

NATURAL HISTORY OF DISEASE

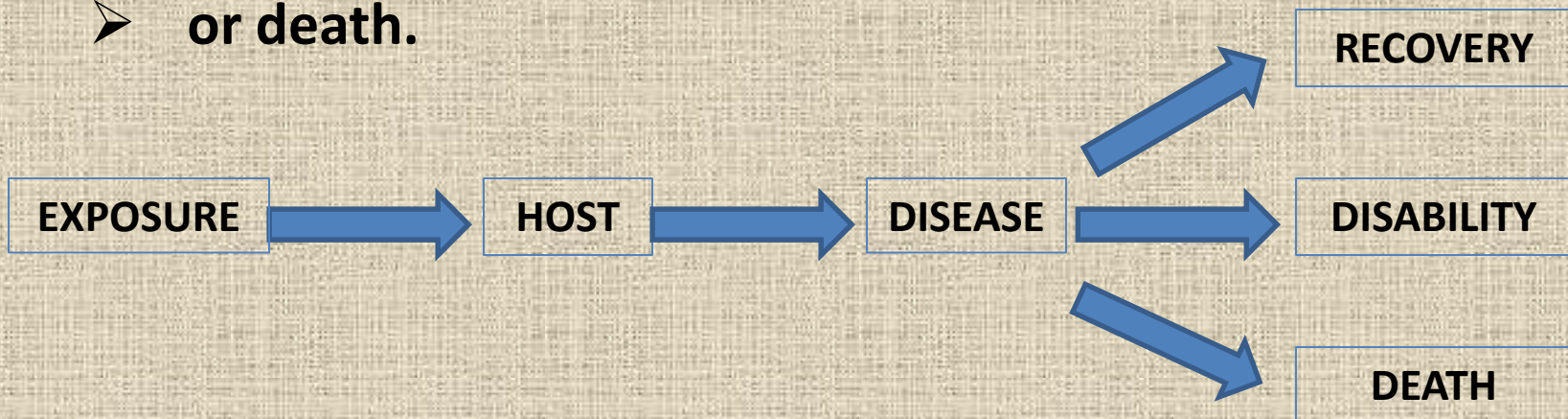
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Introduction

- **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**,
 - **or death**.



Introduction

- Natural history of disease is one of the **major elements of descriptive epidemiology.**
- Any disease results from a complex interaction between man, agent(or cause of disease) and the environment.
- Understanding the progress of disease process and its pathogenetic chain of events is must for the **application of preventive measures.**

Concept of Disease

- **Disease** literally means “**without ease**”. It can be simply defined as **the opposite of health** - i.e. , any deviation from normal functioning or state of complete physical or mental well being – since health and disease are mutually exclusive.
- **Oxford English Dictionary** defines disease as “a condition of the body or some part or organ of the body in which its functions are disrupted or deranged.”

Concept of Disease

- The **WHO** has defined health but not disease. This is because disease has many shades (“spectrum of disease”) ranging from inapparent (subclinical) cases to severe manifest illness.
- **Health** is defined as a **state of complete physical, mental and social well-being** and not merely an absence of disease or infirmity.

Concept of Disease

DISEASE



•Physiological or psychological dysfunction.

ILLNESS



•Presence of a specific disease as well as the individual's perception and behavior in response to the disease.

SICKNESS



•State of social dysfunction, i.e., a role that individual assumes when ill.

Concept of Causation

Germ Theory of Disease

LOUIS PASTEUR



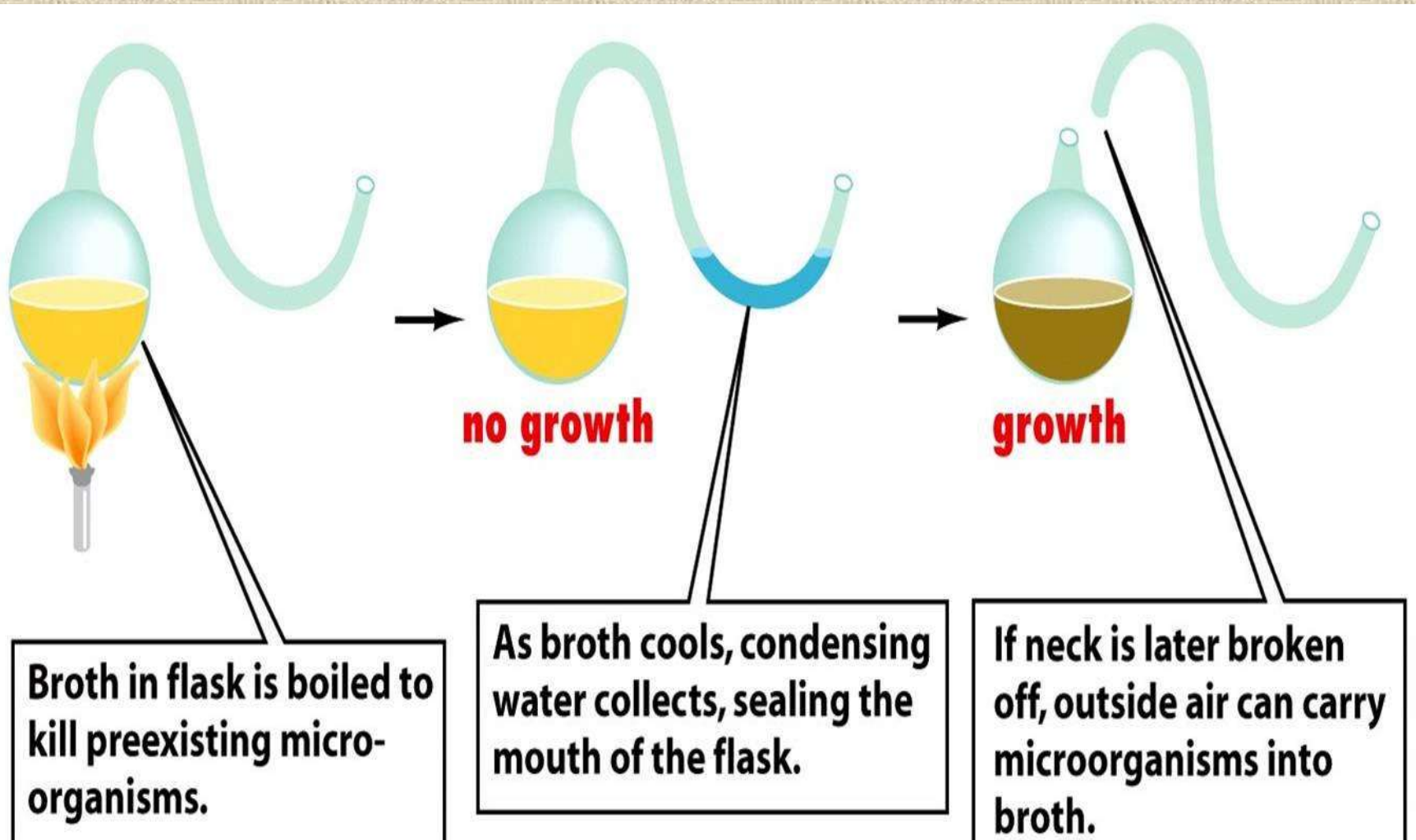
Demonstrated the presence of bacteria in air in 1860.

