Concepts in infectious disease epidemiology

MATHEMATICAL MODELING FOR INFECTIOUS DISEASE PLANNING IN AFRICA

(30 minutes)

UNIVERSITY OF Global Health EQUITY
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CENTER for COMMUNICABLE DISEASE DYNAMICS

Learning objectives

- Define infectious diseases and basic-related concepts
- Explain the epidemiological triad in the concept of disease transmission
- Recall the modes of transmission of infectious diseases
- Understand targets for control measures

1. What are infectious diseases?
2. What is the difference between infection and disease?

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What are infectious diseases?

- Infectious diseases are diseases caused by microorganisms- such as bacteria, viruses, fungi, or parasites.

- Infections –not diseases –are transmitted.

Classifications of infectious disease

- Taxonomy
  - Species
  - Bacteria, virus, protozoan
  - Specific disease-causing lineages
- Route of transmission
- Clinical relevance/syndromic
- Site of infection

Source:Science.org

Terminologies

- Pandemic
- Epidemic
- Endemic
- Control
- Elimination
- Eradication

Pandemic versus Epidemic versus Endemic

- Endemic refers to the "constant presence and/or usual prevalence of a disease or infectious agent in a population within a geographic area".

- An epidemic is an "increase, often sudden, in the number of cases of a disease above what is normally expected in that population in that area".

- A pandemic refers to an "epidemic that has spread over several countries or continents, usually affecting a large number of people".

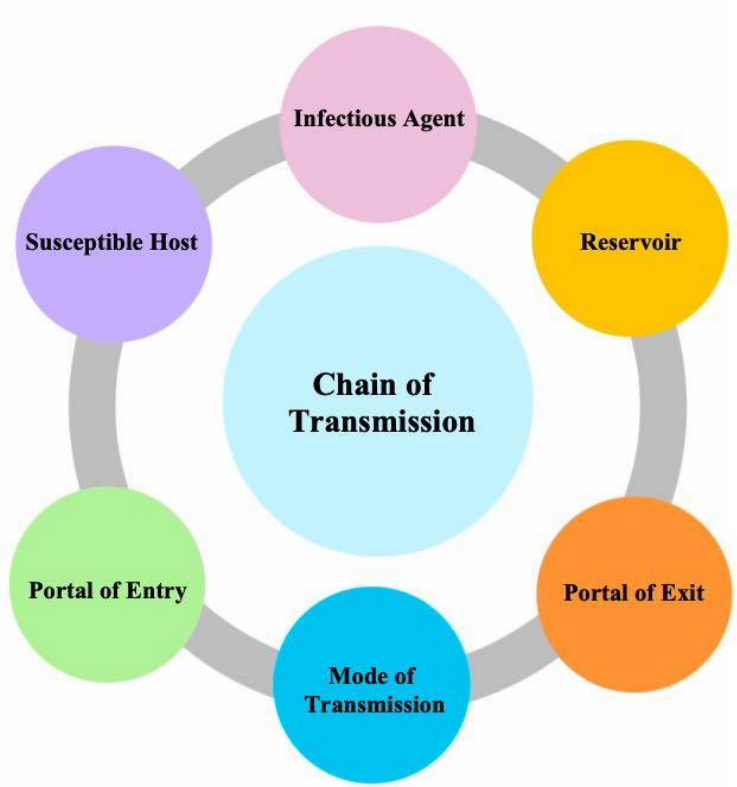
Control versus Elimination versus Eradication

- **Control**: "reduction of disease incidence, prevalence, morbidity or mortality to a locally acceptable level as a result of deliberate efforts; continued intervention measures are required to maintain the reduction".

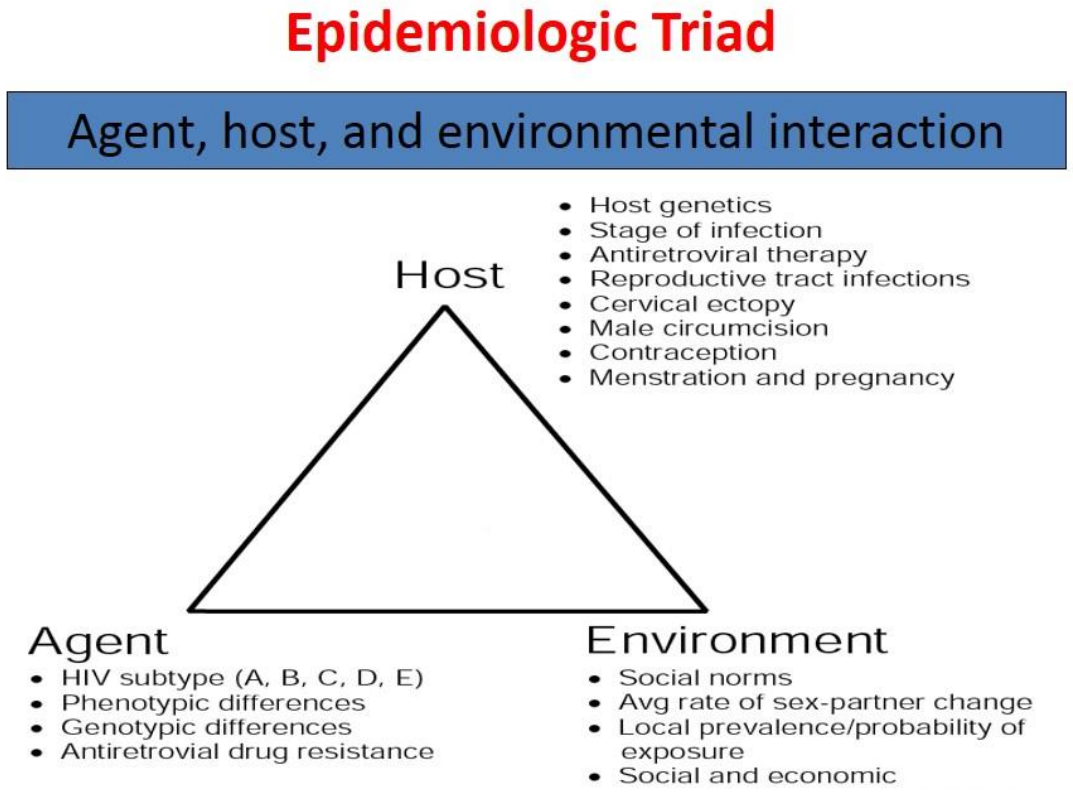
- **Elimination**: "reduction to zero of the incidence of a specified *disease* in a defined geographical area as a result of deliberate efforts; continued intervention measures are required".

