Disease Causation

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Objectives

After attending this lecture, students will be able to:

1. Describe spectrum of disease
2. Explain natural history of disease
3. Discuss theories of disease causation
4. Differentiate between disease Elimination & Eradication.

Spectrum of Disease

- At one end are subclinical infections which are not ordinarily identified and at the other end are fatal illnesses.
- In the middle of the spectrum lie illnesses ranging in severity from mild to severe.
- In infectious diseases, the spectrum of disease is also referred to as the “gradient of infection”.

Cont’d

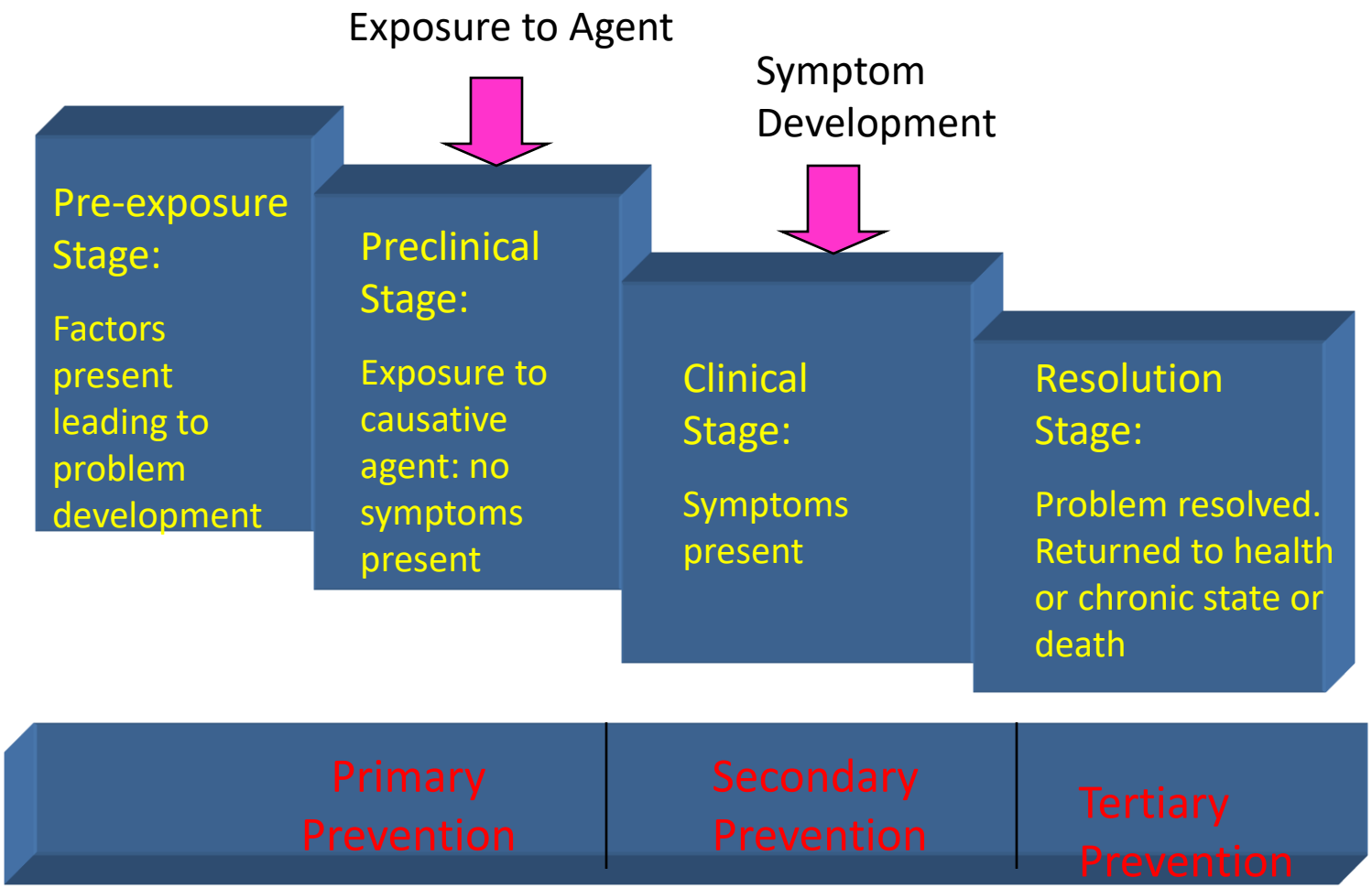
- Leprosy is an excellent example of the spectral concept of disease.
- Rabies: For almost every disease there exists a spectrum of severity, with few exceptions such as Rabies
- HIV (in apparent, to mild e.g. AIDS-related complex to severe e.g., wasting syndrome)
- Coronary Artery Disease: asymptomatic form (atherosclerosis), transient myocardial ischemia, & myocardial infarctions of various severities.

The sequence of events in the spectrum of disease can be interrupted by early diagnosis and treatment or by preventive measures which if introduced at a particular point will prevent or retard the further development of the disease.