ROBERT KOCH



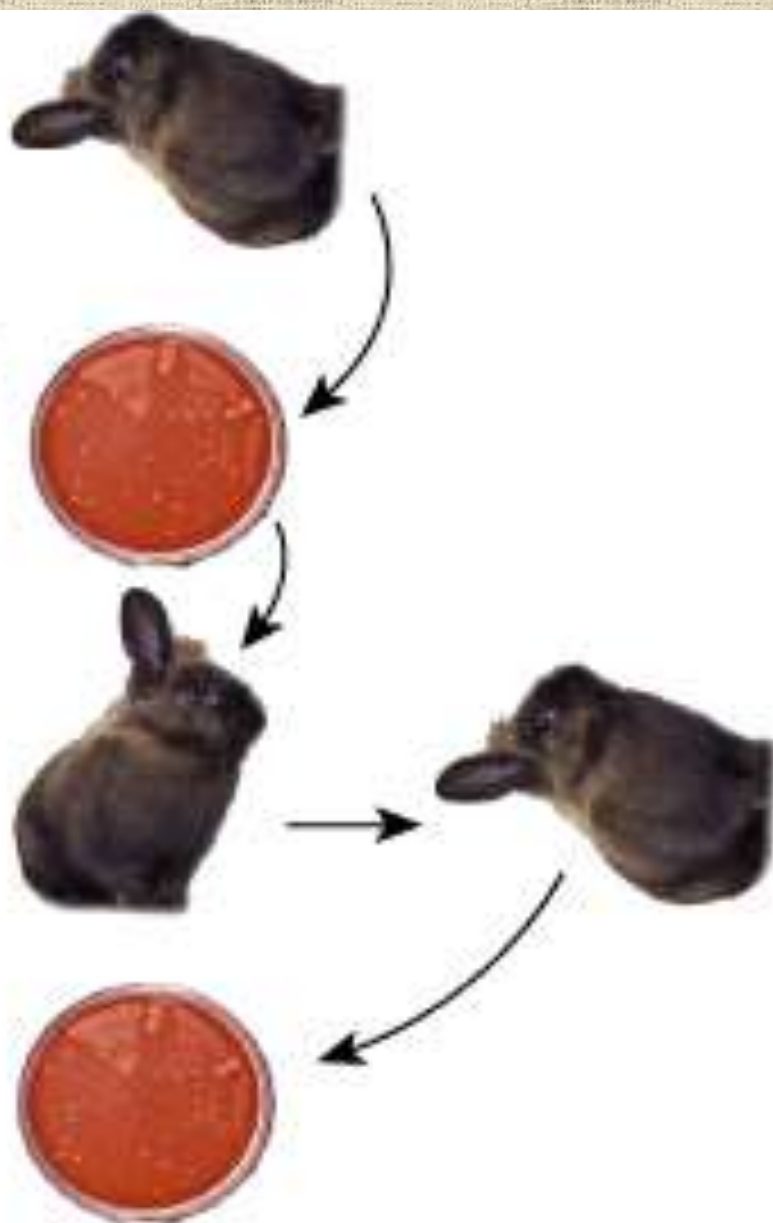
Showed that **Anthrax** is caused by a bacteria in 1877.

Louis Pasteur's experiment to refuse the theory of Spontaneous generation



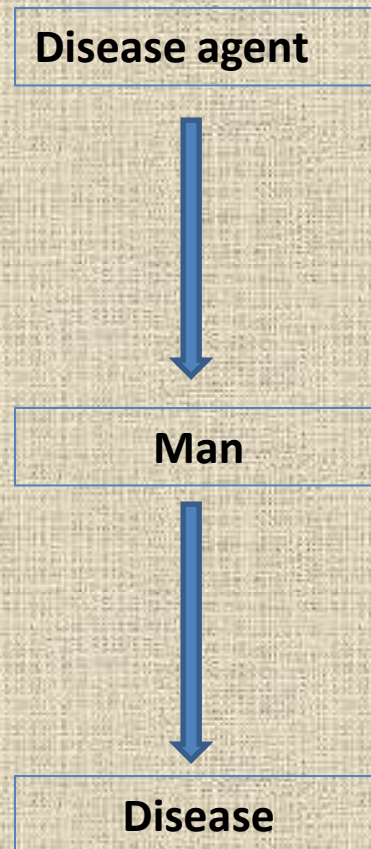
Koch's postulates

1. Isolate the pathogen (virus, microbe, etc.) from sick creature.
2. Grow the pathogen in the laboratory and obtain a pure culture.
3. Inoculate a healthy creature with a sample from the pure culture. The pathogen should cause the same disease symptoms that were seen in first creature.
4. Reisolate the same pathogen from the second sick animal.



