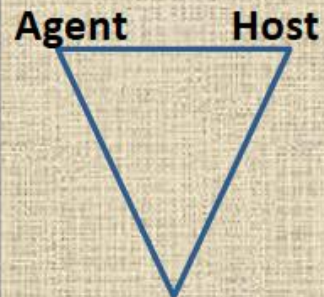
- It can be defined as “ **action taken prior to the onset of disease**, which removes the possibility that a disease will ever occur.
- It signifies **intervention in the pre-pathogenesis** phase of a disease.

## Prepathogenesis

## Pathogenesis

### •Disease process

Before man is involved



**Environmental factors**

(Bring agent and host together or produce a disease provoking stimulus)

In the human host

Clinical horizon

Signs and symptoms

Tissue or physiological changes

Multiplication of agent

The course of disease in man

Death

Chronic state

Defect

Disability

Illness

Recovery

### •Levels of prevention

Primary prevention



### •Modes of intervention

•Health promotion  
•Specific protection

Secondary prevention



Early diagnosis and treatment

Tertiary prevention



•Disability limitation  
•Rehabilitation

# Primary Prevention

## Two types of strategies

- Population( mass ) strategy
- High risk strategy



# Primary Prevention

## Population strategy

- directed at **whole population** irrespective of the individual risk levels.
- directed towards socio-economic, behavioral and lifestyle changes.

## High risk strategy

- Includes **identification** of “**High risk groups**” in the population and bring **preventive** care to these risk group.
- e.g., People having the family history of Hypertension, allergic disease, Diabetes .

# Primary Prevention

## Population strategy

Advantages:  
Radical  
Large potential for population  
Behaviourally appropriate

Disadvantages:  
Small benefits to individual  
Poor motivation of subject  
Poor motivation of physician  
Benefit to risk ratio may be low

## High risk strategy

Advantages :  
Appropriate to individuals  
Subject motivation  
Physician motivation  
Benefit to risk ratio is favourable

Disadvantages:  
High screening costs.  
Temporary effects  
Limited effect  
Behaviourally inappropriate

# Secondary prevention

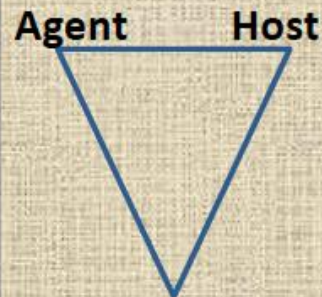
- Defined as “**action which stop the progress of a disease at its initial stage and prevents complications**”.
- It is applied in the **early pathogenesis** stage of disease.
- It reduce the prevalence of the disease by shortening its duration.
- It may also protect others in the community from acquiring the infection and thus provide, at once, **secondary prevention for the infected individuals** and **primary prevention for their potential contacts**.

## Prepathogenesis

## Pathogenesis

### •Disease process

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### •Levels of prevention

Primary prevention



### •Modes of intervention

•Health promotion  
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Secondary prevention



Early diagnosis and treatment

Tertiary prevention



•Disability limitation  
•Rehabilitation

# Secondary prevention

- The specific interventions used is :
  - Early diagnosis and treatment.
- **Early detection of health impairment** is defined as “ the *detection of disturbances of homoeostatic and compensatory mechanism while biochemical, morphological and functional changes are still reversible.*
- e.g. , **screening** for disease for breast cancer (using mammography) and cervical cancer (using pap smear).
- Medical examinations of school children, of industrial workers and various disease screening camps.

# Tertiary prevention

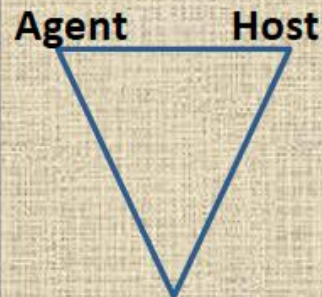
- These include **all measures undertaken when the disease has become clinically manifest or advanced**, with a view to
  - prevent or delay death,
  - reduce or limit the impairments and disabilities,
  - minimize suffering and
  - promote the subject's adjustment to incurable conditions.
- **Tertiary prevention has two types of approaches**
  - disability limitation
  - rehabilitation.

