Natural History of Disease and Concepts of Prevention and Control

Dr. Shatha Alduraywish, *MBBS; MEpi; PhD*

Assistant Professor, Epidemiologist

Department of Family and Community Medicine

College of Medicine - King Saud University

Email: salduraywish@ksu.edu.sa

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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

Etiology

Risk Factors

Diagnostic measures

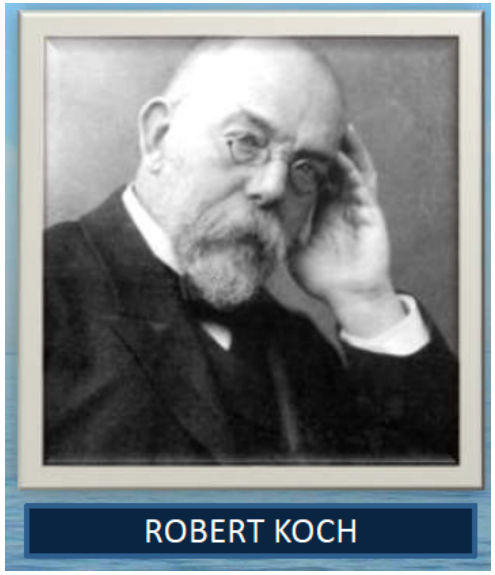
Therapeutic measures

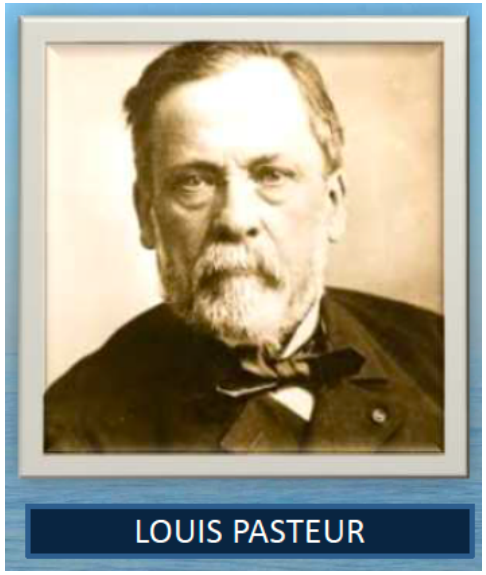
Preventive measures

Theories Of Disease Causation

Germ Theory

- In the second half of 19th century
- Proposed by Robert Koch and Louis Pasteur (discovery of bacteria).





Germ Theory

Every human disease is caused by a microbe or germ, which is specific for that disease and one must be able to isolate the microbe from the diseased human being.

Germ Theory

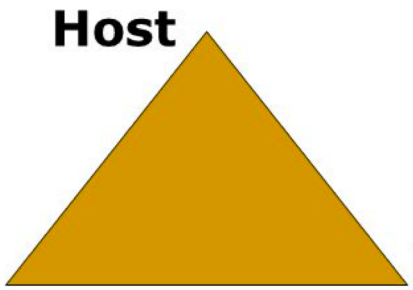
One to one relationship between causal agent and disease.

Disease agent → **Man** → **Disease**

The Epidemiological Triad

Epidemiologic triad

- Demographic characteristics
- Biological characteristics
- Socioeconomic characteristics



- Biological agents
- Physical agents
- Chemical agents
- Nutrient agents
- Mechanical agents
- Social agents

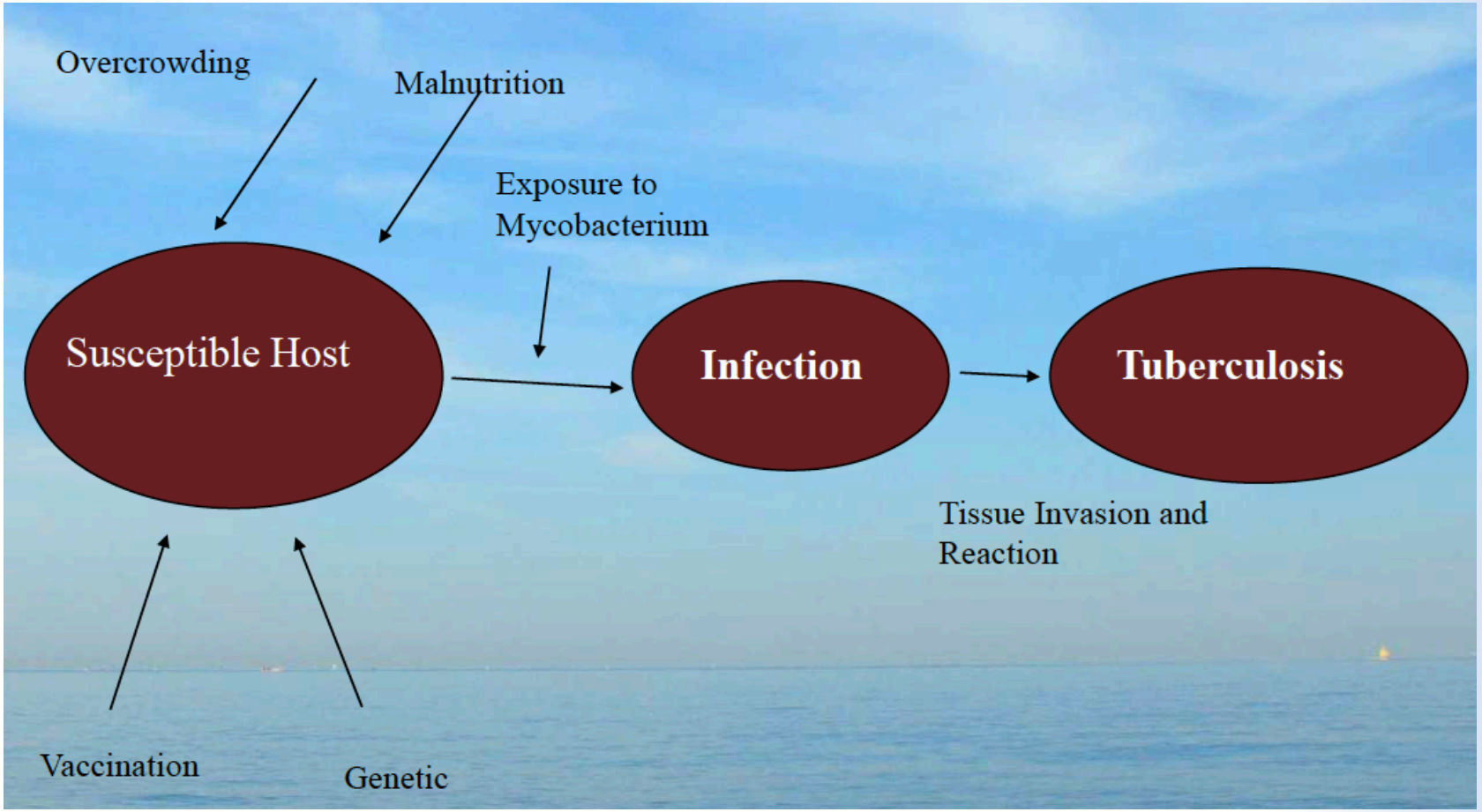
- Physical environment
- Biological environment
- Social environment

The Epidemiological Triad

Example

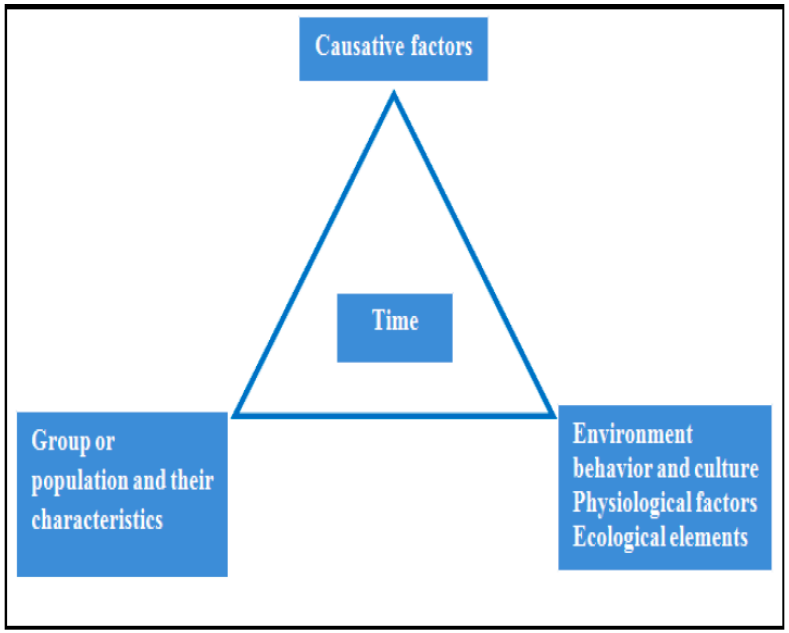
Not everyone exposed to tubercle bacteria develops tuberculosis but the same exposure in an undernourished or immunocompromised person may result in clinical disease and exposure occurs more in overcrowding.