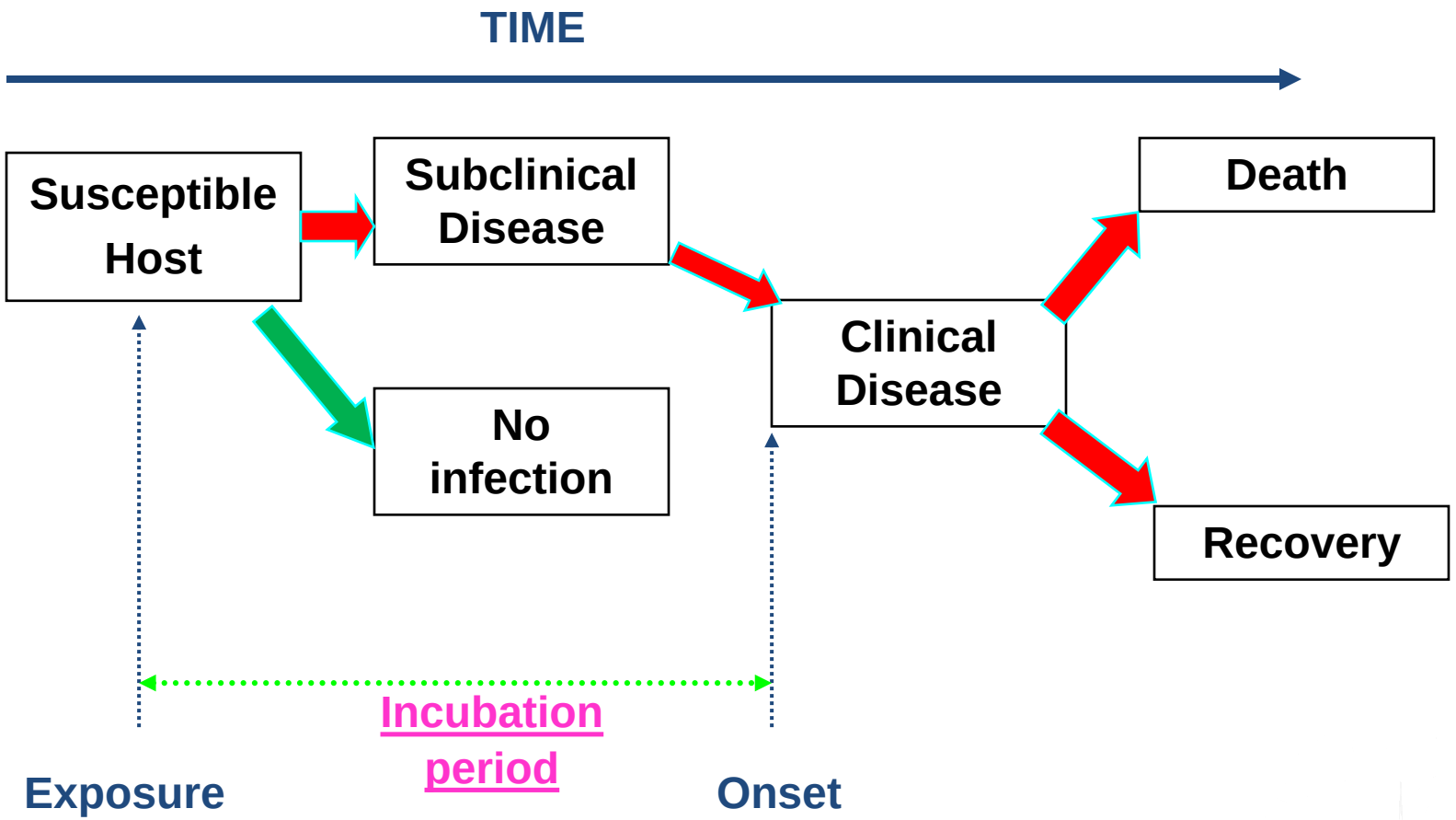
Natural History of Disease

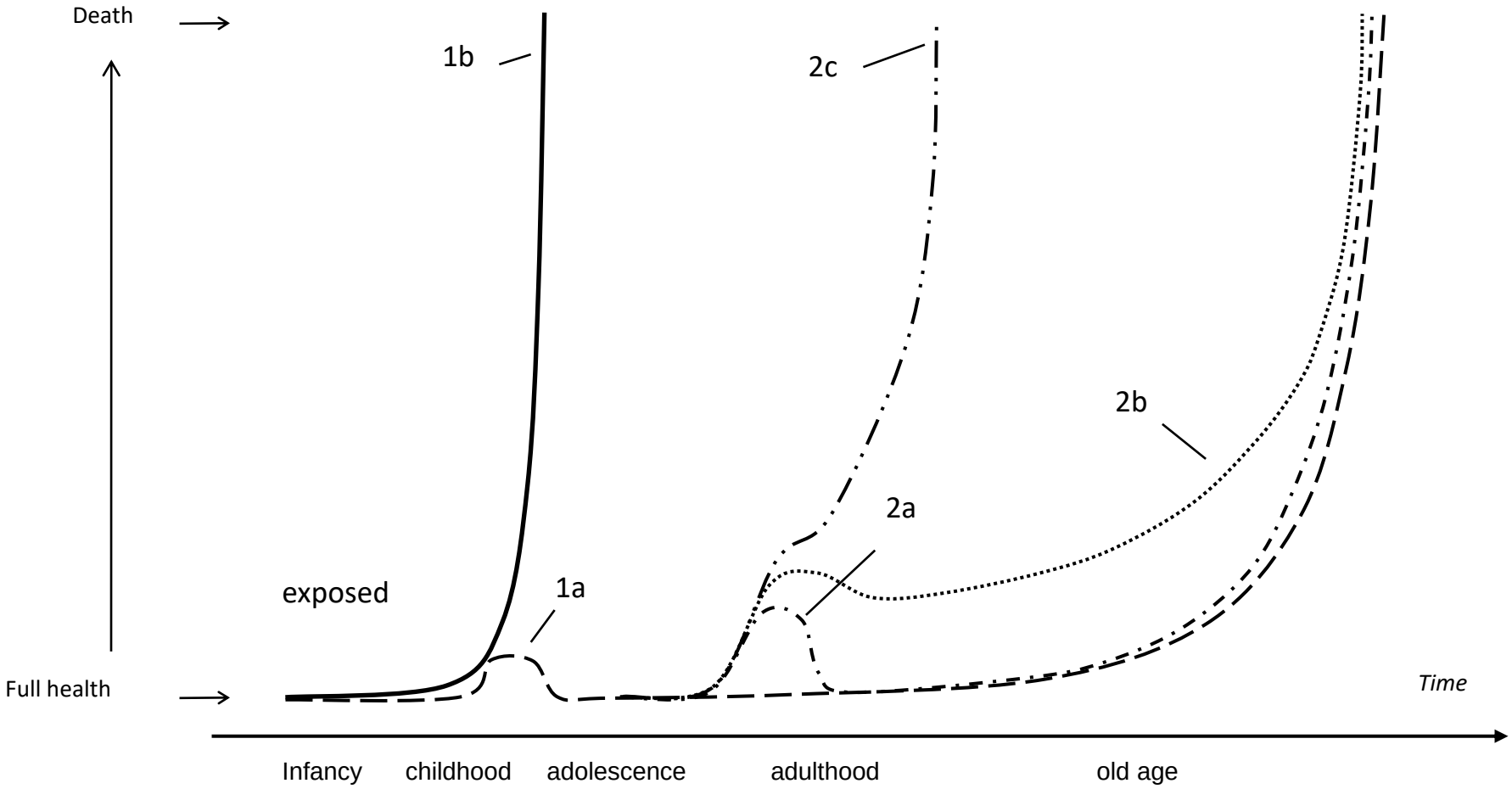
- The process by which diseases occur and progress in humans in the absence of intervention.
- The process begins with exposure to or accumulation of factors capable of causing disease.
- Without medical intervention, the process ends with recovery, disability, or death.

