# BASIC CONCEPTS IN EPIDEMIOLOGY

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# OUTLINE OF THE LECTURE

- Models of disease causation
- Epidemiologic triad concept
- The natural history of disease
- Chain of transmission
- The iceberg phenomena
- Herd immunity

- What is the disease ?

# What is the definition of the disease ?

- A satisfactory definition of disease is yet to be found
- Dictionary defines disease as:

  a condition in which health is impaired or

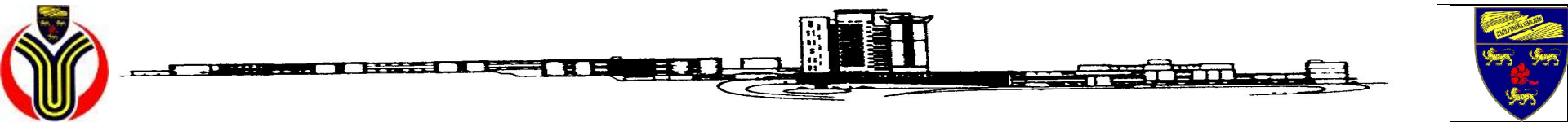
  a departure from a state of health….
- Definition of the health:
- Is state of well being in which all the components of health are in balance

# Concept of disease causation

- Supernatural theory of disease
- Germ theory of disease
- Ecological theory
- Multifactorial causation

# Supernatural theory :

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



# Germ theory

Germ theory: Microbes (germs) were found to be the cause for many known diseases.

# Ecological theory

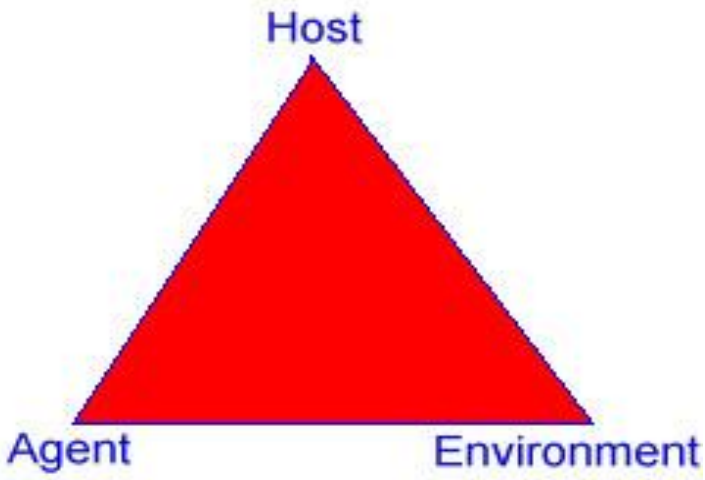
Around 463 BC, Hippocrates is the first epidemiologist who advised to search the environment for the cause of the disease

# Multifactorial theory

**Pettenkoffer**

**Stated that agent, host and environmental factors will act and interact synergistically causing the disease**

# EPIDEMIOLOGICAL TRIANGLE




- Changes in one of the elements of the triangle can influence the occurrence of disease

# Epidemiologic Triad Concepts

**The traditional model of disease causation**

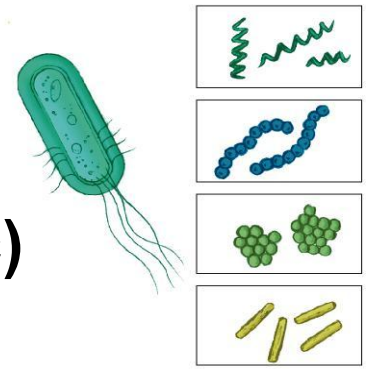
**3 components**

- ✔ **an external agent**
- ✔ **a susceptible host**
- ✔ **an environment**

# Epidemiologic Triad - Agent

## Agent

- Entity necessary to cause disease in a susceptible host

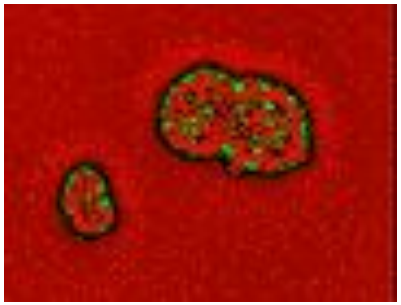


Examples

- **Biological (bacteria, virus, parasites, etc)**
- **Physical (radiation, physical force)**
- **Chemical (pollutants, drugs, etc)**
- **Nutrients (nutritional deficiency)**