The Epidemiological Triad



Epidemiological Tetrad

- In addition to HOST, AGENT and ENVIRONMENT, one more factor TIME factor is added.
- *TIME accounts* for incubation periods, life expectancy of the host or pathogen, duration of the course of illness .



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"

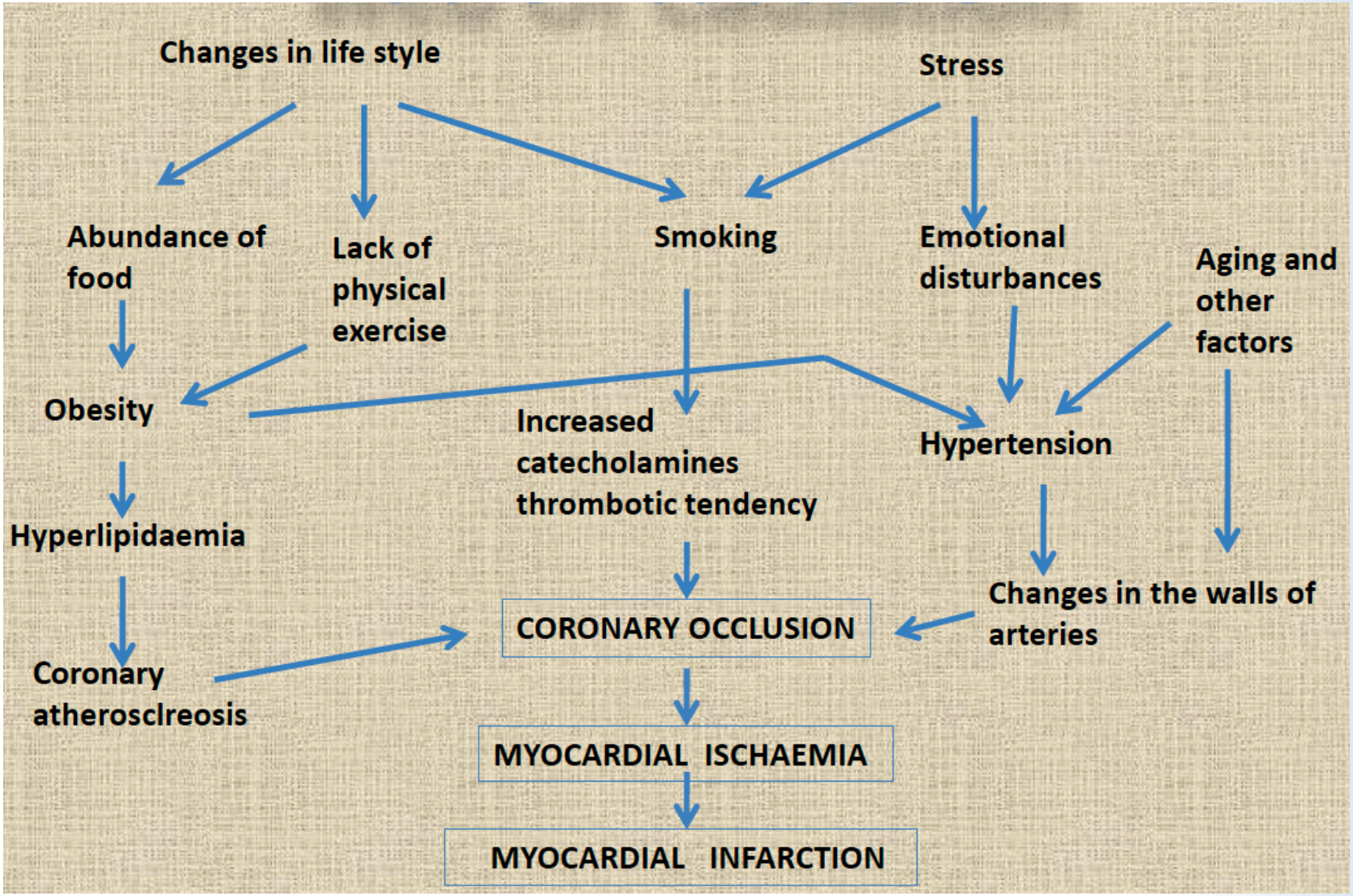
- Suggested by MacMohan and Pugh.
- The various factors (e.g. hypercholesterolemia, smoking, hypertension) are like an interacting web of a spider.
- Each factor has its own relative importance in causing the final departure from the state of health, as well as interacts with others, modifying the effect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

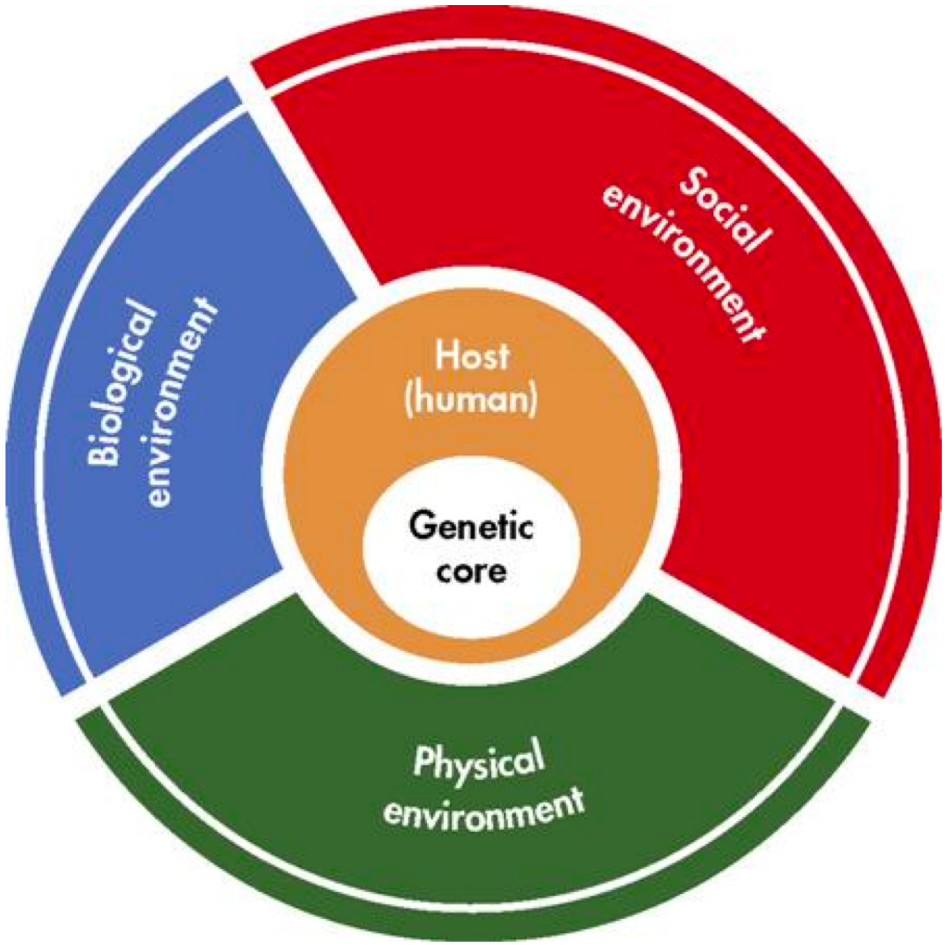
The Theory of "Web of Causation"