Natural History of Disease



Typical course of infectious disease





***1a**: primary infection with complete remission (death from other causes); **1b**: Fatal tuberculous meningitis;*
***2a**: recurrence with successful treatment (death from other causes); **2b**: TB with residual disability (and TB contributary or actual cause of death); **2c**: recurrence with fatal outcome*

Obstacles to studying the natural history of disease

- Information on natural history is very hard to obtain.
- What difficulties can you see in studying the true natural history of disease?
- Would you be willing to participate in a natural history study?
- What might be the effect on you of being in such a study?

Natural history studies: consequences

- First, the mere act of diagnosis and follow-up by a physician may initiate changes in the disease process.
- Second, the scientific objective of observing the natural history of disease clashes with the ethical medical imperative to act to alleviate, contain or treat the disease.
- Studies of the natural history of disease are potentially ethically explosive e.g the US Public Health Service's Tuskegee syphilis study, where 600 "negro" men with syphilis in the state of Alabama in the USA were followed up for a period of about 40 years.
- Follow up, or cohort, studies are needed to define the natural history of disease and such long-term observations may prove costly or impossible.
- Natural history is, therefore, usually pieced together from a mixture of observations.

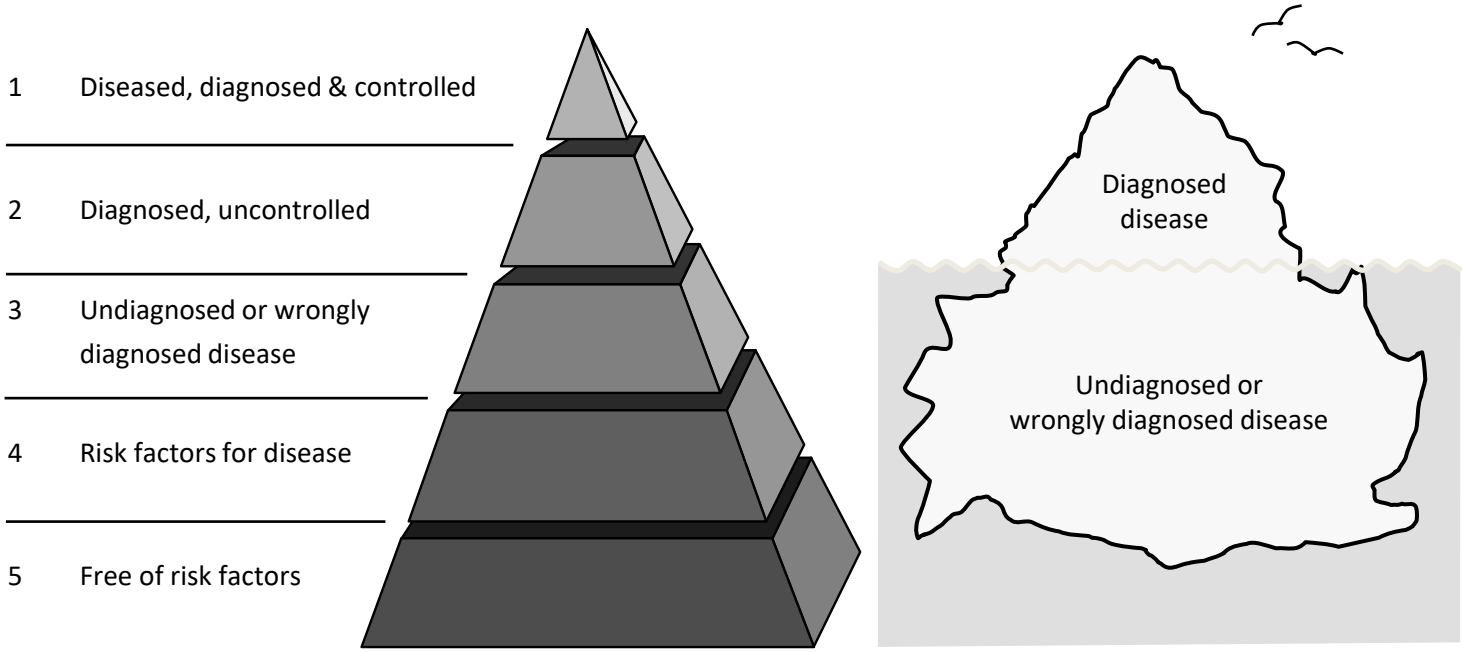
The Tuskegee Study raised a host of ethical issues such as

- **informed consent**
- **Racism**
- **Paternalism**
- **unfair subject selection in research**
- **maleficence, truth-telling and justice**

Natural history: applications

- Natural history is vital for disease prevention policies.
- It underlies secondary prevention based on screening
- It provides a rationale for all health care.
- Purpose of health care, including medicine, is to influence the natural history of disease by reducing and delaying ill-health.
- When achieved through deliberate actions by societies the collective endeavour is public health.