# Epidemiologic Triad - Agent

- **Infectivity** – ability to invade a host
- **Pathogenicity** – ability to cause disease
- **Virulence** – ability to cause severe disease or death



# Epidemiologic Triad - Host

- **Infectivity, Pathogenicity , Virulence**

all are dependent upon the condition of the host

- immunity (active, passive)
- nutrition
- adequate rest & sleep
- good hygienic practices

# Epidemiologic Triad - Host

Definition: person/organism that is susceptible to effect of agent

**Characteristics**

- Genetic
- specific immunity
- socio-demographic
  - age
  - sex
  - ethnicity
  - occupation
  - social class

# Epidemiologic Triad - Environment

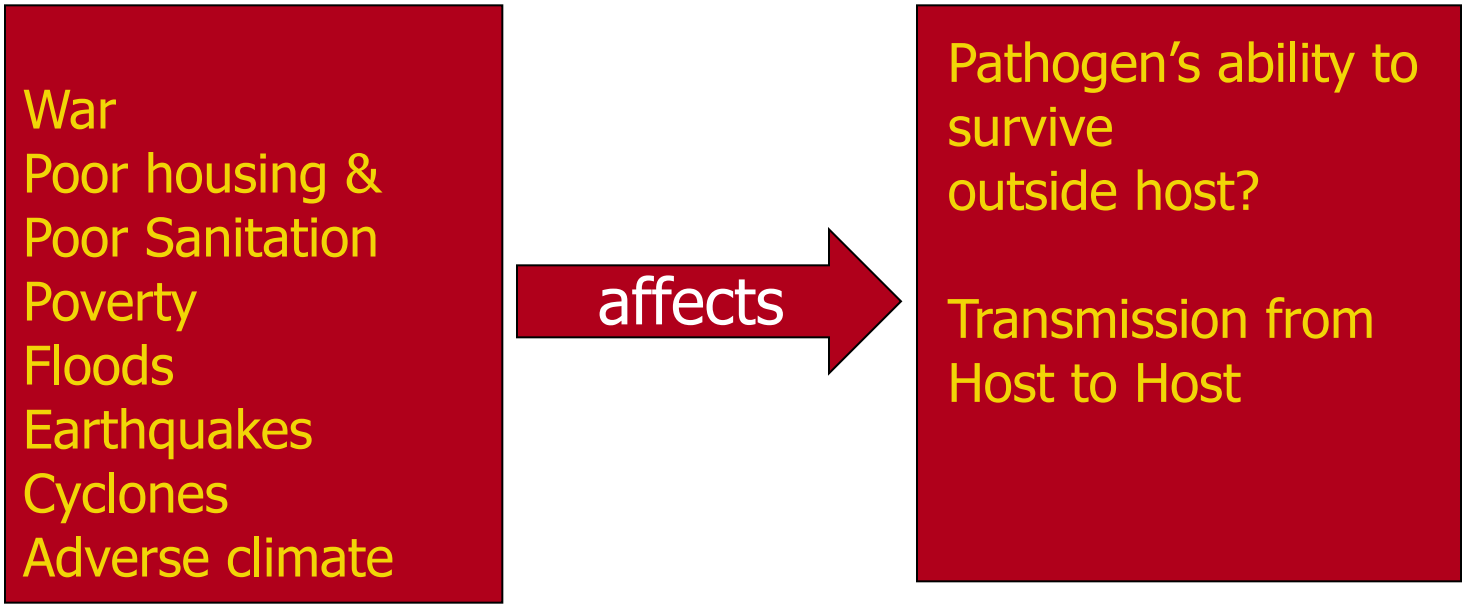
Definition : Conditions that influence interaction between agent & host