Germ Theory Of Disease

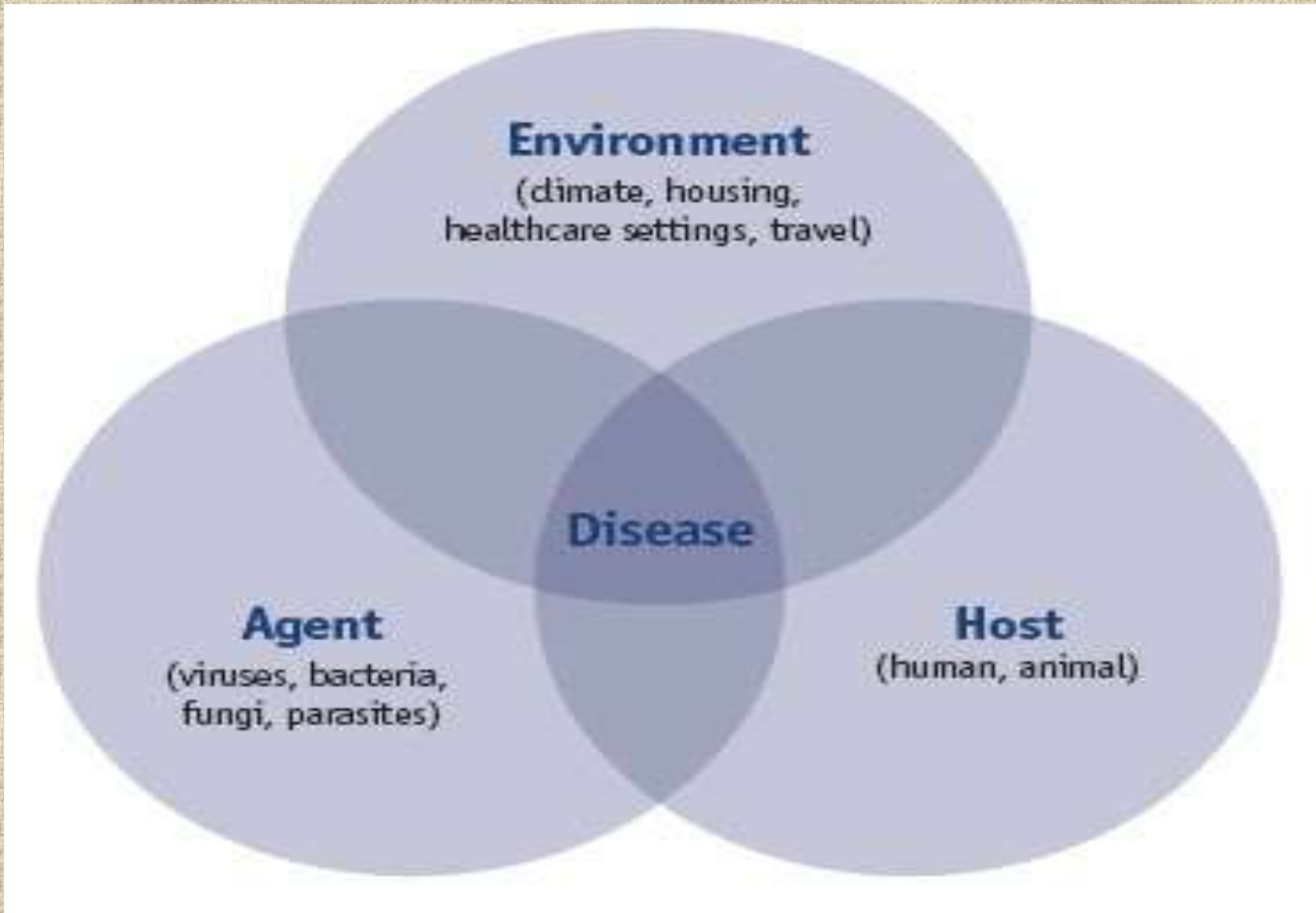
- One to one relationship between causal agent and disease.



Epidemiological Triad

- According to this concept of disease causation, in addition to the **causal agent**, the factors relating to the **host** and **environment** are equally important to determine whether or not disease will occur in the exposed host.
- For 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**.

Epidemiological Triad



Agent Factors

- **AGENT** is defined as a substance, living or non-living , or a force tangible or intangible, the excessive presence or relative lack of which may initiate or perpetuate a disease process.
- A disease may have a single agent, a number of independent alternative agents or a complex of two or more factors whose combined presence is essential for development of disease.

Agent Factors

- **Biological agents:-** these are living agents of disease e.g. viruses, bacteria , fungi , protozoa etc.

INFECTIVITY

Ability of agent to invade and multiply in host.

PATHOGENICITY

Ability to induce clinically apparent illness.

VIRULENCE

Proportion of clinical cases resulting in severe clinical manifestations (including sequelae)

Agent Factors

- **Nutrient agents** :- e.g. proteins, fats, carbohydrates, vitamins, minerals and water.
- **Physical agents** :- e.g. excessive heat, cold, radiation, electricity, sound.
- **Chemical agents** :-
 - Endogenous :- e.g. urea(ureamia), serum bilirubin(jaundice), uric acid(gout) etc.
 - Exogenous :- e.g. allergens, metals, fumes, dust etc.
- **Mechanical agents** :- e.g. exposure to chronic friction and pressure.

Agent Factors

- **Absence or insufficiency or excess of a factor necessary to health** :- e.g. ,
 - chemical factors(hormones and enzymes)
 - lack of structure(thymus)
 - lack of part of structure(cardiac defects)
 - chromosomal factors(Down's syndrome, Turner's syndrome)
 - immunological factors e.g.,
agammaglobulinaemia.
- **Social factors**:- e.g. poverty, alcohol and drug abuse, smoking, social isolation etc.

Host Factors

- In epidemiological terminology, the human host is referred to as “soil” and disease agent as “seed”.
- Intrinsic factors that influence an individual’s exposure, susceptibility, or response to a causative agent.
- In some situations, host factors play a major role in determining the outcome of an individual’s exposure to infection e.g. tuberculosis.

Host Factors

DEMO-
GRAPHIC



Age, sex,
ethnicity

BIOLOGICAL



Genetic
factors,
blood
groups and
enzymes,
immuno-
logical
factors

SOCIAL AND
ECONOMICAL



Socio-
economic
status,
education,
occupation

LIFESTYLE
FACTORS



Use of
alcohol,
drugs and
smoking,
physical
exercise
and
nutrition

Environmental Factors

- The **external or macro-environment** is defined as “ all that which is external to the individual human host, living and non-living, and with which he is in constant interaction.