Figure 6.6 The pyramid and iceberg of disease



Screening

- Screening is the use of tests to help diagnose diseases (or their precursor conditions) in an earlier phase of their natural history or at the less severe end of the spectrum than is achieved in routine clinical practice.
- Screening attempts to uncover the iceberg of disease.
- On the pyramid model in 6.7 screening is applied to block 3, and less commonly, to block 4.
- Aim is to reverse, halt or slow the progression of disease.
- Screening is also done to protect society.
- Screening may be done to select out unhealthy people e.g. for a job.
- Screening is sometimes done to help allocate health care resources.
- Screening may be done simply for research, for example, to identify disease at an early stage to help understand the natural history.

Theories of Disease Causation

1. Supernatural theory of disease
2. Ecological theory
3. Germ theory
4. Epidemiological Triad
5. Multifactorial causation theory or web of causation.

SUPERNATURAL THEORY OF DISEASE

In the early past, the disease was thought mainly due to either the curse of god or due to the evil force of the demons. Accordingly, people used to please the gods by prayers and offerings or used to resort to witchcraft to tame the devils.

NO UNANIMOUS OPINION

- At least 10% of the people in developed countries and 30% in developing countries still believe in supernatural origin
- Even today superstitions are becoming major obstacles in disease control
- Most of the literates view that disease is the result of microbes
- Most of the uneducated people (90%) believe that disease is due to bad physical environment

ECOLOGICAL THEORY

- **Around 463 BC, HIPPOCRATES was the first epidemiologist who advised to search the environment for the cause of the disease.**

Environmental Influence

- Interactions among humans, other living creatures, plants, animals, micro organisms, ecosystems and climate, geography, and topography are so complex that despite much study we are often uncertain what is really happening.

ECOLOGICAL DETERMINANTS OF DISEASE

- Thomas McKeown emphasized the importance of economic growth, rising living standards, and improved nutrition as the primary sources of most historical improvements in the health of developed nations.
- He pointed out that improved health owes less to advances in medical science than to the operation of natural ecological laws

GERM THEORY

ROBERT KOCH

- *Germ theory*: Microbes (germs) were found to be the cause for many known diseases. Pasteur, Henle, Koch were the strong proponents of microbial theory after they discovered the micro-organisms in the patients' secretions or excretions.

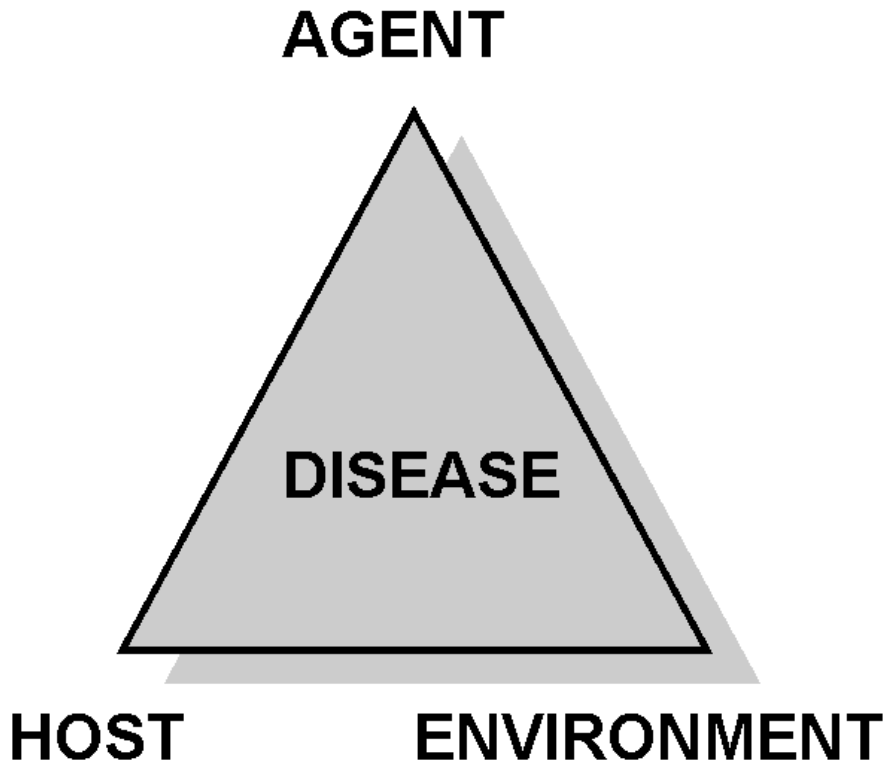
Robert Koch's Postulates

- The microorganism must be found in abundance in all organisms suffering from the disease, but should not be found in healthy organisms.
- The microorganism must be isolated from a diseased organism and grown in pure culture.
- The cultured microorganism should cause disease when introduced into a healthy organism.
- The microorganism must be re-isolated from the inoculated, diseased experimental host and identified as being identical to the original specific causative agent.