Examples

- Biological
- physical (+ climate) & physical surroundings
- social (+ socioeconomic conditions)

# Epidemiologic Triad - Environment

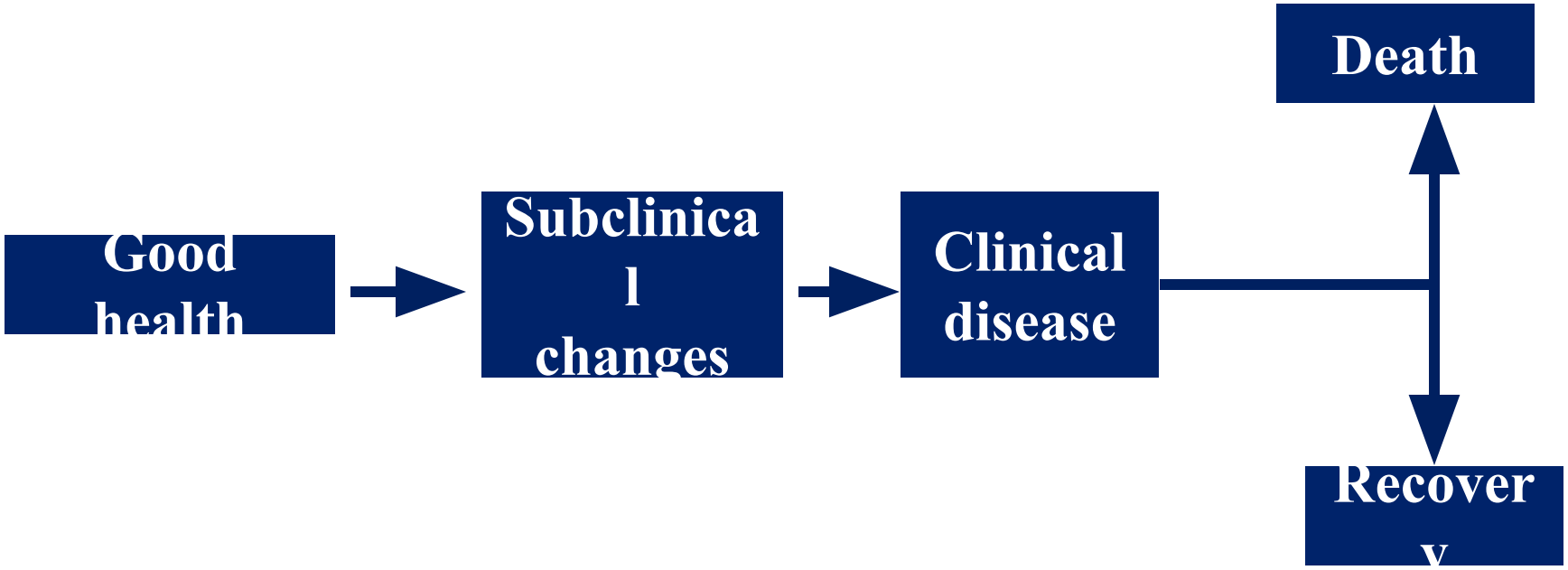
- Environmental conditions  major influence on health status of individuals in the population



# Natural History of Disease

- The progress or course of disease in an individual over time without any external inversion .
- It has 3 stages :

# Natural History of Disease




- Cholera
- Dengue fever

# Natural History of Disease

1. **Stage of susceptibility (before onset of disease)**

   age, sex, occupation, family history,Weight (obesity), smoking

2. **Stage of exposure to the agent**

3. **Stage of subclinical disease**

   etiologic agent present in the body but has not caused any visible symptoms or signs of disease.