## Prepathogenesis

## Pathogenesis

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Before man is involved



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### •Levels of prevention

Primary prevention

Secondary prevention

Tertiary prevention

### •Modes of intervention

•Health promotion  
•Specific protection

•Early diagnosis and treatment

•Disability limitation  
•Rehabilitation

# Tertiary prevention

## Disability Limitation

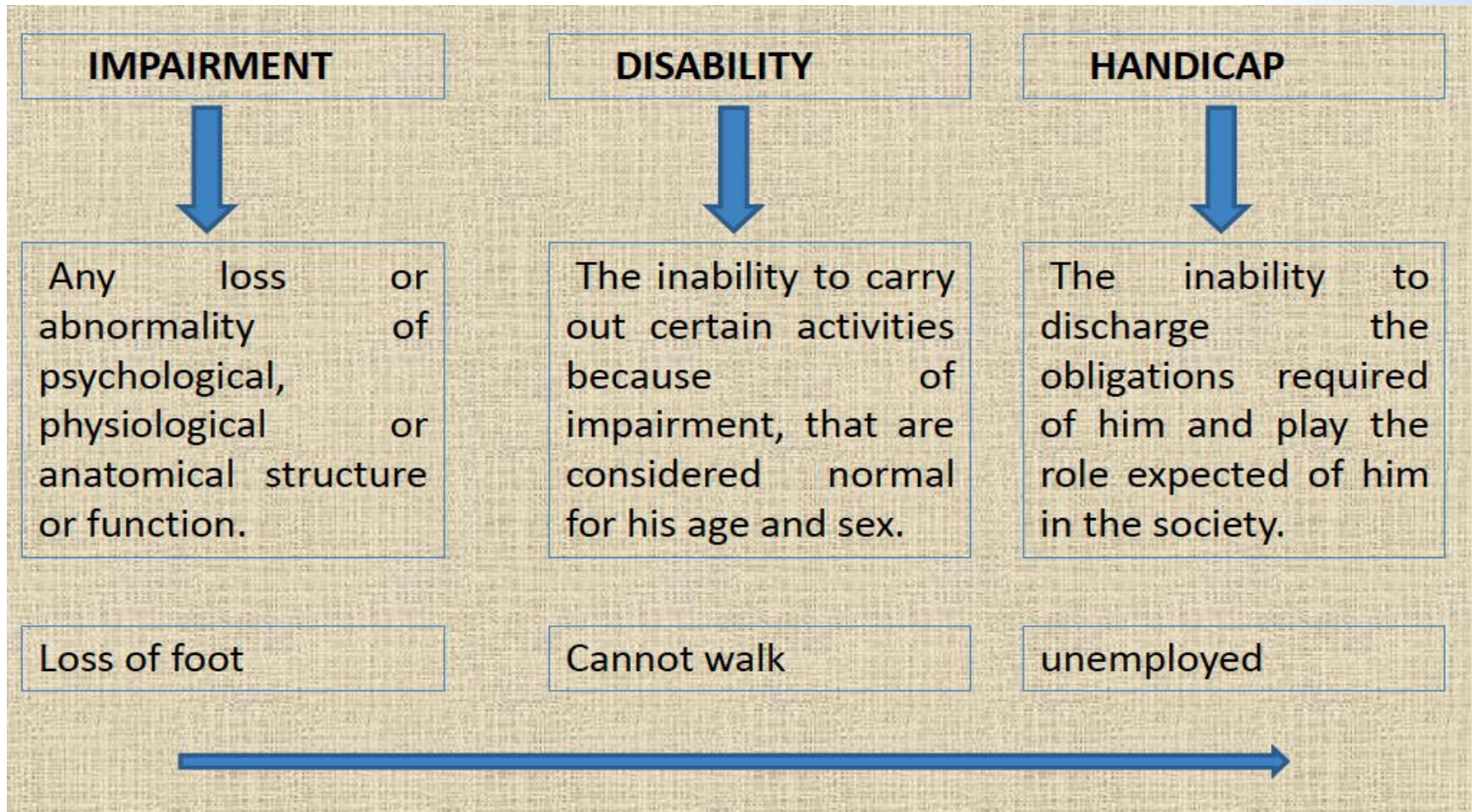
- These include all measures to prevent the occurrence of further complications, impairments, disabilities and handicaps or even death.