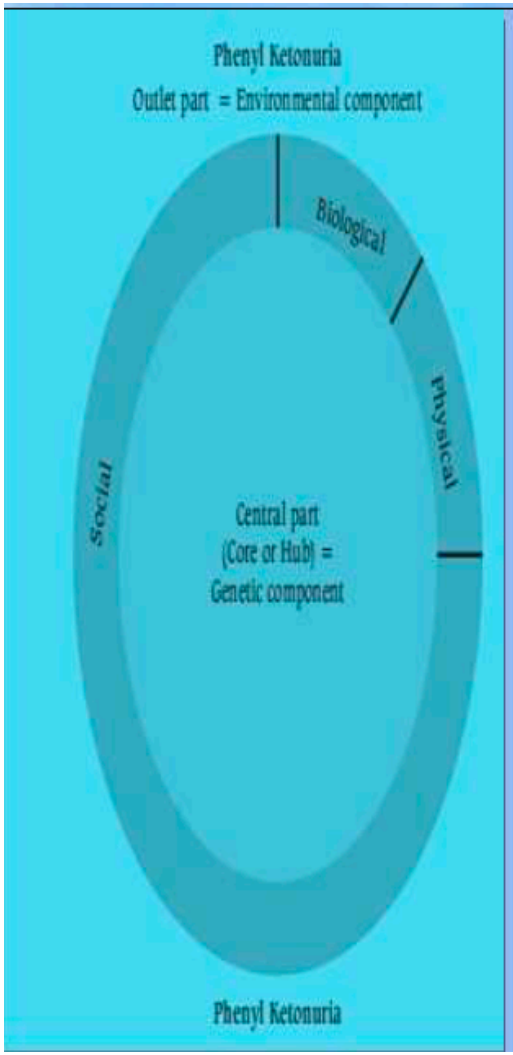
Wheel theory

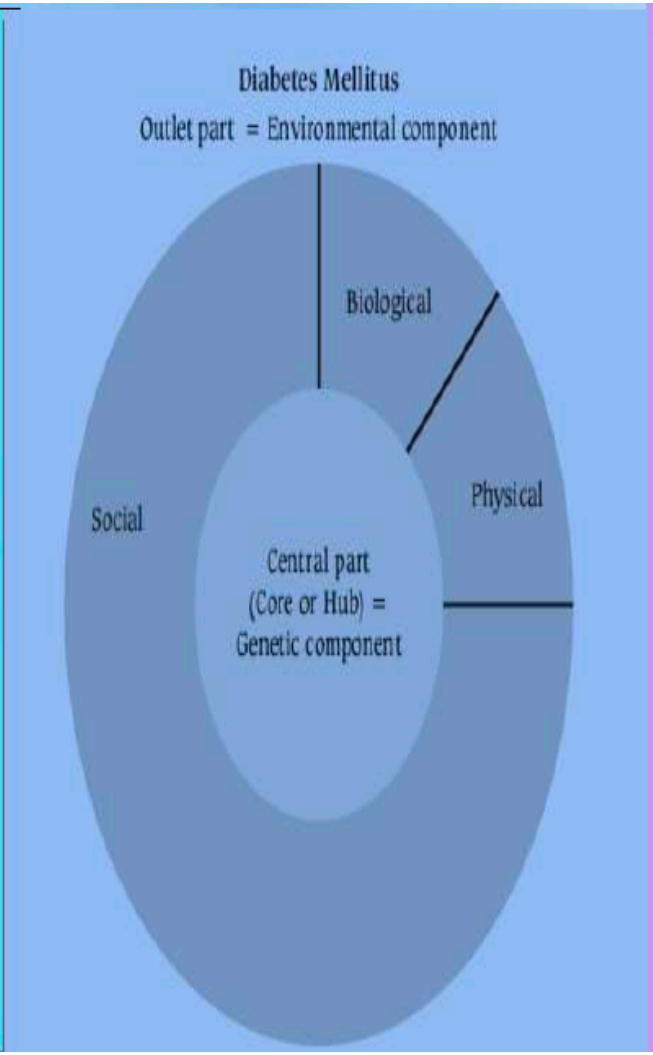
- As medical knowledge advanced, an additional aspect of interest that came into play is the comparative role of "genetic" and the "environmental" (i.e. extrinsic factors outside the host) factors in causation of disease.
- The "triad" as well as the "web" theory does not adequately cover up this differential.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