Epidemiologic Triad

Disease is the result of forces within a dynamic system consisting of:

- **agent of infection**
- **host**
- **environment**



Classic Epidemiologic Theory

- Agents
  - Living organisms
  - Exogenous chemicals
  - Genetic traits
  - Psychological factors and stress
  - Nutritive elements
  - Endogenous chemicals
  - Physical forces
- Agents have characteristics such as infectivity, pathogenicity and virulence (ability to cause serious disease)
  - They may be transmitted to hosts via vectors

Classic Epidemiologic Theory *(cont.)*

- **Host factors:**
  - **Immunity and immunologic response**
  - **Host behavior**

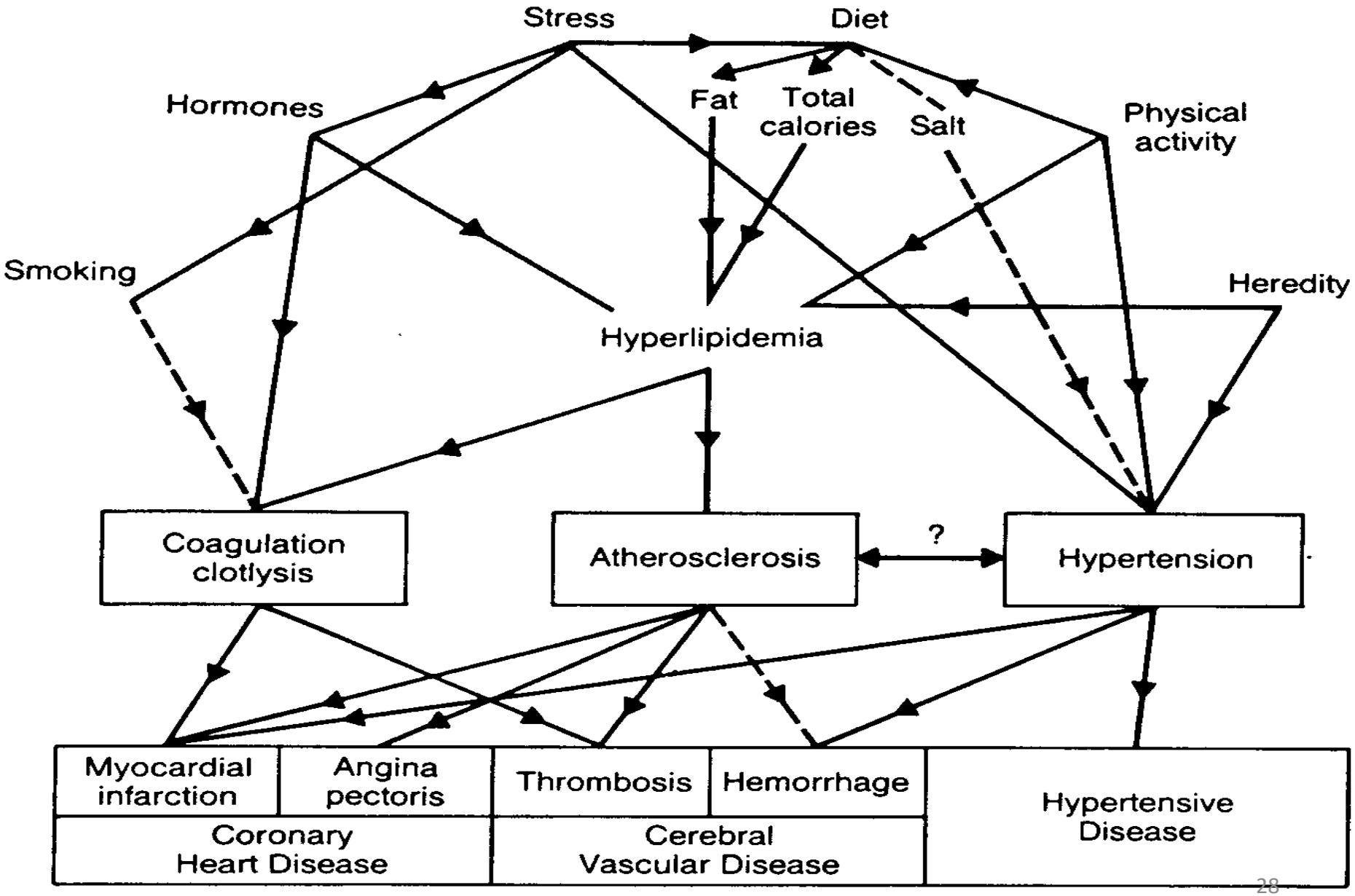
- **Environmental factors:**
  - **Physical environment (heat, cold, moisture)**
  - **Biologic environment (flora, fauna)**
  - **Social environment (economic, political, culture)**

Multifactorial Causation Theory Or Web Of Causation

Pettenkofer

Pettenkofer stated that agent, host and environmental factors will act & interact synergistically and act as joint independent partners in causing the disease.