## Examples

- Complete rest, morphine, oxygen and streptokinase is given to a patient of **Acute MI**, to prevent death or complications like arrhythmias / CHF.
- Application of plaster cast to a patient who has suffered **Colle's fracture**, is done to prevent complications and further disability like mal-union or non-union.



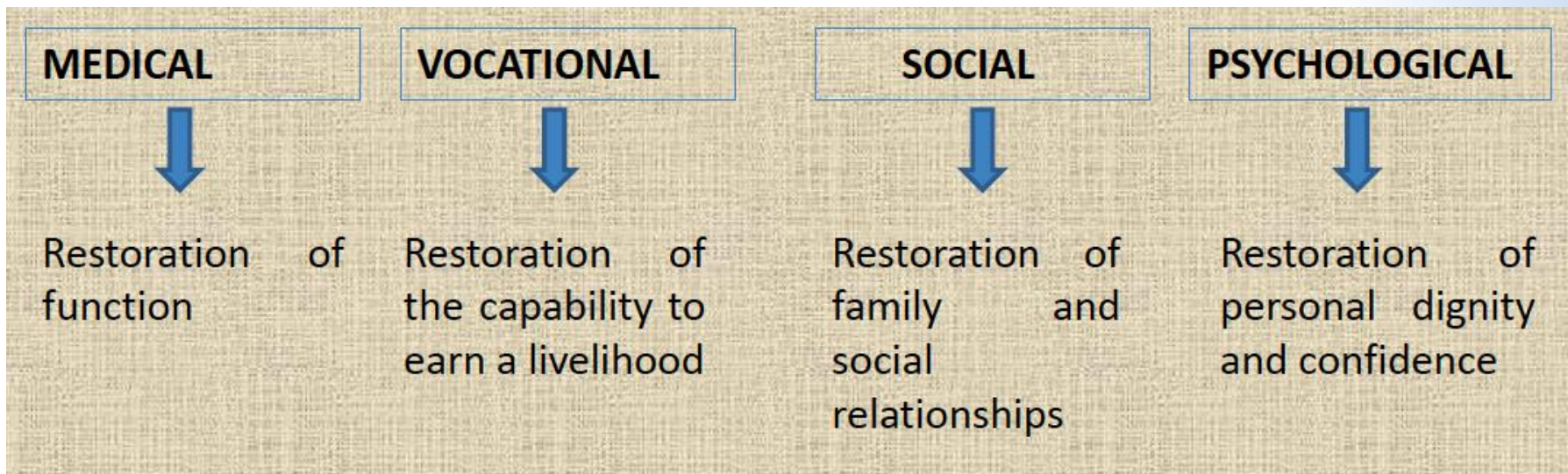
# Tertiary prevention



# Tertiary prevention

## Rehabilitation

- It is defined as the **combined and coordinated** use of medical, social, educational and occupational measures for training and retraining the individual to the **highest possible level of functional ability**.



# Tertiary prevention

- **Examples of Rehabilitation**
  - Establishing schools for blinds
  - Provision of aids for the handicapped
  - Reconstructive surgery in leprosy
  - Muscle re-education and graded exercises in neurological disorders