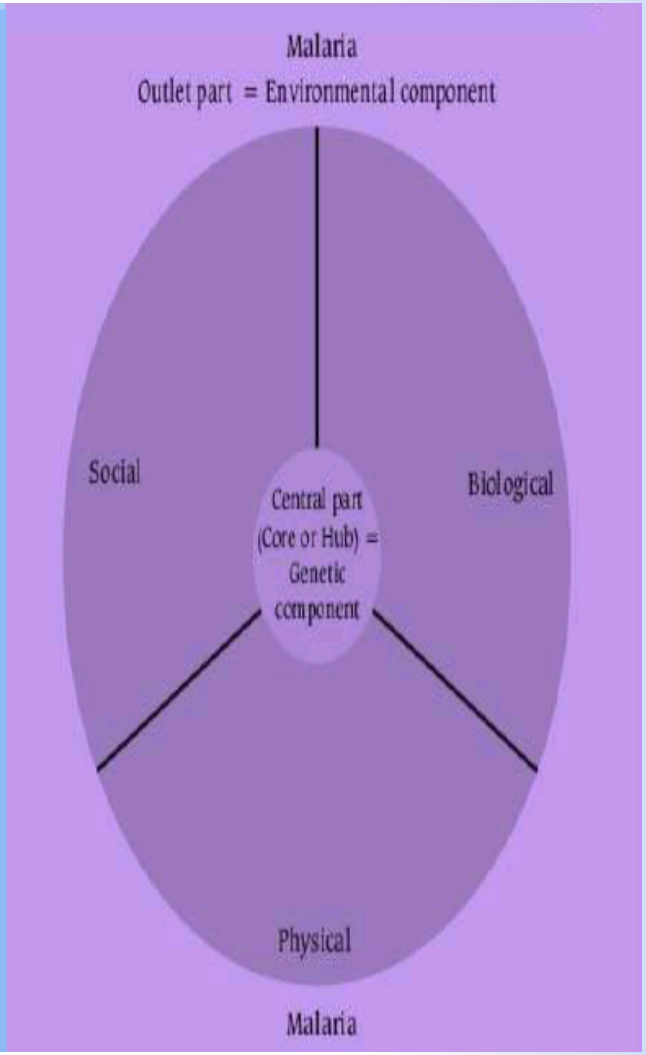
Wheel theory



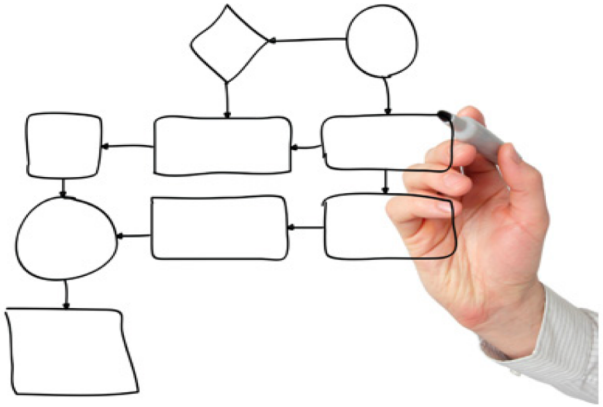
Wheel theory







Natural History of Disease



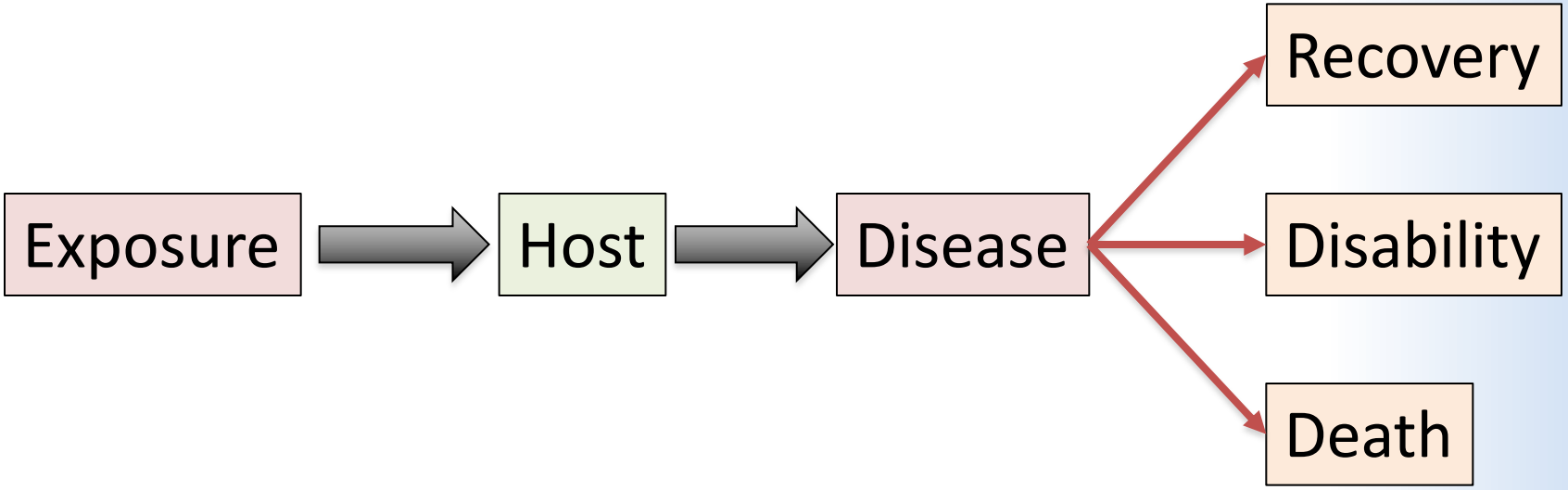
Definition

- 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

Without medical intervention, the process ends with:

- Recovery
- Disability
- Death



Why it is important?

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 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 and retrospective studies, undertaken in different population settings.

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

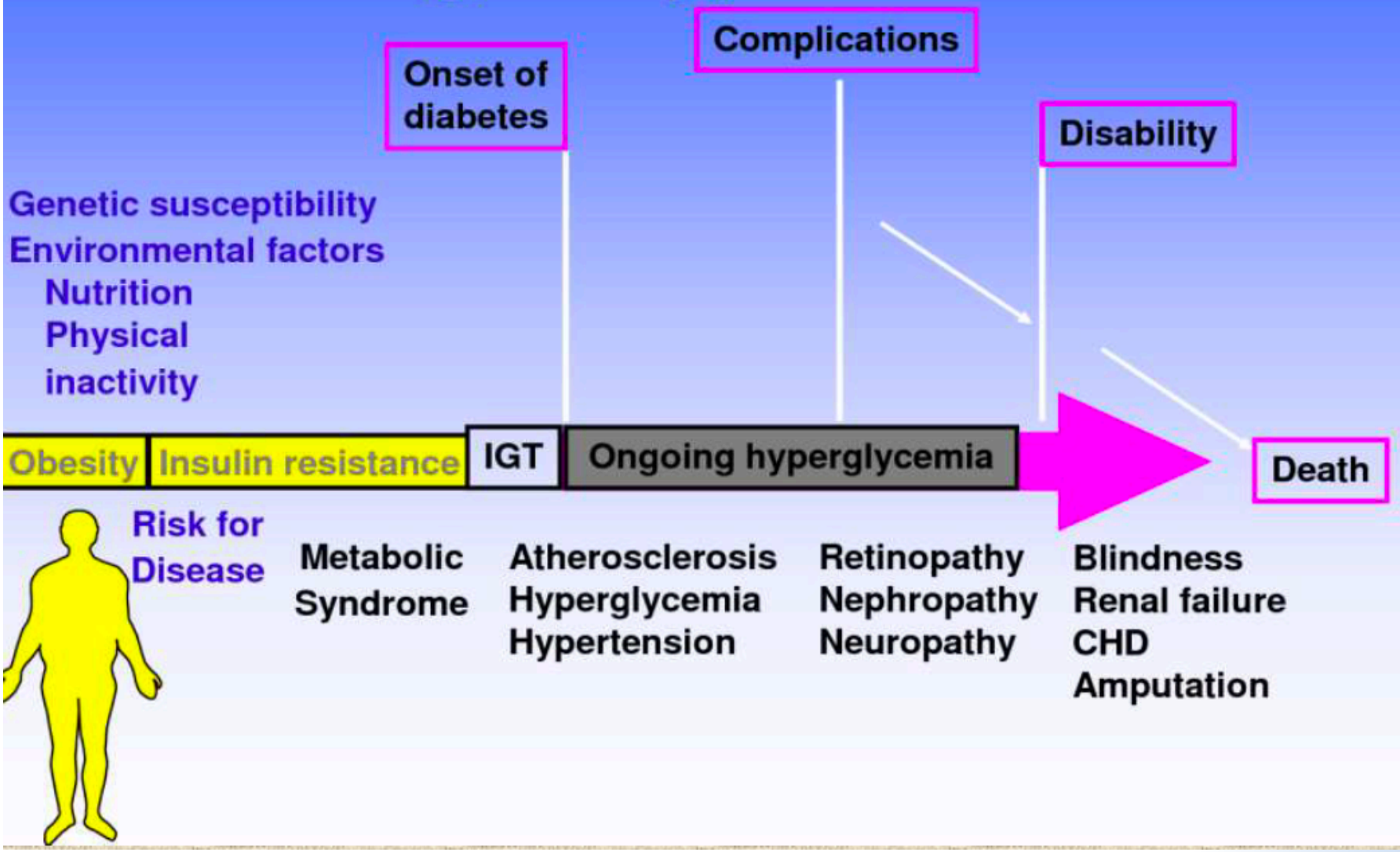
- The epidemiologist, by studying the natural history of disease in the community setting is in a unique position to *fill the gaps in the knowledge* about the natural history of disease.

Schematic Diagram of The Natural history of disease in a patient

Why ?

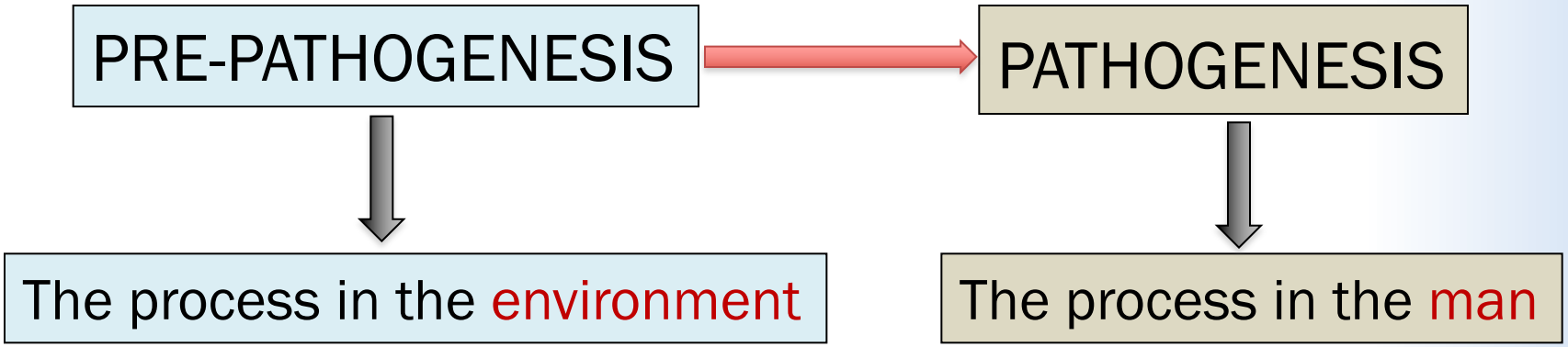
It is framework to understand the pathogenic chain of events for a particular disease, and for the application of preventive measures.