PHYSICAL



Non-living things and physical factors e.g. air, water, soil, radiation, heat etc.

BIOLOGICAL



Living things around man, including man himself e.g. insects, rodents, animals etc.

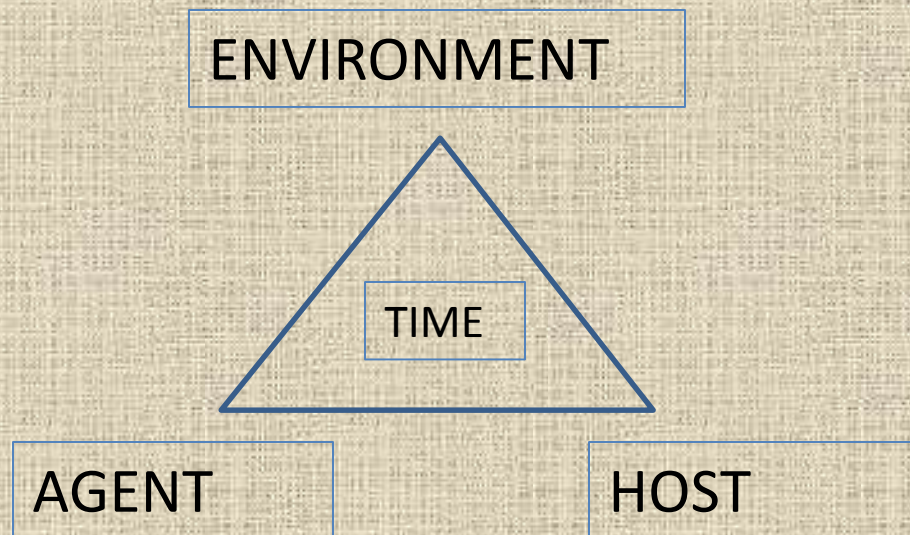
PSYCHOSOCIAL



Includes factors that stem from psychological make-up of individuals and structure and functions of social groups.

Triangle Of Epidemiology

- 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** .

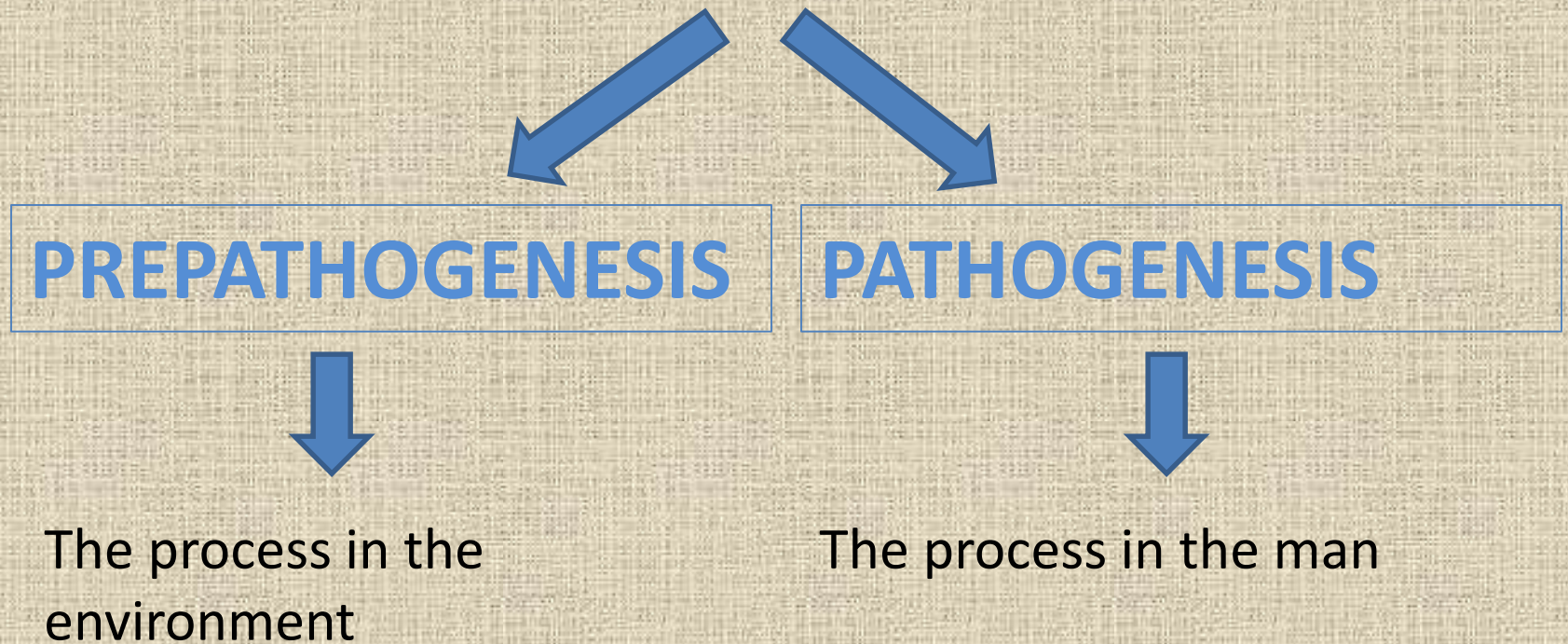


Web Of Causation

- Suggested by **MacMohan** and **Pugh**.
- 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.