Web of Causation for the Major Cardiovascular Diseases



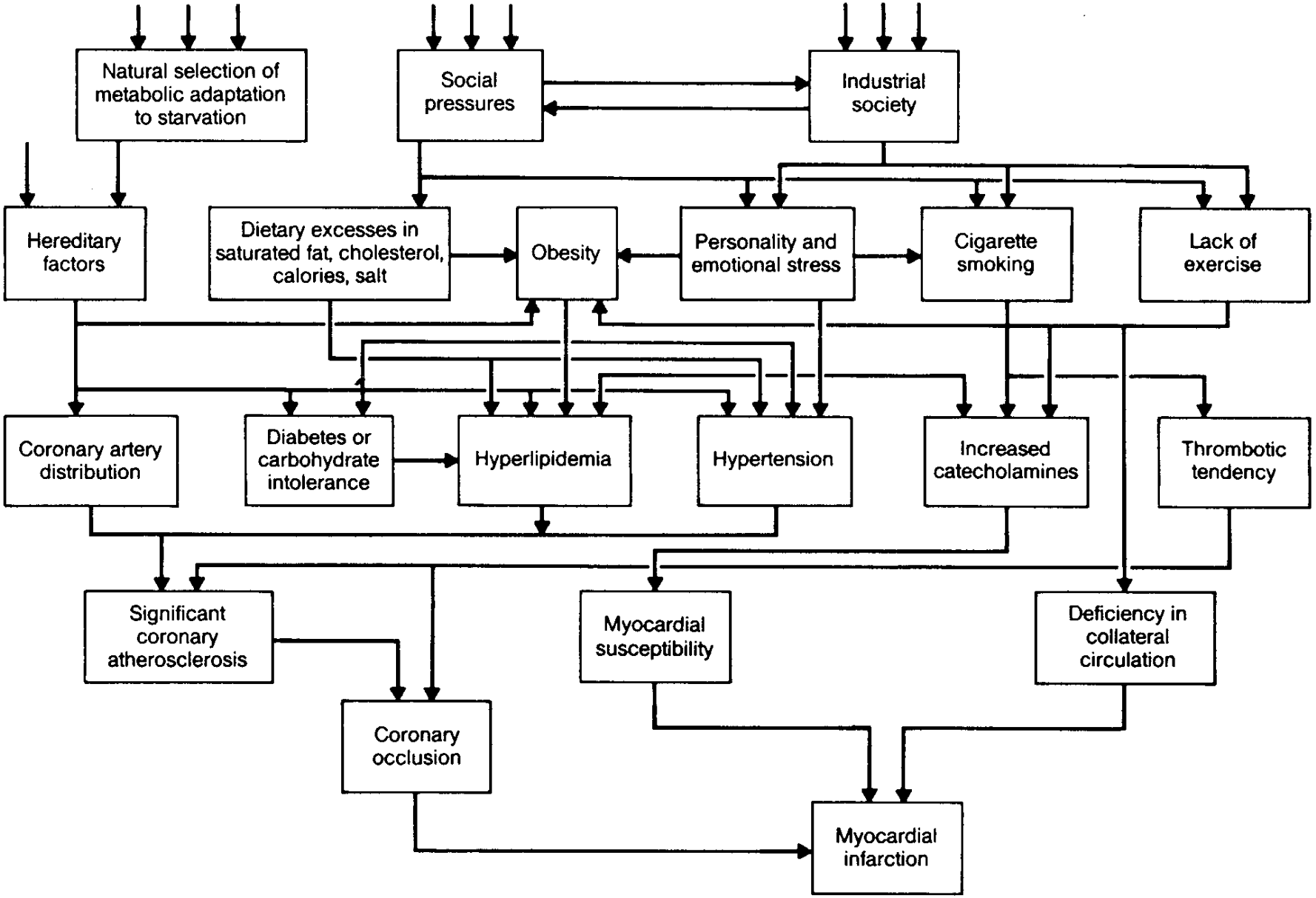


Figure 3.4 A Web of Causation for Myocardial Infarction. (*Source:* Friedman, G. D. (1980) *Primer of epidemiology*. New York: McGraw-Hill p. 4. Reprinted with permission.)

Causal Relationships

- **A causal pathway may be direct or indirect**
- **In direct causation, A causes B without intermediate effects**
- **In indirect causation, A causes B, but with intermediate effects**
- **In human biology, intermediate steps are virtually always present in any causal process**

Types of Causal Relationships

- **Necessary and sufficient** – without the factor, disease never develops
  - With the factor, disease always develops (this situation rarely occurs)

- **Necessary but not sufficient** – the factor in and of itself is not enough to cause disease
  - Multiple factors are required, usually in a specific temporal sequence (such as carcinogenesis)

- **Sufficient but not necessary** – the factor alone can cause disease, but so can other factors in its absence
  - Benzene or radiation can cause leukemia without the presence of the other

- **Neither sufficient nor necessary** – the factor cannot cause disease on its own, nor is it the only factor that can cause that disease
  - This is the probable model for chronic disease relationships

Assignment

Differentiate between disease Elimination and Eradication with real life examples.