4. **Stage of clinical**

5. **Recovery or death**

# Incubation Period

- Interval between time of contact and/or entry of agent and onset of illness

- Time required for microorganism to multiply within the host up to a threshold where the microorganism population is large enough to produce symptoms and/or signs of disease

# Dynamics of Disease Transmission

Transmissible

- Infectious diseases
- Genetic diseases

Non-Transmissible

- Many chronic diseases, eg : diabetes and cancer,

# Mode of Transmission

- Definition: mechanism through which infective agent move from reservoir to susceptible host
  - Direct
  - Indirect

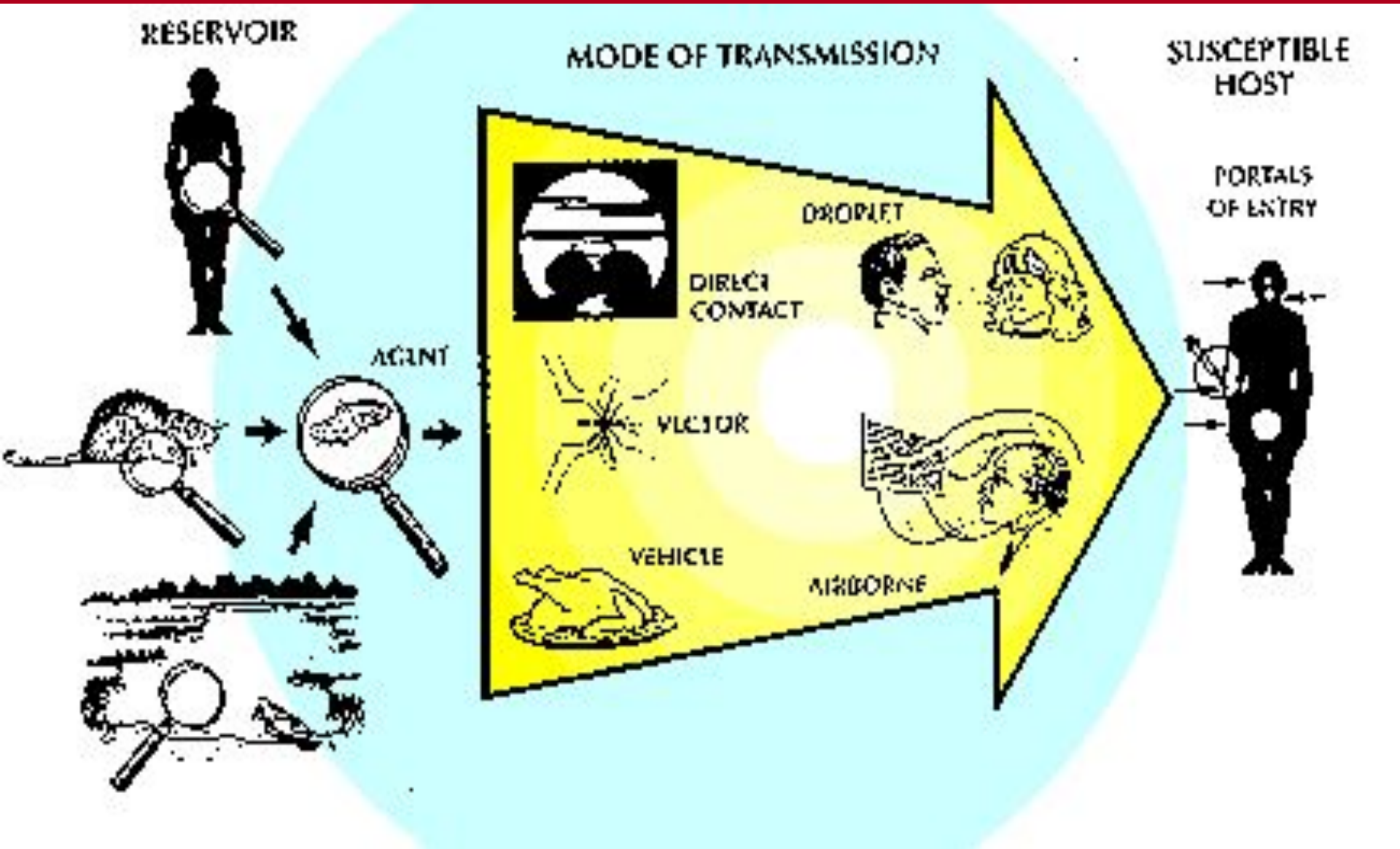
# RESERVOIRS OF INFECTION

- Definition:

habitats where infective  agent can survive & (multiply).