Natural History Of Disease In Man

- Consists of two phases :-



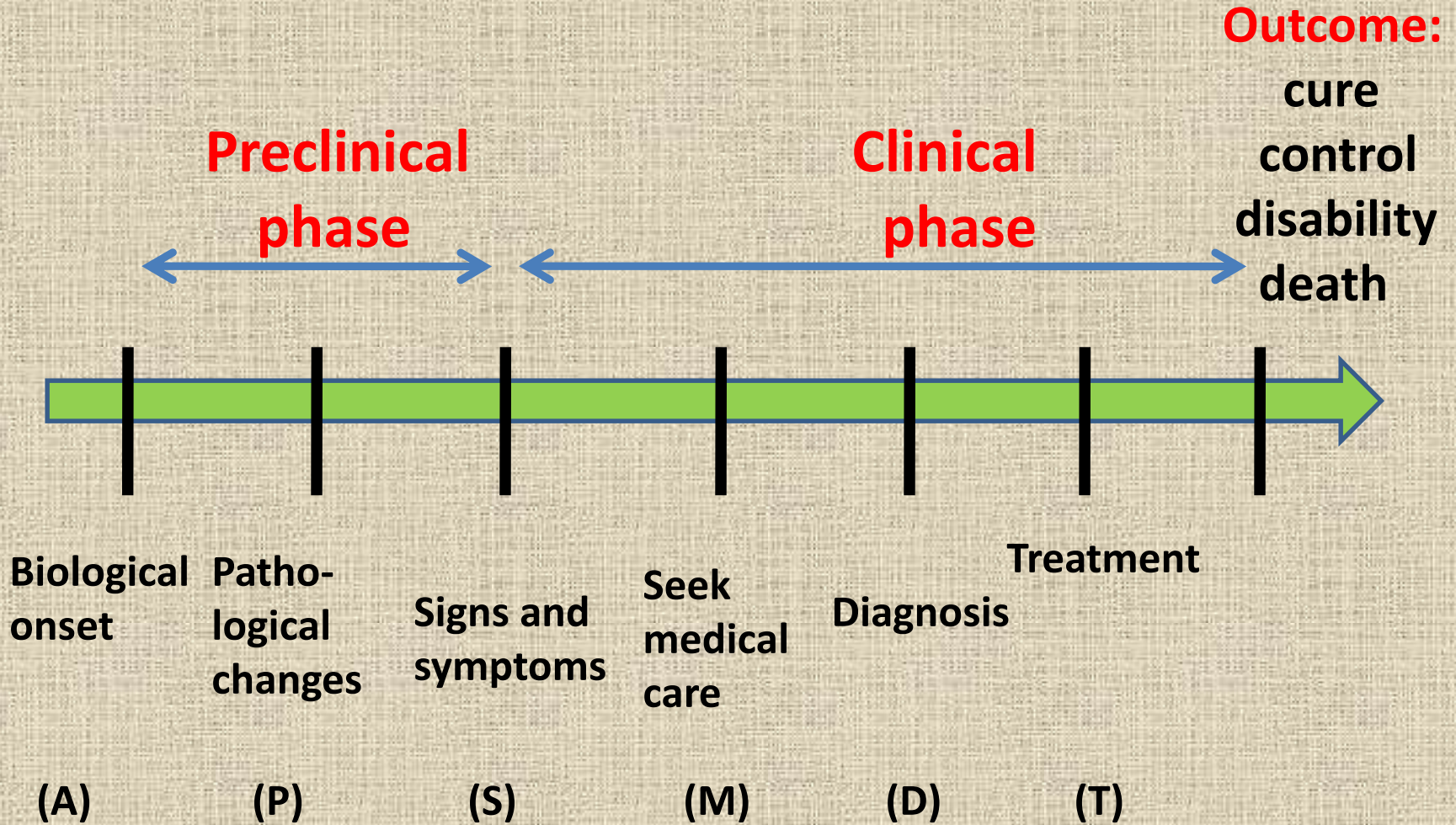
Pre pathogenesis Phase

- 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 favour its interaction with the human host are already existing in the environment.
- This situation is frequently referred to as “**man in the midst of disease**” or “**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**.

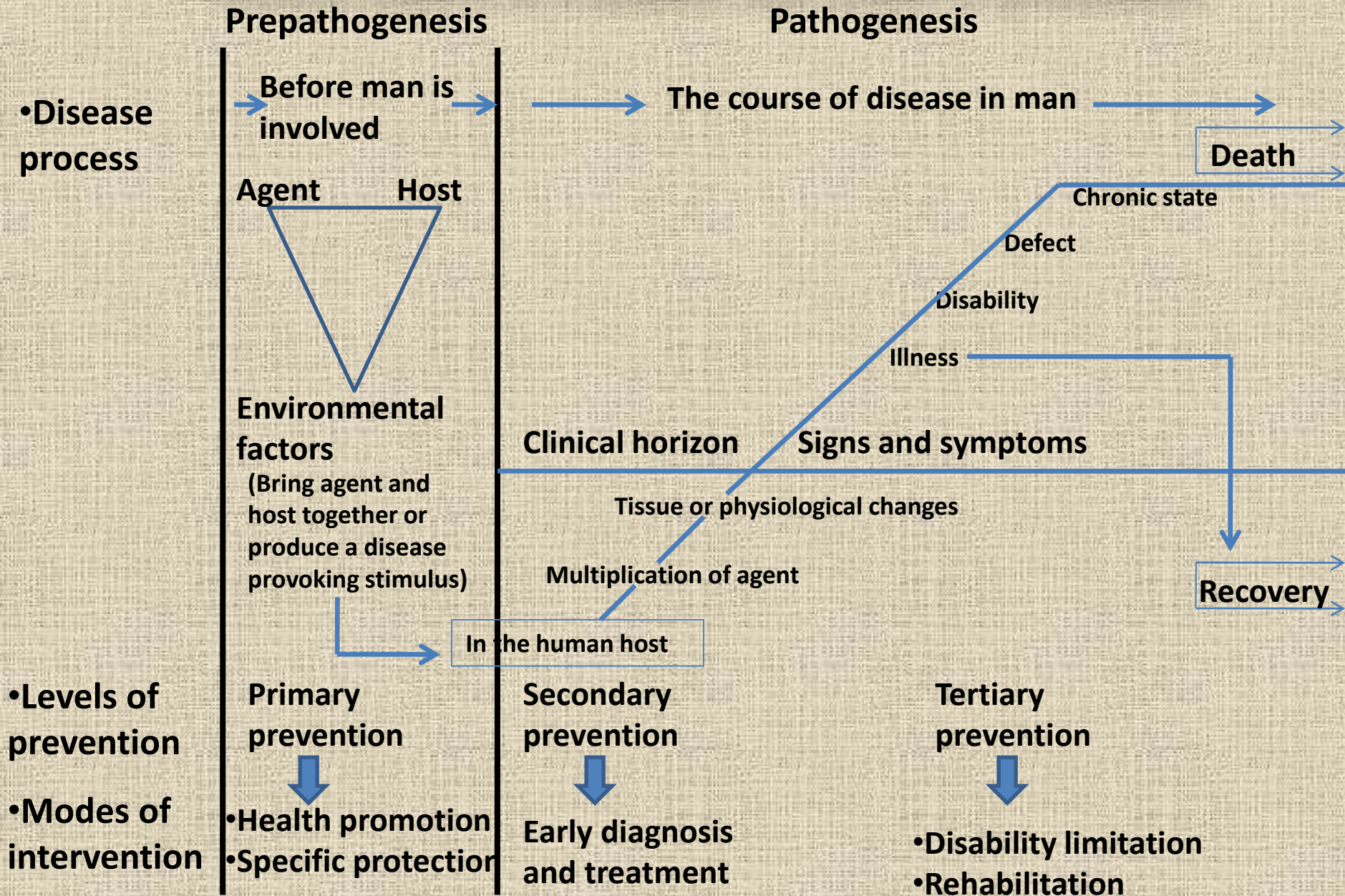
Natural history of a disease in a patient