Natural History of Obesity Leading to Type 2 Diabetes



Schematic Diagram of The Natural history of disease in a patient

Consists of two phases



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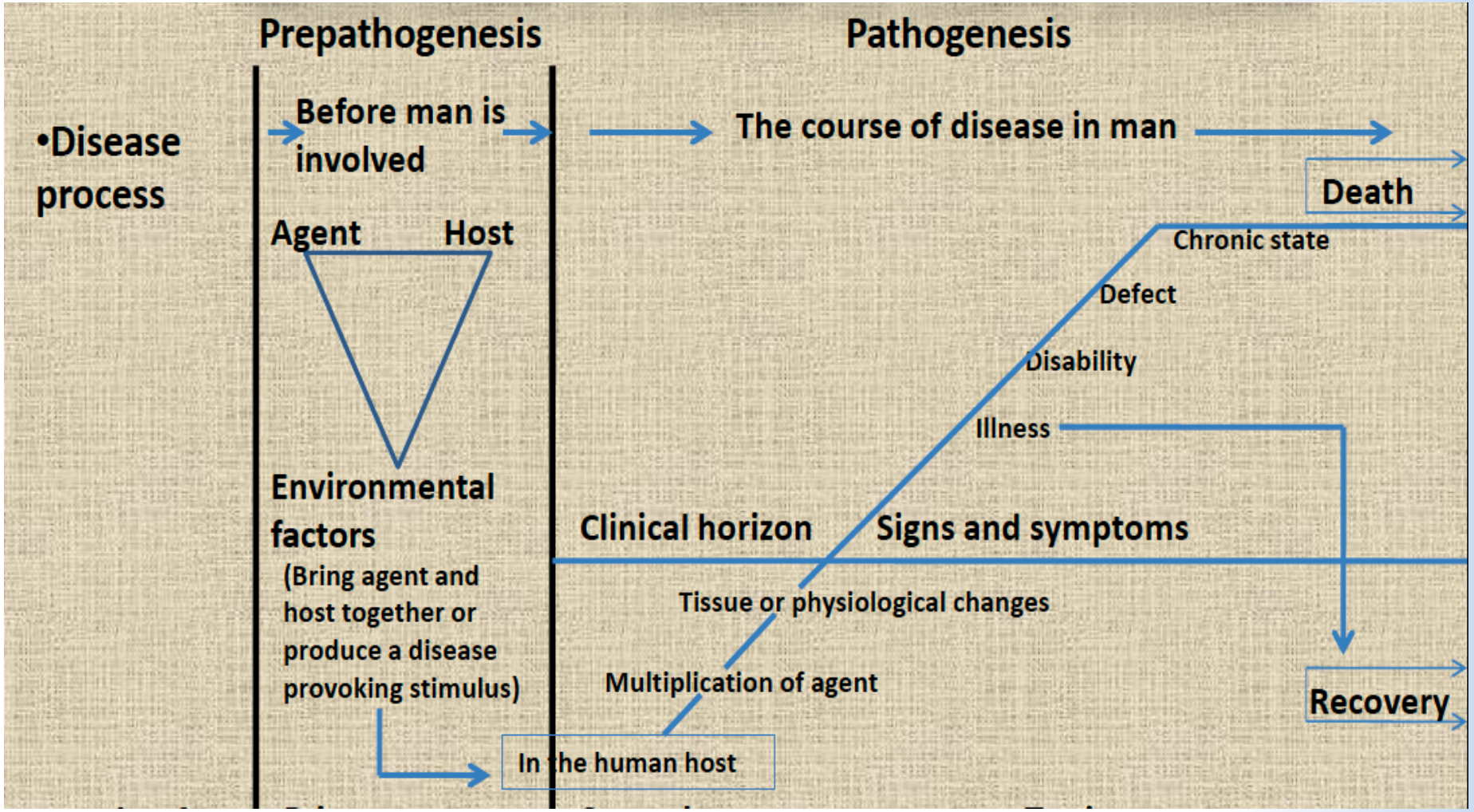


Pre-pathogenesis phase

- 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".

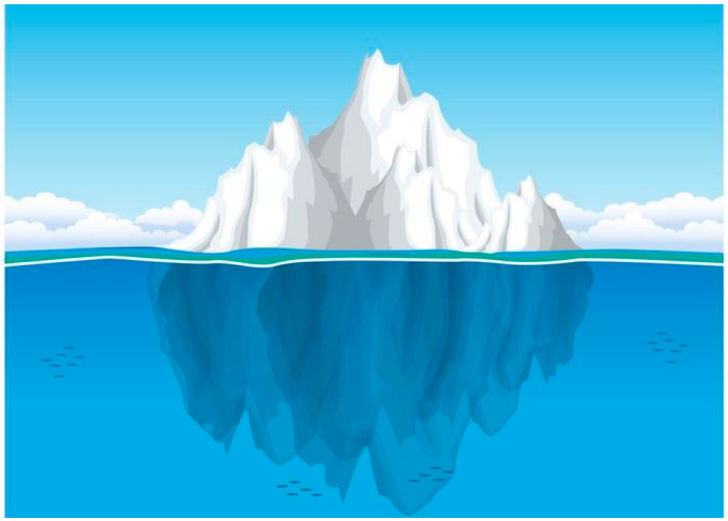
Pathogenesis phase

- 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.

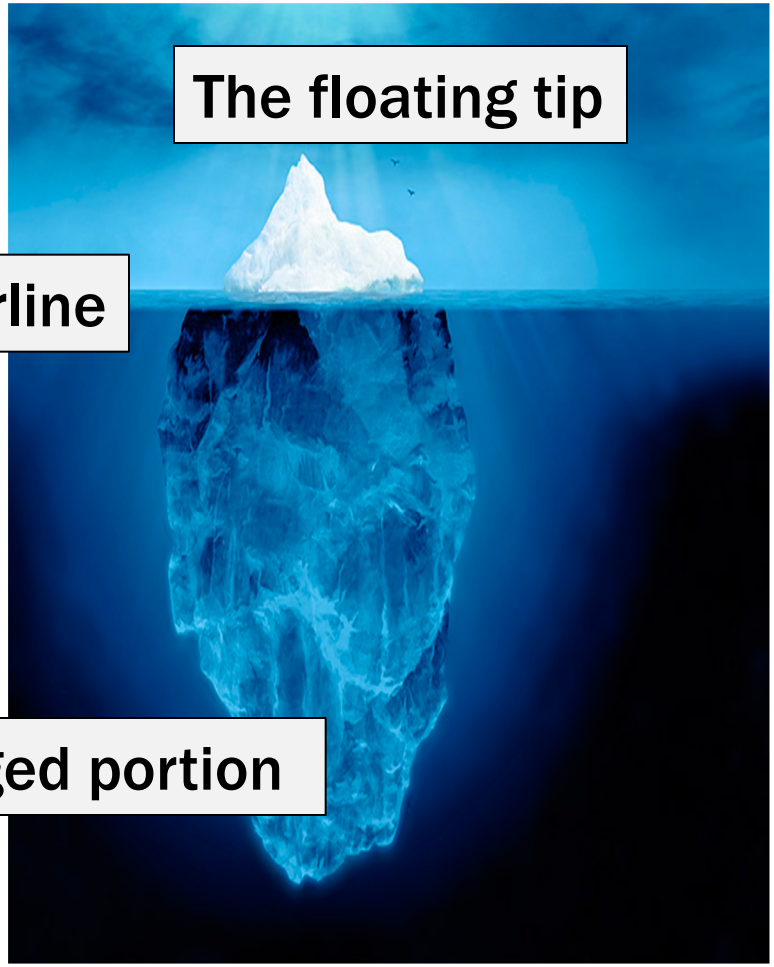
Spectrum of Disease and Iceberg Phenomenon