- Animals : zoonoses (animal  human)
- Environment : plants, soil, water
- Human : case (person having disease)

# Chain Of Transmission



# Mode of Transmission

I. Direct:

From person-to-person

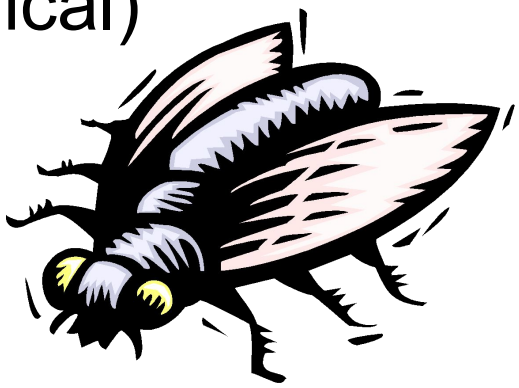
- Sexual contact
- Transdermal
- vertical from the mother to the baby

# Mode of Transmission

II. Indirect :

contaminated vehicles such as food, water, inert objects (dressings),

- Vector borne (biological, mechanical)



# Transmission of Disease

- **Fomites**
  - Inanimate Objects
  - Tissues, towel, drinking glasses, needles

- **Droplet Transmission**
  - Saliva and Mucus
  - Coughing, Sneezing, Laughter
  - Less than 1 Meter