References

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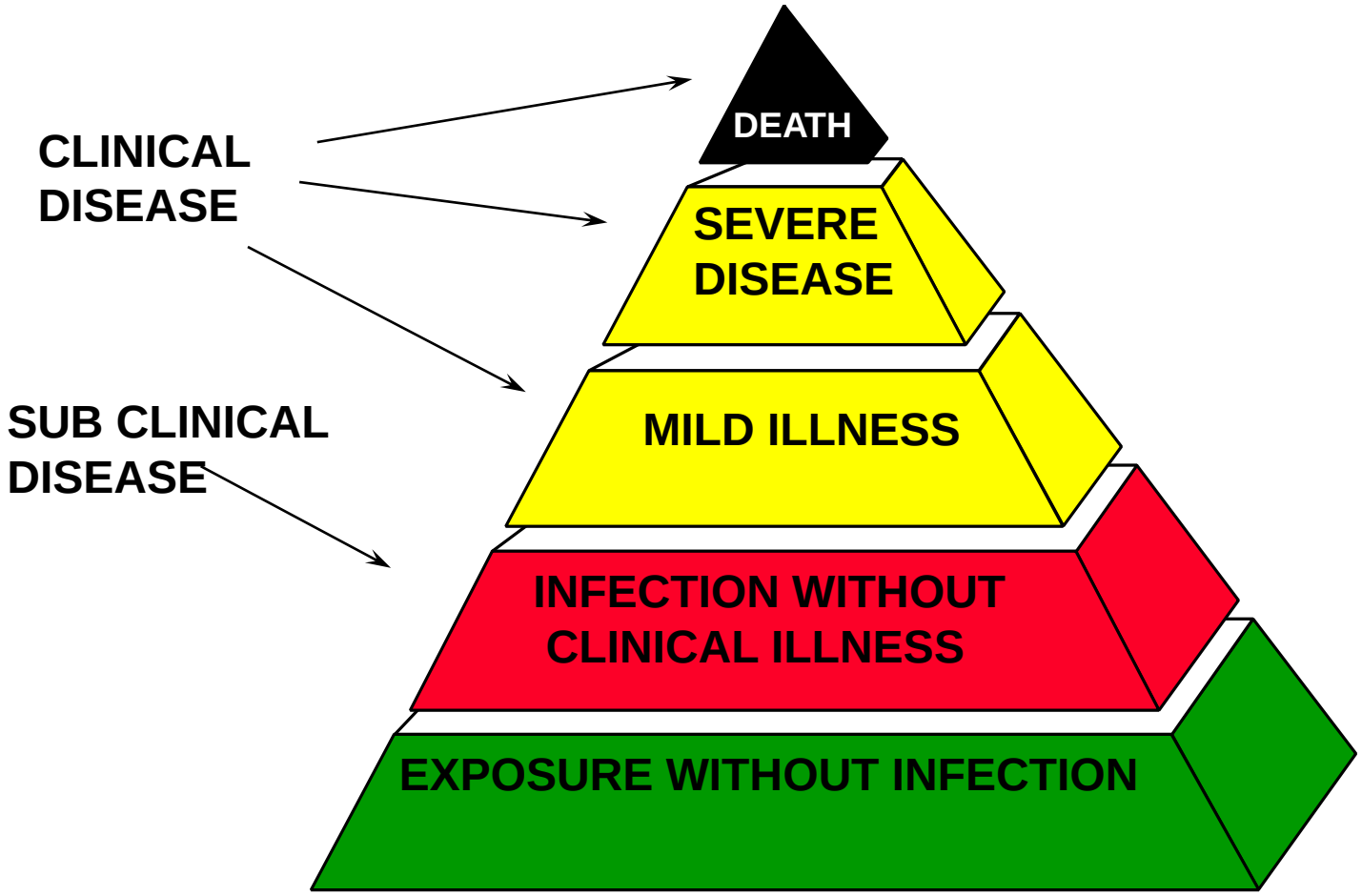
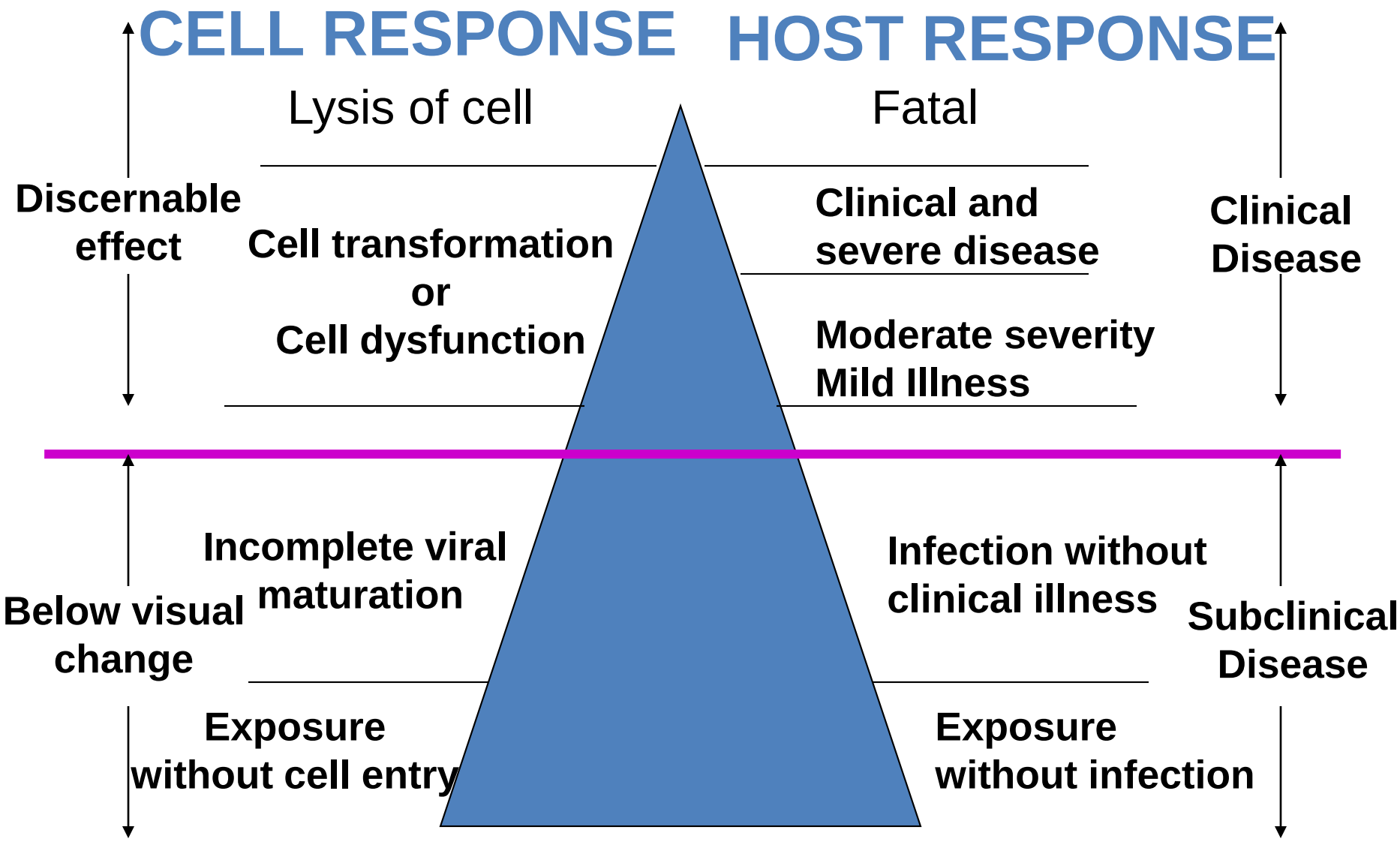
“Iceberg” concept of infectious disease in populations



Iceberg Concept of Infection



Subclinical/Clinical Ratio for Viral Infections

Virus	Clinical feature	Age at infection	Estimated ratio	Clinical cases
Polio	Paralysis	Child	± 1000:1	0.1% to 1.0%
Epstein-Barr	Mononucleosis	1 to 5 years	> 100:1	1%
		6 to 15 years	10:1 to 100:1	1% to 10%
		16 to 25 years	2:1 to 3:1	50% to 75%
Hepatitis A	Icterus	< 5 years	20:1	5%
		5 to 9 years	11:1	10%
		10 to 15 years	7:1	14%
		Adult	1.5:1	80% to 95%
Rubella	Rash	5 to 20 years	2:1	50%
Influenza	Fever, cough	Young adult	1.5:1	60%
Measles	Rash, fever	5 to 20 years	1:99	>99%
Rabies	CNS symptoms	Any age	<1:10,000	>>>>99%

Levels of Prevention

- **Primordial Prevention**
- **Primary Level of Prevention**
- **Secondary Level of Prevention**
- **Tertiary Level of Prevention**

Primordial Prevention

- Primordial prevention is defined as prevention of risk factors themselves, beginning with change in social and environmental conditions in which these factors are observed to develop, and continuing for high risk children, adolescents and young adults.
- A relatively new concept, is receiving special attention in the prevention of chronic diseases. For example, many adult health problems (e.g. obesity, hypertension) have their early origins in childhood, because this is the time when lifestyles are formed.