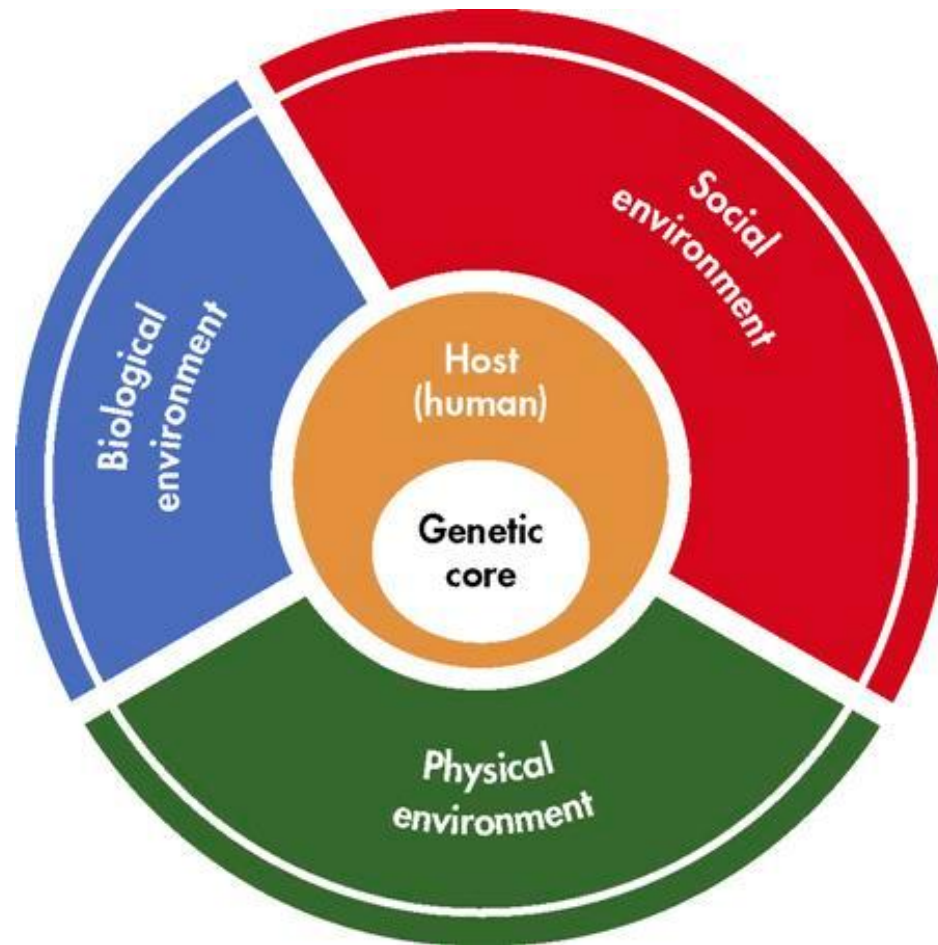
# Levels of prevention

| Level of prevention | Phase of disease                          | Target  |
|---------------------|---|---|
| Primordial          | Underlying condition leading to causation | Total population and selected groups                      |
| Primary             | Specific causal factors                   | Total population, selected groups and healthy individuals |
| Secondary           | Early stage of disease                    | Patients  |
| Tertiary            | Late stage of disease                     | Patients  |