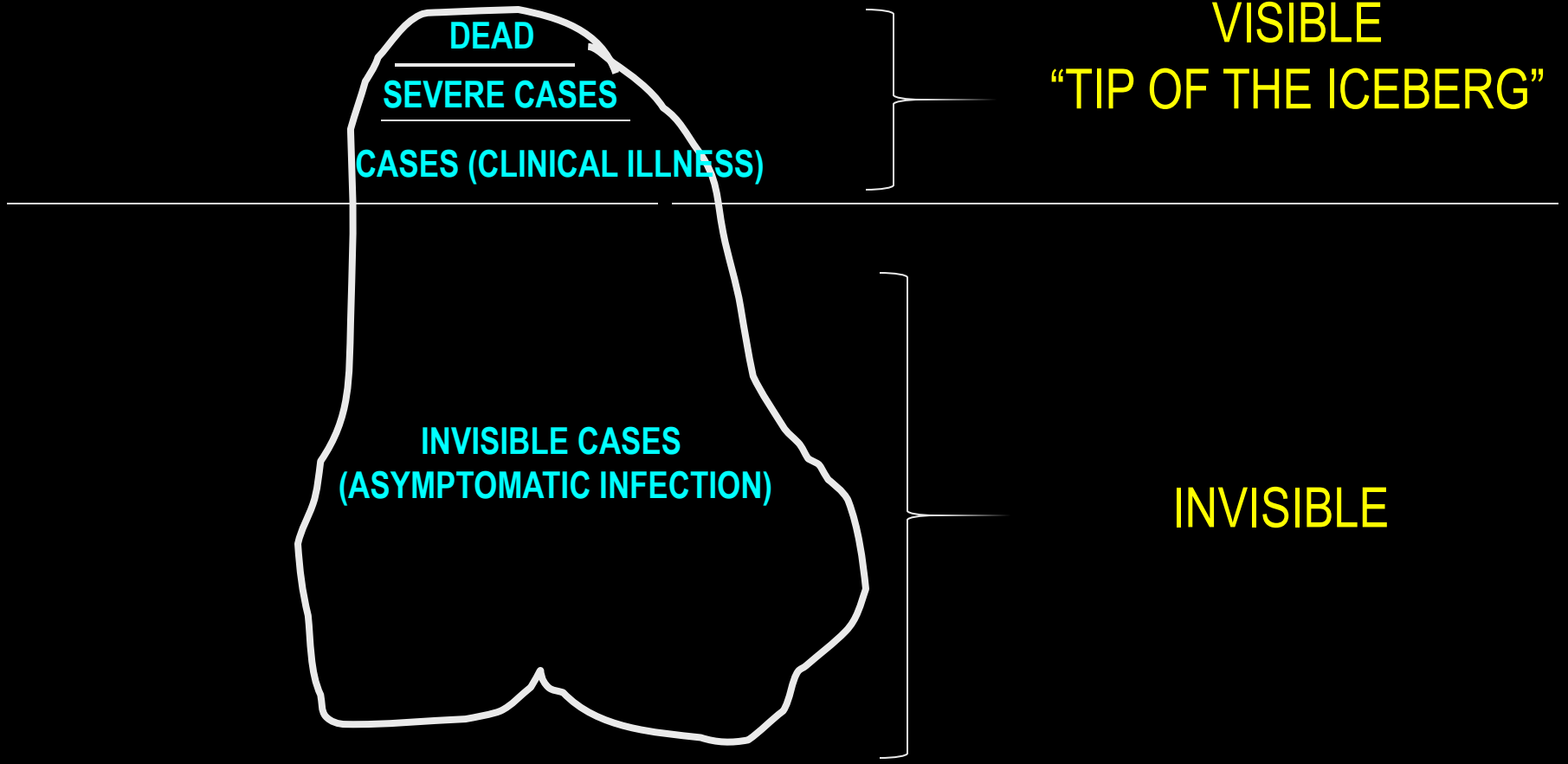
# Mode of Transmission

- **Person-to-person** (respiratory, oral, genital, skin, body fluids)
  E.g. tuberculosis, SARS, HIV, measles
- **Vector** (insects)
  E.g. rabies, yellow fever, dengue, malaria
- **Common vehicle** (food, water)
  E.g. Salmonellosis, cholera
- **Fomites** (contaminated objects)
  E.g. nosocomial infection
- **Intra Venous** (blood & blood products)
  E.g. malaria, hepatitis B
- **Transplacental**
  E.g.rubella, HIV