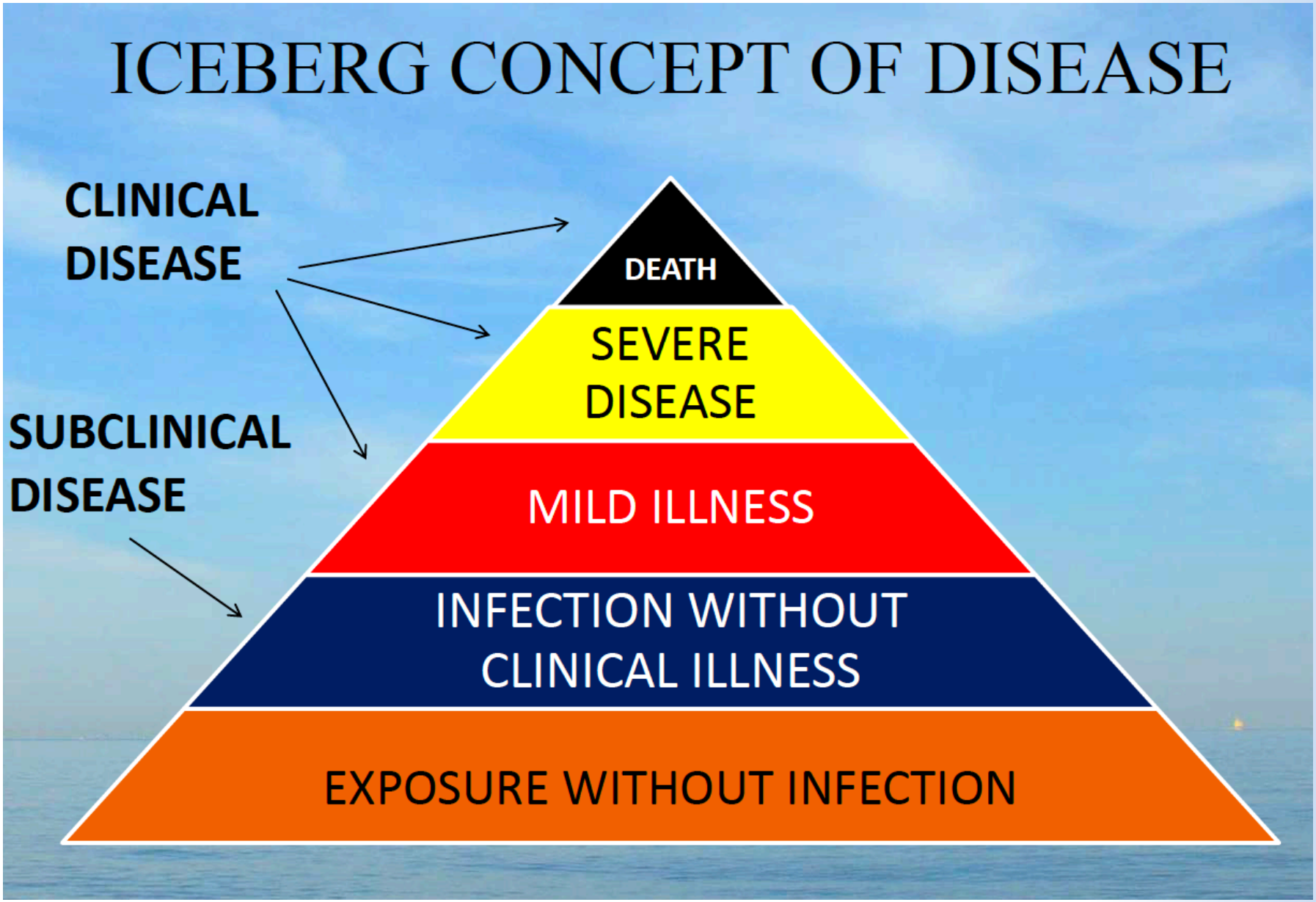
Spectrum of disease

- 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.

Iceberg of disease



ICEBERG CONCEPT OF DISEASE



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.

Concept of Prevention

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

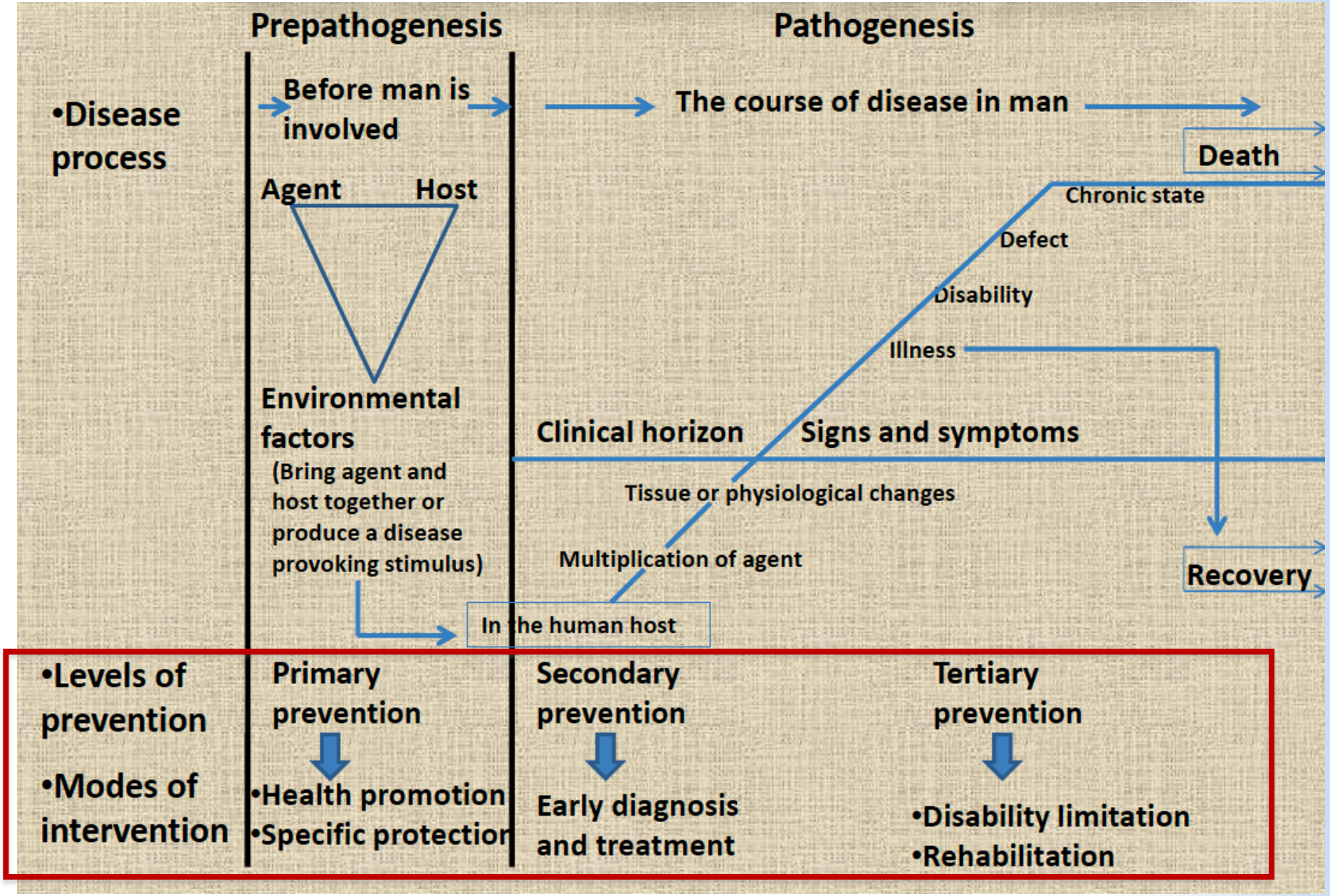
Primordial prevention

- 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.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Pathogenesis
•Disease process
Before man is involved
The course of disease in man
Death
Agent
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Chronic state
Defect
Disability
Illness
Environmental factors
(Bring agent and host together or produce a disease provoking stimulus)
Clinical horizon
Signs and symptoms
Tissue or physiological changes
Multiplication of agent
Recovery
In the human host
•Levels of prevention
•Modes of intervention
Primary prevention
•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