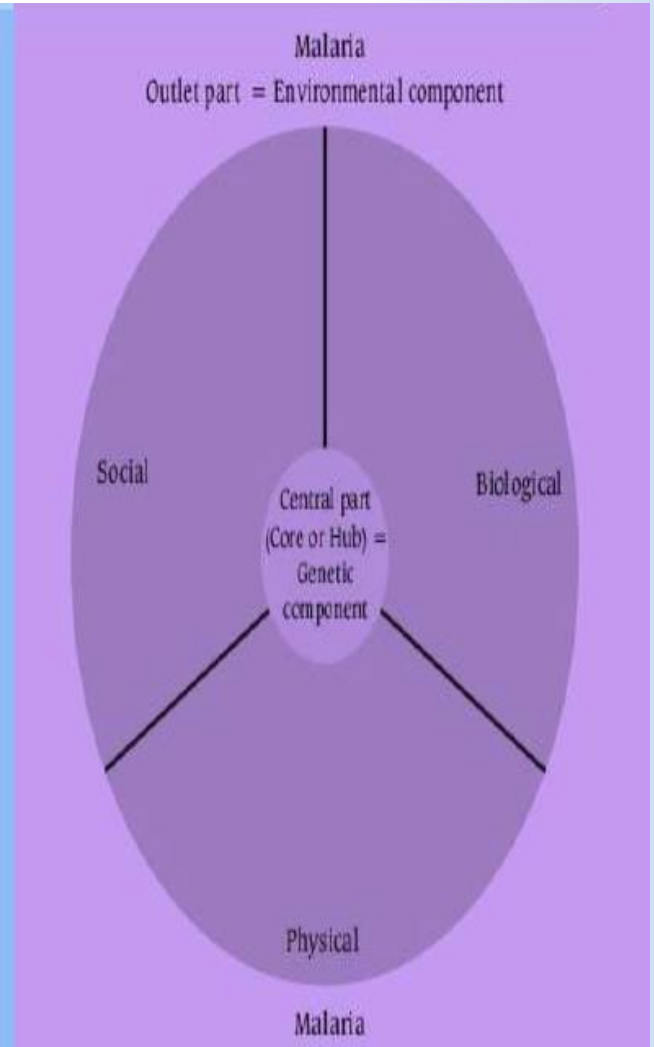
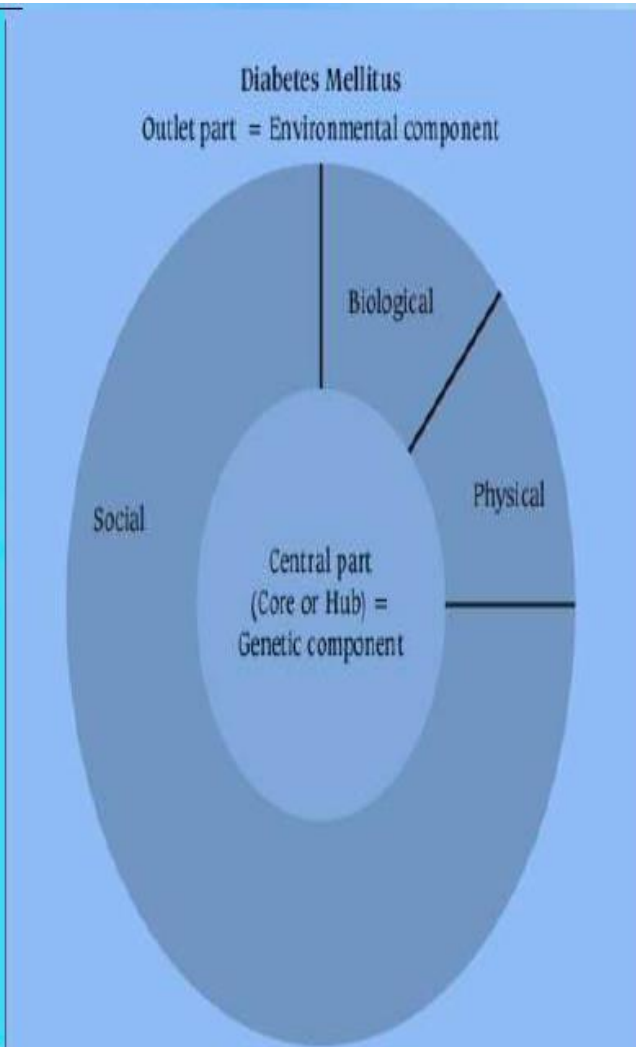
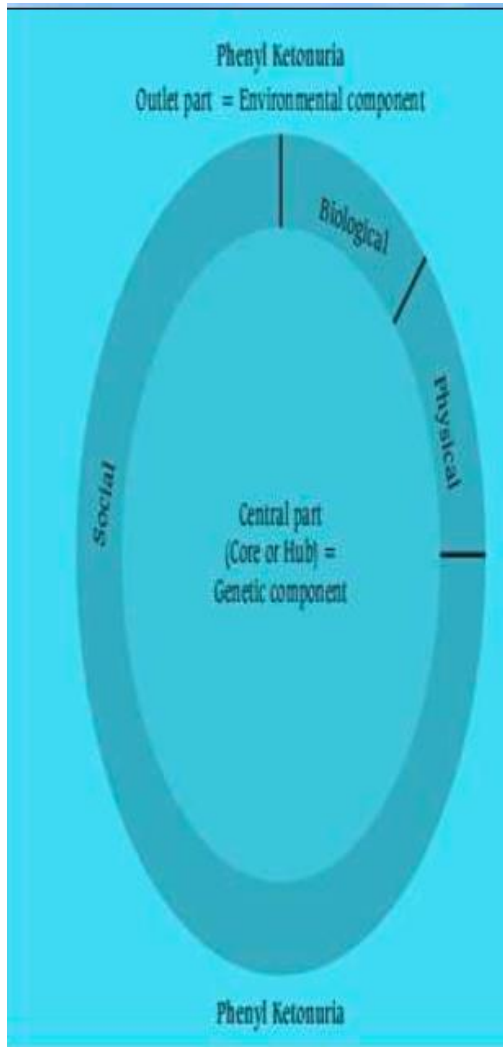
# Wheel theory

- As medical knowledge advanced, an additional aspect of interest that came into play is the comparative role of “genetic” and the “environmental” (i.e. extrinsic factors outside the host) factors in causation of disease.
- The “triad” as well as the “web” theory does not adequately cover up this differential.
- To explain such relative contribution of genetic and environmental factors, the “wheel” theory has been postulated.