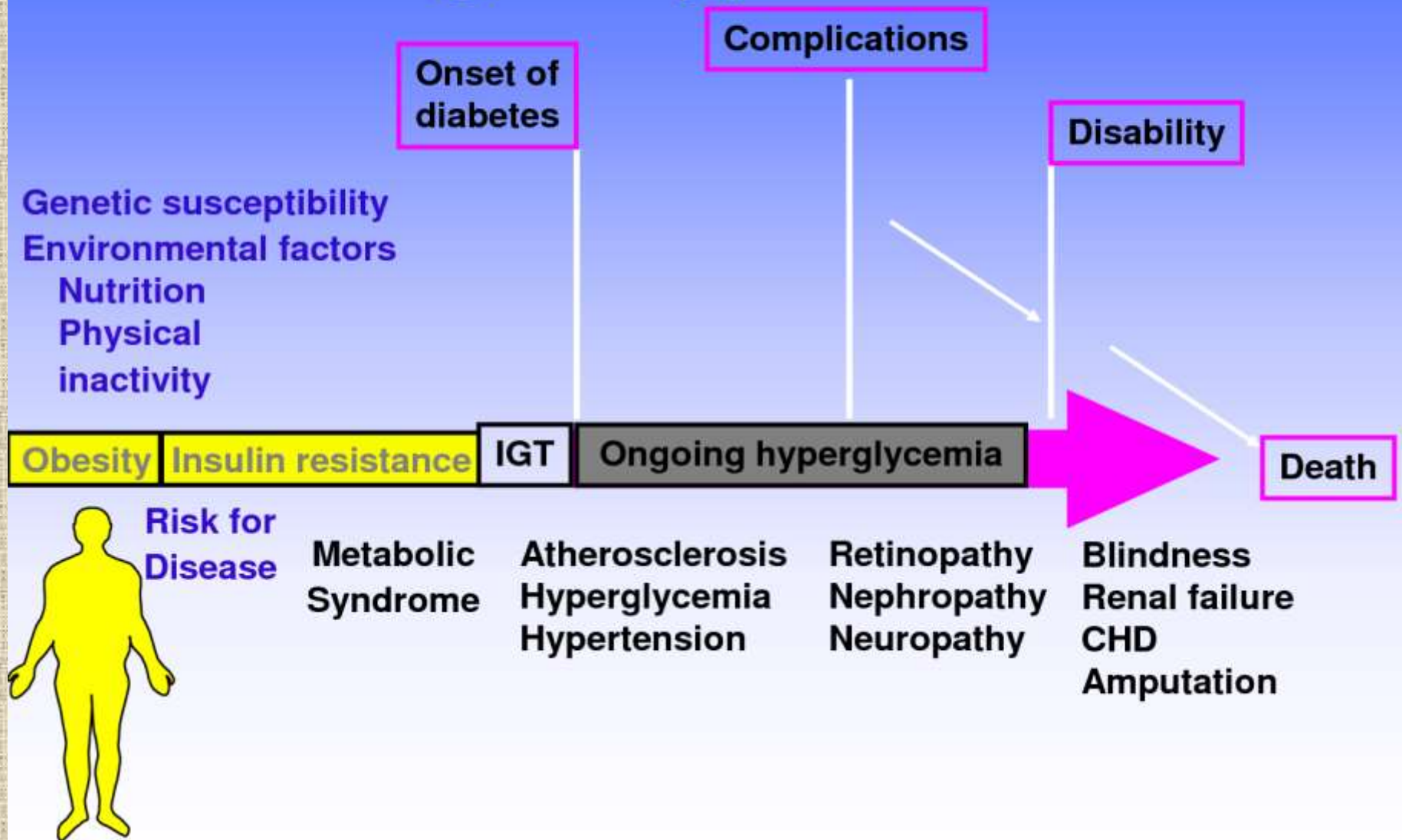
Pathogenesis Phase

- In **chronic diseases**, the early pathogenesis phase is less dramatic and is also called as **presymptomatic phase**.
- During presymptomatic 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 a disease and Levels of prevention



Natural History of Obesity Leading to Type 2 Diabetes



Spectrum Of Disease

- The term “spectrum of disease” is a graphic representation of variations in the manifestations of disease.
- At the one end of disease spectrum are **subclinical 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**.