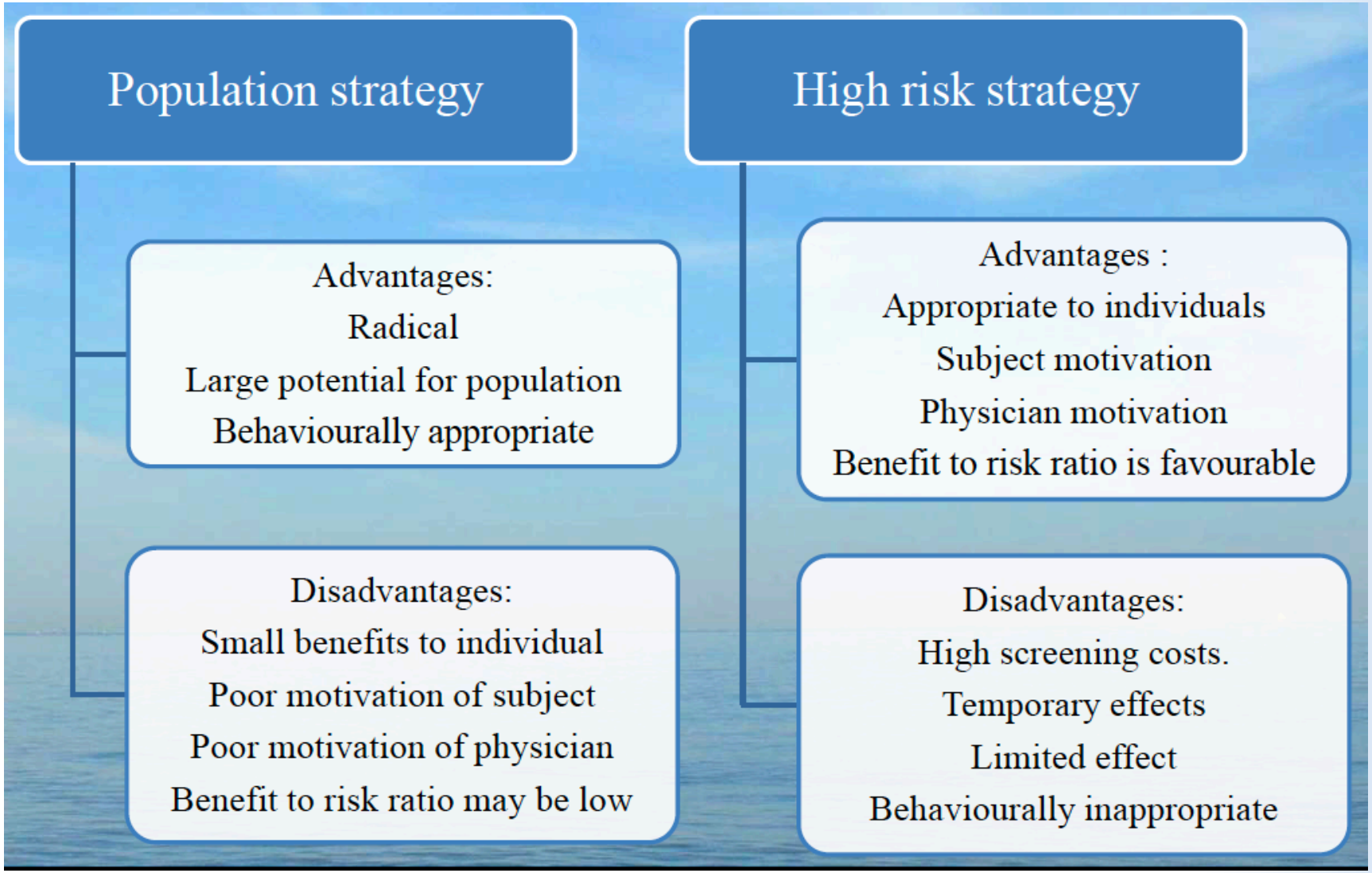
Population strategy

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

High risk strategy

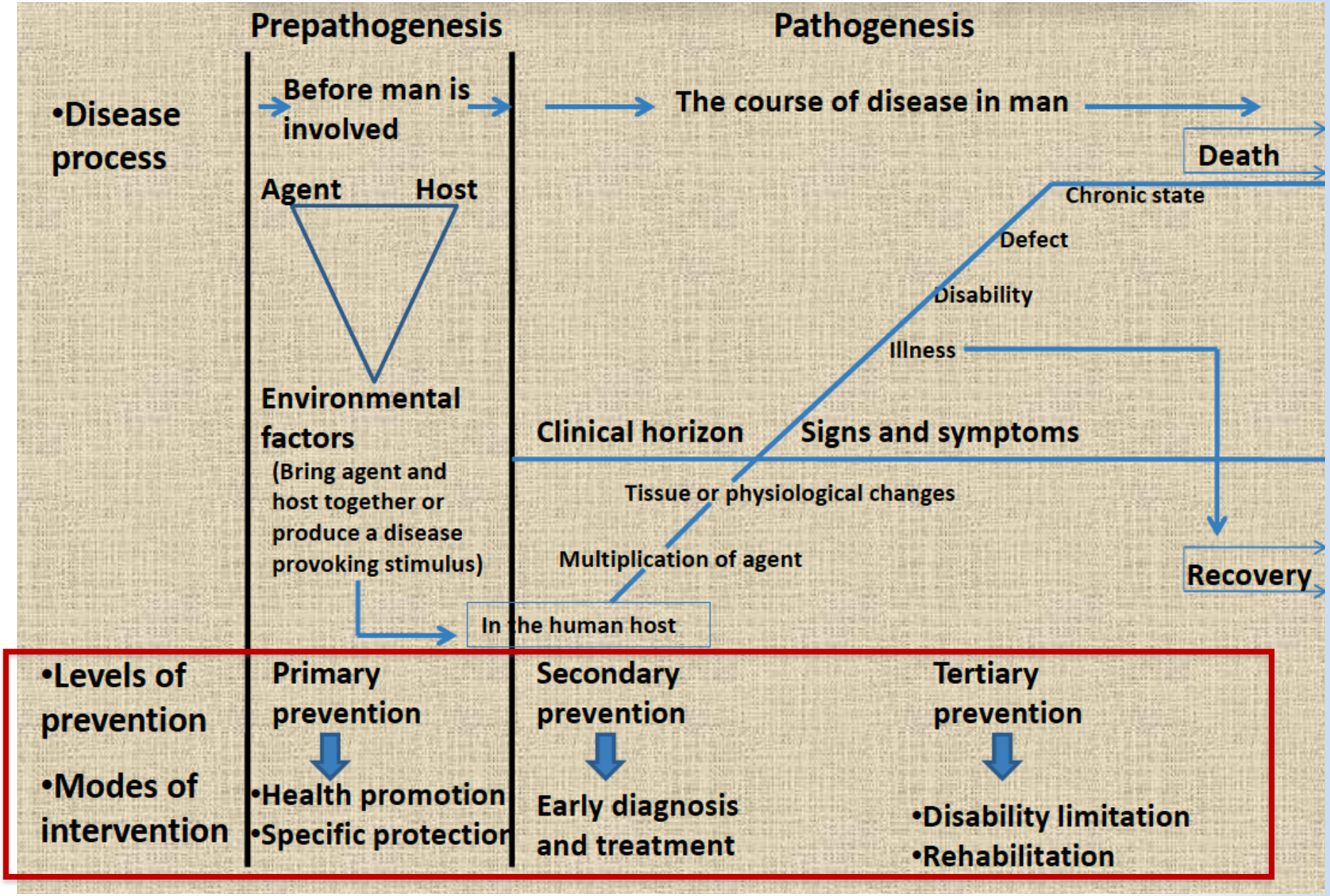
- Includes **identification** of "High risk groups" in the population and bring **preventive** care to these risk group.
- e.g., People having the family history of Hypertension, allergic disease, Diabetes .

Primary Prevention



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.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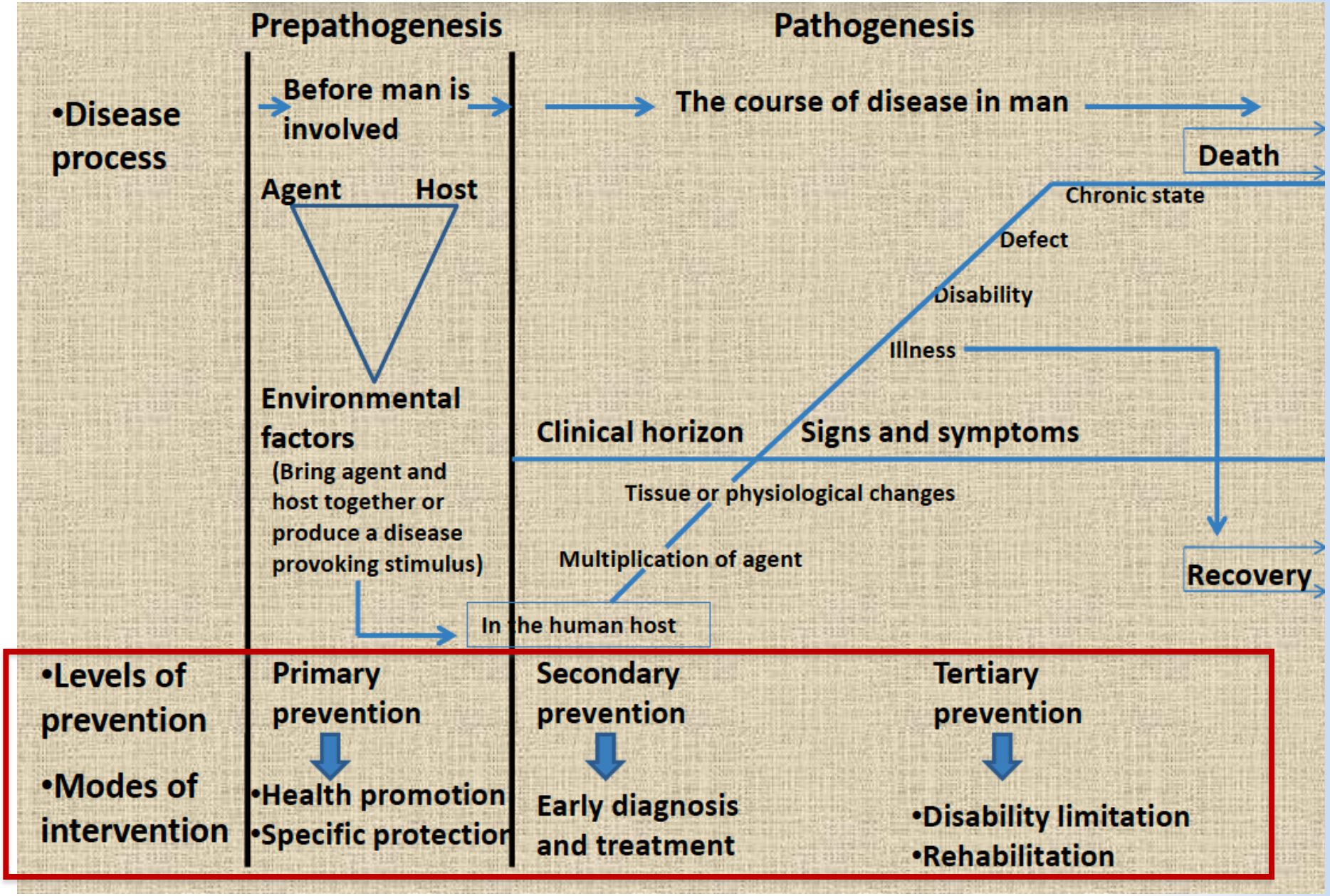
Secondary prevention