# Wheel theory

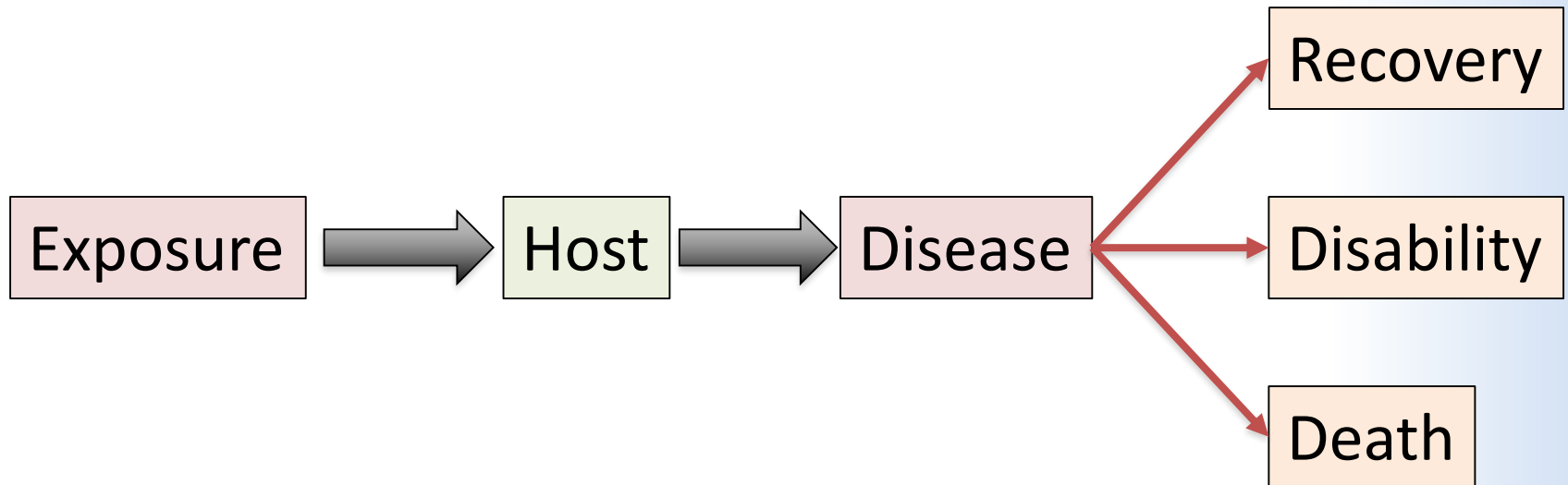


# Wheel theory



Without medical intervention, the process ends with:

- Recovery
- Disability
- Death





# Pre-pathogenesis phase

- This refers to the period **preliminary to the onset** of disease in man.
- The disease **agent** has **not** yet entered man, but the **factors** which favor its interaction with the human host are already existing in the environment.
- This situation is frequently referred to as “**man exposed to the risk of disease**”.