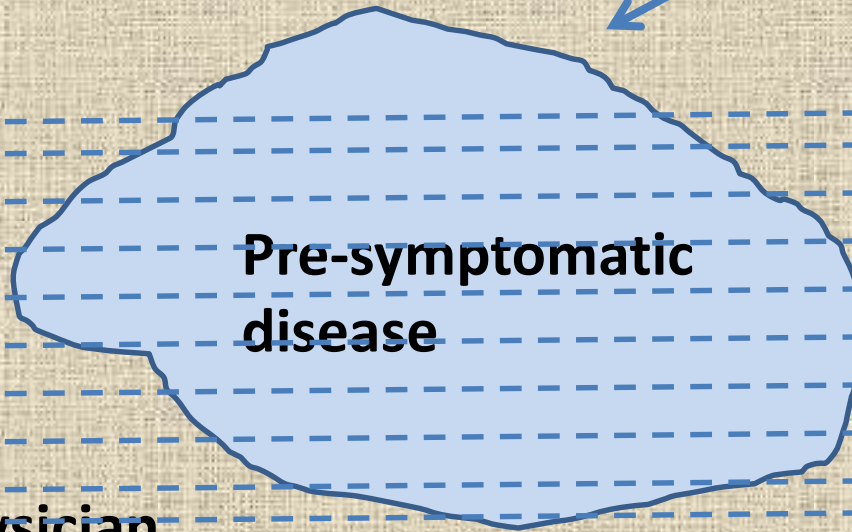
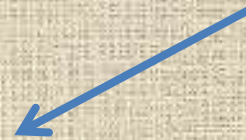
Iceberg Phenomenon

- According to this concept, disease in a community may be compared with an **iceberg**.
- The **floating tip** of the iceberg represents what the physician sees in the community, i.e. , clinical cases.
- The vast **submerged portion** of iceberg represents the hidden mass of the disease , i.e. , latent, inapparent, presymptomatic and undiagnosed cases and carriers in the community.
- The **waterline** represents the demarcation between apparent and inapparent cases.

Iceberg Phenomenon

What the physician
sees

Symptomatic
disease



Pre-symptomatic
disease

What the physician
does not see

e.g., Hypertension, Diabetes, Anaemia, mental illness etc.

Concept Of Prevention

- Prevention is the process of intercepting or opposing the “cause” of a disease and thereby the disease process.
- 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.
- 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, behavioural 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, Diabetes .

Primary Prevention

- **Two types of modes of intervention :-**
 - Health promotion
 - Specific protection
- **Health promotion** – It is the process of enabling people to control over, and to improve health.
 - Health education
 - Environmental modifications
 - Nutritional interventions
 - Lifestyle and behavioural changes

Primary Prevention

- **Specific protection :- e.g.**
 - Immunization
 - Chemoprophylaxis
 - food fortification e.g., iodized salt
 - Protection against occupational hazards
 - Protection against accidents e.g. , use of helmets
 - Avoidance of allergens etc.

Secondary Prevention

- Secondary prevention can be defined as “ **action which halts the progress of a disease at its incipient 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.

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 to promote the subject's adjustment to irremediable conditions.
- Tertiary prevention has two types of approaches :
 - **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. E.g. ,
 - 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

IMPAIRMENT



Any loss or abnormality of psychological, physiological or anatomical structure or function.

Loss of foot

DISABILITY



The inability to carry out certain activities because of impairment, that are considered normal for his age and sex.

Cannot walk

HANDICAP



The inability to discharge the obligations required of him and play the role expected of him in the society.

unemployed



Tertiary Prevention

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

MEDICAL



Restoration of
function

VOCATIONAL



Restoration of
the capability to
earn a livelihood

SOCIAL



Restoration of
family and
social
relationships

PSYCHOLOGICAL



Restoration of
personal dignity
and confidence

Tertiary Prevention

- Examples of Rehabilitation are :-
 - 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

Indicators Of Prognosis

- Prognosis is defined as “forecasting of the probable course and outcome of a disease, especially of the chances of recovery”.
- Examples of prognostic indicators are :-
 - Case Fatality Rate
 - 5 Year Survival Rate
 - Observed Survival Rate
 - Median Survival Time
 - Relative Survival Rate

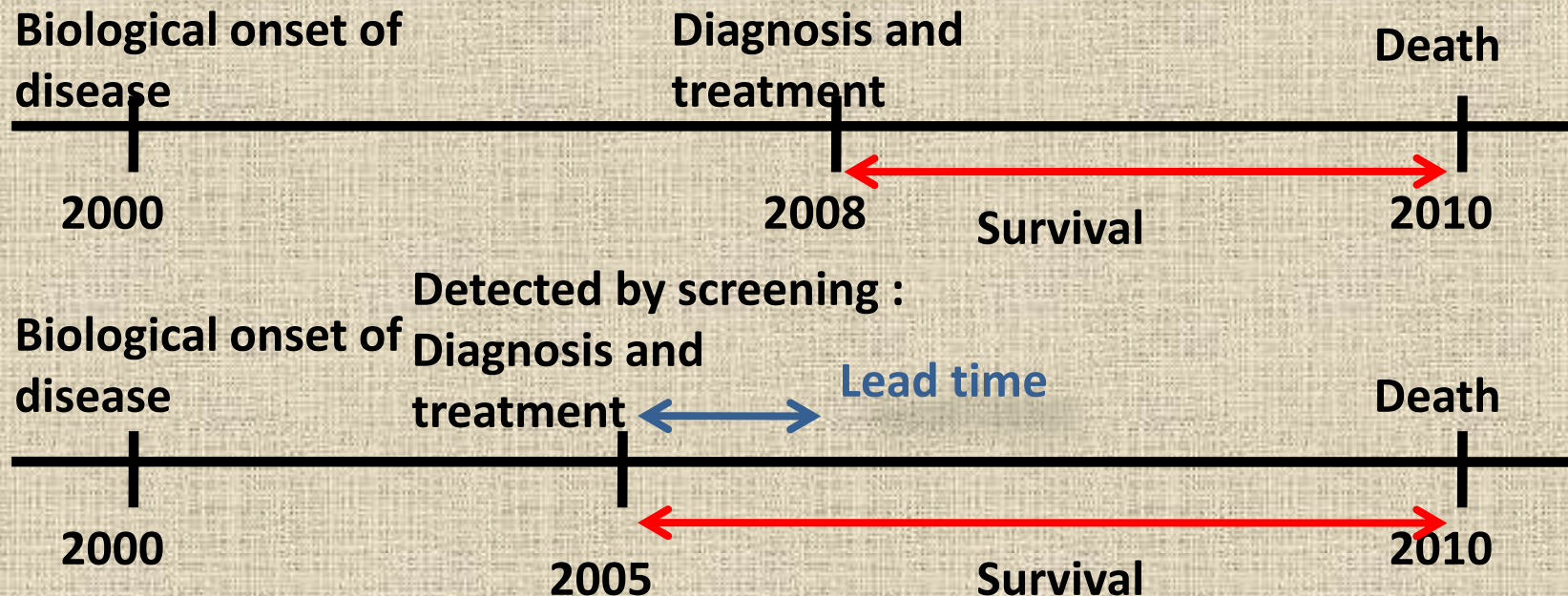
Case Fatality Rate

- It represents the **killing power** of a disease.
- It is defined as the number of people who die of a disease divided by the number of people who have the disease.
- Typically used in acute infectious disease e.g. , food poisoning, cholera, measles

$$\text{CFR} = \frac{\text{Total no. of deaths due to a particular disease}}{\text{Total no. of cases due to the same disease}} \times 100$$

5-Year Survival Rate

- The 5-year survival rate is the percentage of patients who are alive 5 years after treatment begins or 5 years after diagnosis.
- This term is frequently used in clinical medicine, particularly in evaluating treatment for cancers.