- 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.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Tertiary prevention

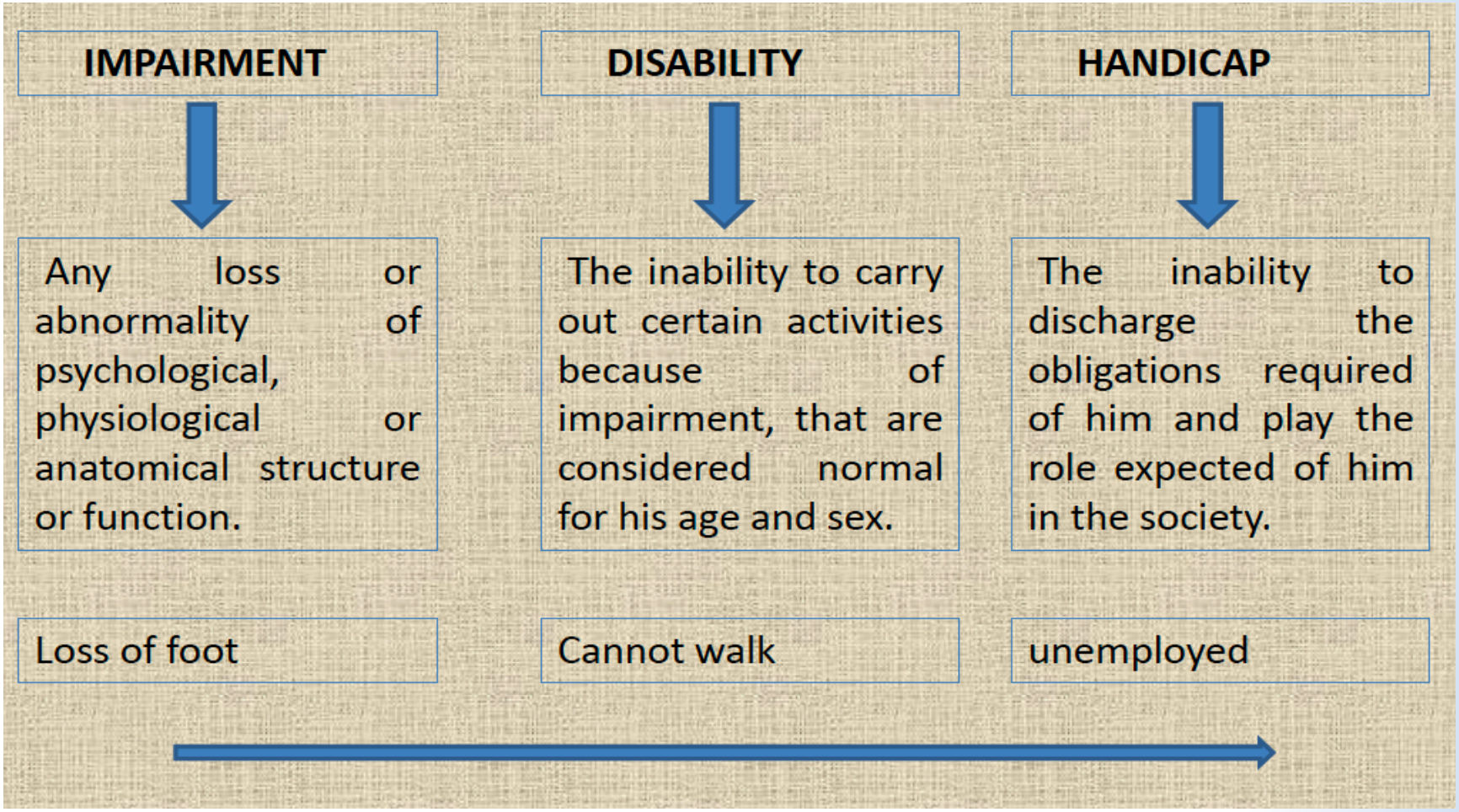
Disability Limitation

- 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.

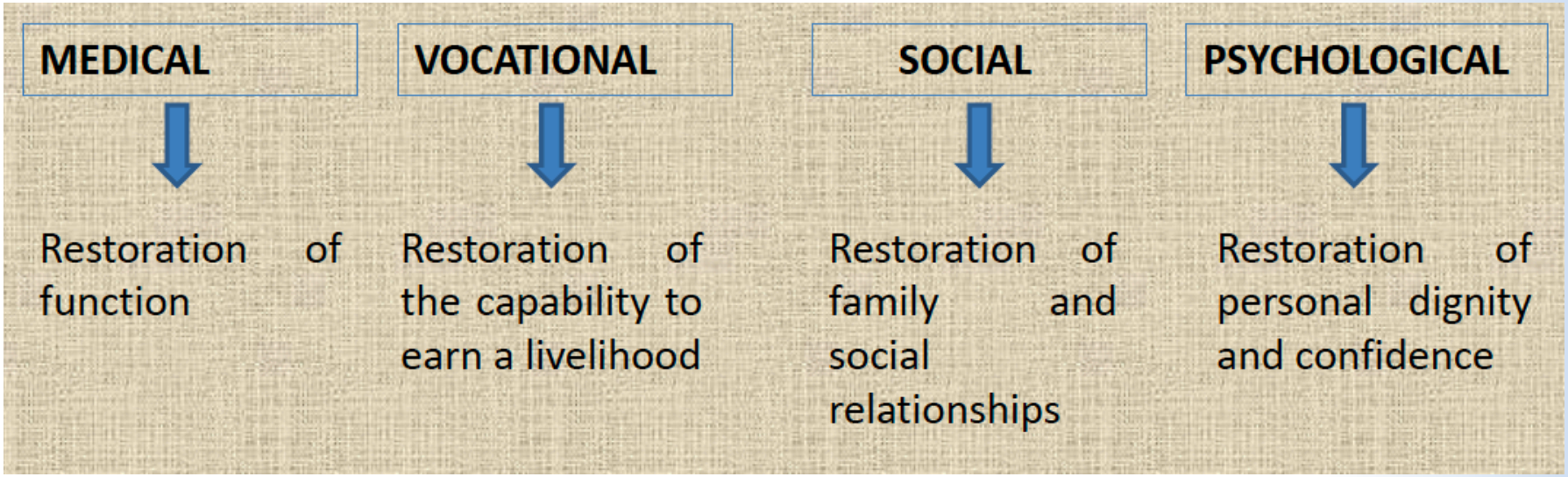
Tertiary prevention



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


thank
you