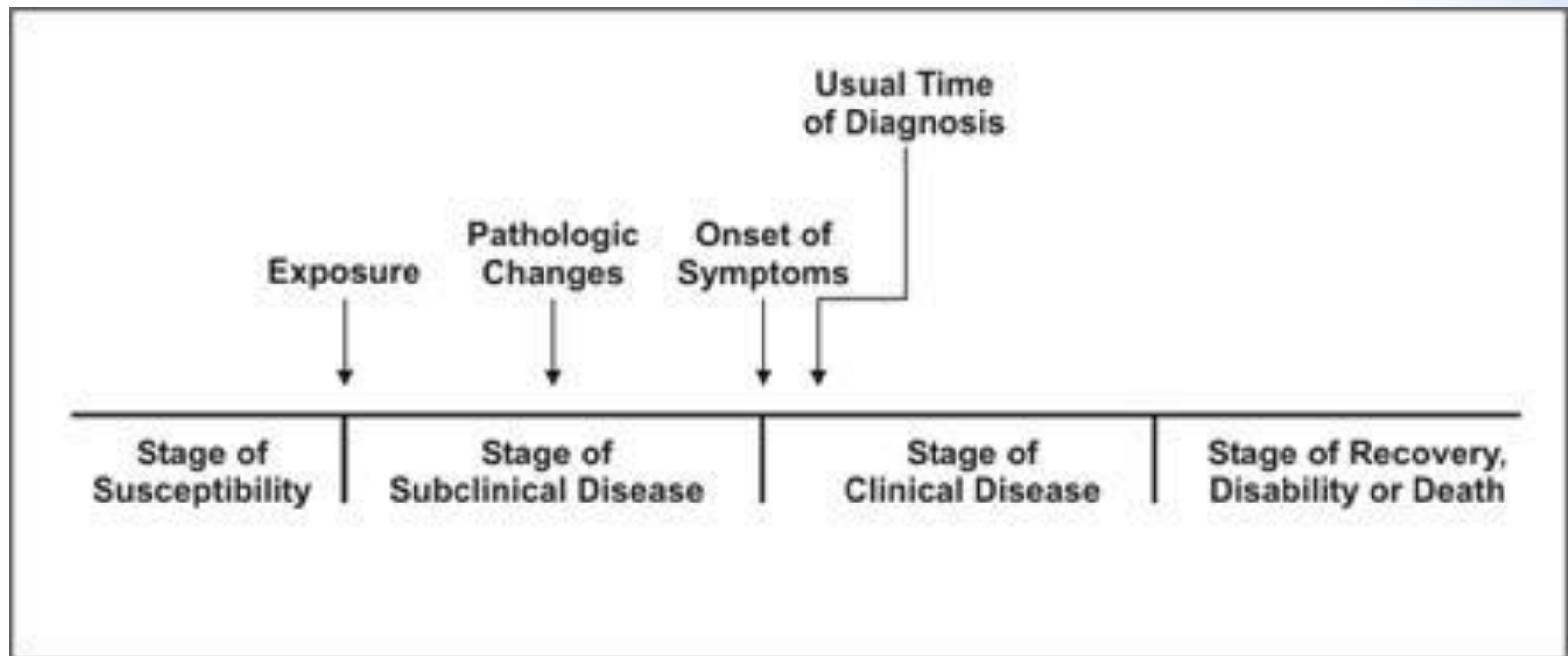
# Pathogenesis phase

- This phase begins with **entry of the disease “agent”** in the susceptible human host.
- After the entry, agent multiplies and induces tissue and **physiological changes**, the disease progresses through the period of **incubation** and later through the period of **early** and **late** pathogenesis.
- The final outcome of the disease may be **recovery**, **disability** or **death**.

# Pathogenesis phase

- In **chronic diseases**, the early pathogenesis phase is **less dramatic** and is also called as **pre-symptomatic** phase.
- During pre-symptomatic stage, there is **no manifest disease**. The **pathological changes** are essentially below the level of the “clinical horizon”.
- The **clinical stage** begins when **recognizable signs or symptoms appear**.
- By the time signs and symptoms appear, the disease phase is already well advanced into the **late** pathogenesis phase.

# Natural History of Disease



# Spectrum of disease

- It is a **graphic** representation of **variations in the manifestations of disease**.
- At the one end of disease spectrum are **sub-clinical infections** which are not ordinarily identified, and at the other end are **fatal illnesses**.
- In the middle of spectrum lie illnesses ranging in severity from **mild to severe**.
- These different manifestations are the result of **individuals' different states of immunity and receptivity**.

# Spectrum of disease

Spectrum of disease presents **challenges** to the clinician and to the public health worker.

## WHY?

- Because of the clinical spectrum, cases of illness diagnosed by clinicians in the community often represent only the “tip of the iceberg.” Many additional cases may be **too early to diagnose or may remain asymptomatic.**
- For the public health worker, the challenge is that persons with **undiagnosed infections may be able to transmit them to others.**