Lead Time

- It is the **advantage gained by screening**, i.e. , the period between diagnosis by early detection and diagnosis by other means.
- There is no use of detecting disease before **usual time of diagnosis** if the disease has crossed the **final critical point** beyond which permanent damage is there and treatment is unsuccessful.

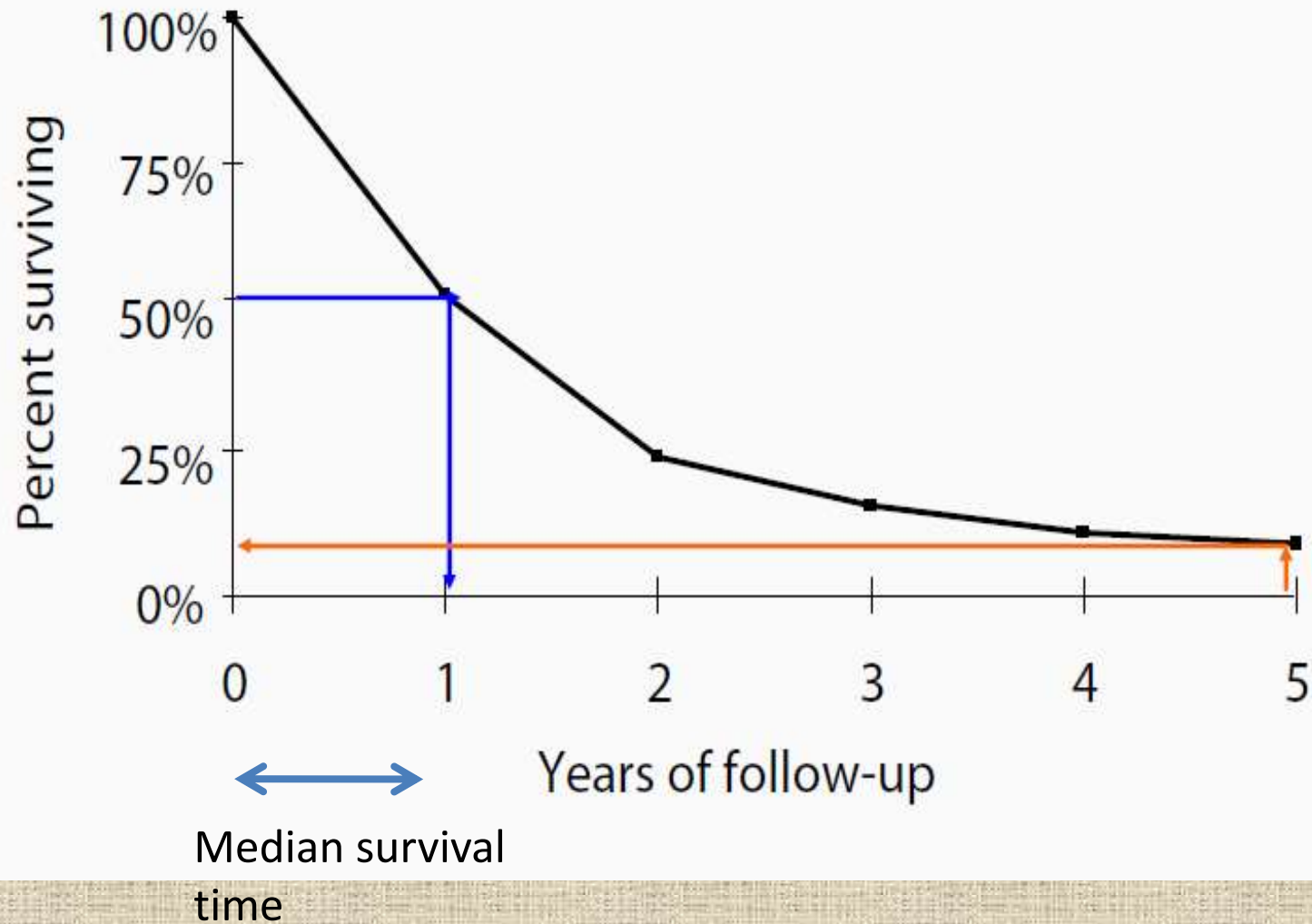
Observed Survival Rate

- The **observed survival rate** is an estimate of the **probability of surviving**.
- Probability of surviving can be calculated using the technique of life table analysis.
- Advantage of using data on all patients, regardless of how long they survive.

Median Survival Time

- It is defined as the **length of time that half of the study population survives.**
- It is **preferred over the mean survival time** (which is the average of the survival times), because :-
 - Less affected by the extremes
 - Only have to observe the deaths of half of the group.

Median Survival Time



Relative Survival Rate

- **Relative survival rate is the ratio of the observed survival (rate) to the expected survival (rate).**
- It compares survival in the study group (e.g., cancer) to the survival of a comparable group without the disease of interest.

$$\text{Relative survival rate} = \frac{\text{Observed survival in people with disease}}{\text{Expected survival if disease was absent}}$$

Relative Survival Rate

Survival rates by age for patients with colon cancer

Age at Diagnosis	Five-Year Survival Rate	
	Observed	Relative
45–54	57.1	59.2
55–64	53.6	58.5
65–74	47.8	57.8
75+	31.7	54.1

Conclusion

“ 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 our knowledge.”

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Thank you