# Iceberg Phenomena

# ICEBERG PHENOMENA

VARIATION OF SEVERITY OF A DISEASE PROBLEM



# ICEBERG PHENOMENA

- EXAMPLES:
- Hepatitis B carriers
- Cholera carriers
- HIV/AIDS

# HERD IMMUNITY

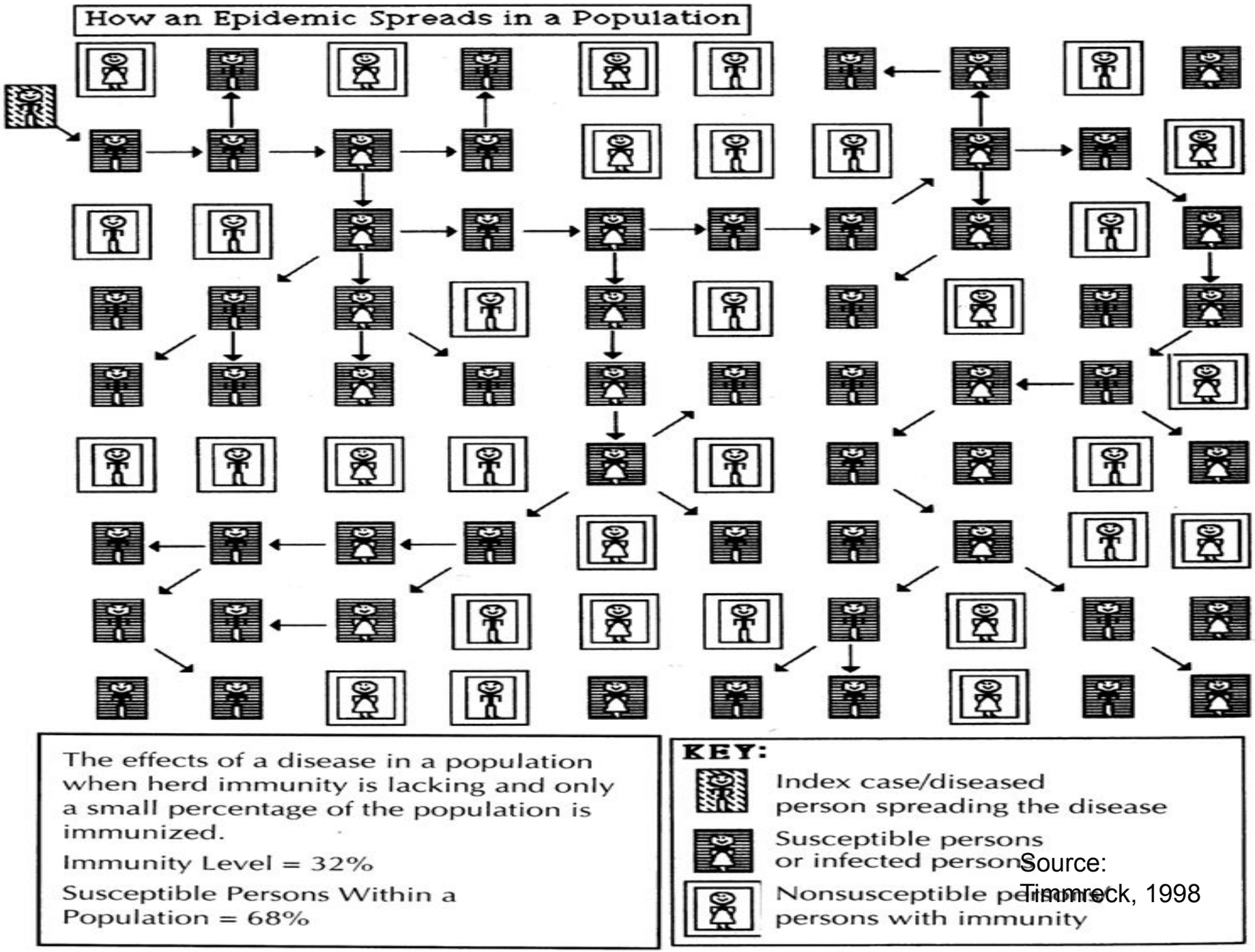
Definition: immunity or resistance of a ***HERD*** (population group or community) to a disease