Primary Level of Prevention

- Control the underlying cause or condition that may result in disability.
- e.g. maternal antiretroviral therapy to reduce the risk of mother-to-child transmission of HIV; fortification of the food supply to prevent birth defects such as spina bifida and iodine deficiency disorders.
- Immunization against infectious diseases
- Edu. & legislation about proper seatbelt & helmet use.

Cont'd

Primary Prevention

- Education about good nutrition, the importance of regular exercise, & the dangers of tobacco, alcohol and other drugs.
- Regular exams and screening tests to monitor risk factors for illness
- Controlling potential hazards at home and in the workplace.

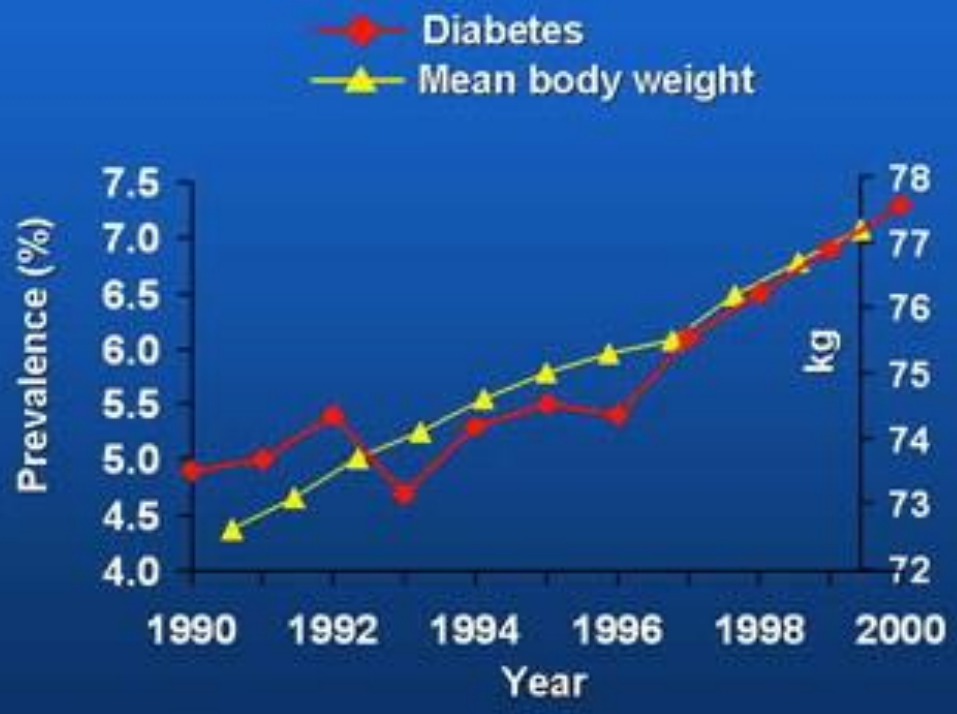
Secondary Level of Prevention

- Aims at preventing an existing illness or injury from progressing to long-term disability
- e.g. telling people to take daily, low-dose aspirin to prevent a 2nd heart attack or stroke.
- Providing suitably modified work for injured workers; effective emergency medical care for head injury

Tertiary Level of Prevention

- Rehabilitation and special educational services to mitigate disability and improve functional and participatory or social outcomes once disability has occurred.
- e.g. rehabilitation of post-stroke patients.
- Chronic pain management programs.
- Patient support groups.

Diabetes and Obesity: The Continuing Epidemic



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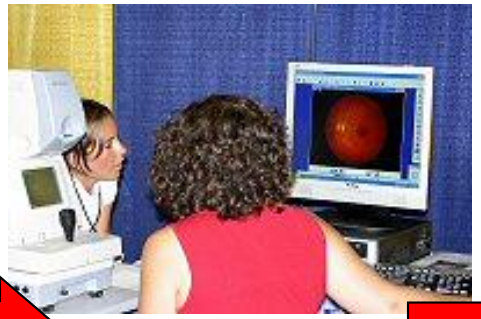
PRIMARY

SECONDARY

TERTIARY



Q-1) Which level of prevention is applicable for implementation in a population without any risk factors?

a) Primordial Prevention
b) Primary Prevention
c) Secondary Prevention
d) Tertiary Prevention

Q-2) Morbidity in a community can best be estimated by:

a) Active surveillance
b) Sentinel surveillance
c) Passive surveillance
d) monitoring

Q-3) The term ‘Disease Control’ employs all of the following except:

a) Reducing the complications
b) Reducing the risk of further transmission
c) Reducing the incidence of disease
d) Reducing the prevalence of disease

Q-4) In the natural Hx of disease, the ‘Pathogenesis phase’ is deemed to start upon:

a) Entry of the disease agent in the human host
b) Interaction between agent, host and environmental factors
c) Appearance of signs and symptoms
d) Appearance of complications

ASSIGNMENT

- Concept of disease control
- Different levels of prevention and their modes of intervention.
- Describe the iceberg phenomenon
- Describe modes of intervention of diseases with emphasis on health education.

Instructions: prepare Power point presentations of 15 minutes on each objective and present in next class


THANKS