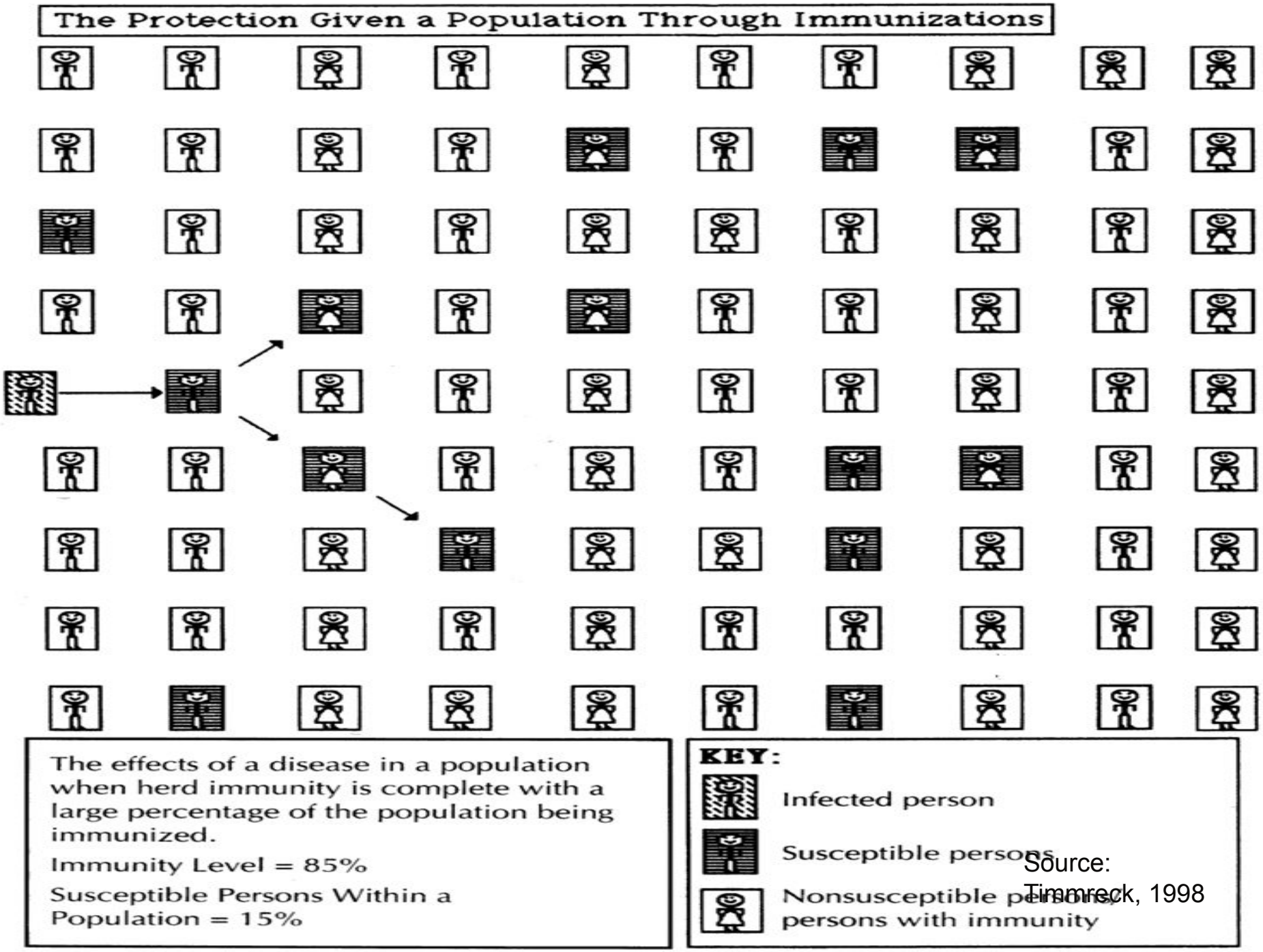
- Resistance of a group to invasion & spread of an infective agent is based upon the resistance to infection of a high proportion of individuals in a group

Public Health Implication:

Thus an entire population does not have to be immunized to prevent the occurrence of an epidemic

- Example: Measles virus transmission would stop if 70% of the population is immunized


How an Epidemic Spreads in a Population
The effects of a disease in a population when herd immunity is lacking and only a small percentage of the population is immunized.
Immunity Level = 32%
Susceptible Persons Within a Population = 68%
KEY:
Index case/diseased person spreading the disease
Susceptible persons or infected persons
Nonsusceptible persons persons with immunity
Source: Timmreck, 1998




Source: Timmreck, 1998

# HERD IMMUNITY

If the infectious agent cannot find a susceptible host to infect, then an epidemic would die out.

- Once a certain level of protection against a given disease is achieved by a population (probably around 70% - 85%), even the unprotected members are protected because the uninfected population is not large enough to serve as a reservoir

# Herd Immunity Threshold for Selected Vaccine-Preventable Diseases

**Modified from Am J Prev Med 2001;20(4S): 88-153**

| DISEASE | Herd Immunity |
|---|---|
| Diphtheria (4 doses) | 85% |
| Measles | 83-94% |
| Mumps | 75-86% |
| Whooping cough | 92-94% |
| Polio | 80-86% |
| Rubella | 83-85% |
| Smallpox | 80-85% |

# SUMMARY

# Quesetion

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Merci
mahalo
Köszi
спасибо
Grazie
Thank you
mauruuru
Takk
Gracias
Dziękuję
Děkuju
danke
Kiitos