- **Eradication**: "permanent reduction to zero of the worldwide incidence of infection caused by a specific agent as a result of deliberate efforts; intervention measures are no longer needed".

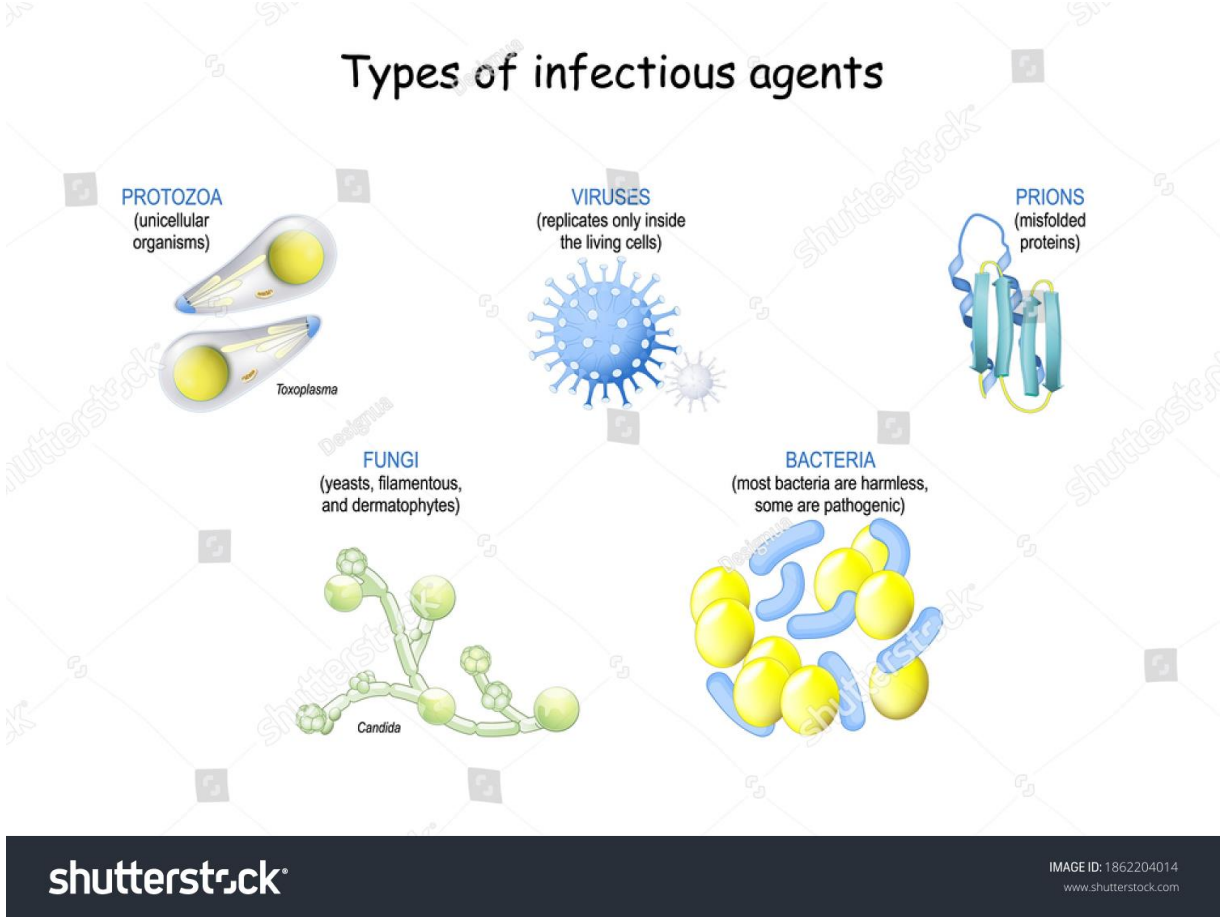
Chain of infectious disease transmission



Epidemiology triad



1. Agent


Types of infectious agents
PROTOZOA
(unicellular organisms)
Toxoplasma
VIRUSES
(replicates only inside the living cells)
PRIONS
(misfolded proteins)
FUNGI
(yeasts, filamentous, and dermatophytes)
Candida
BACTERIA
(most bacteria are harmless, some are pathogenic)
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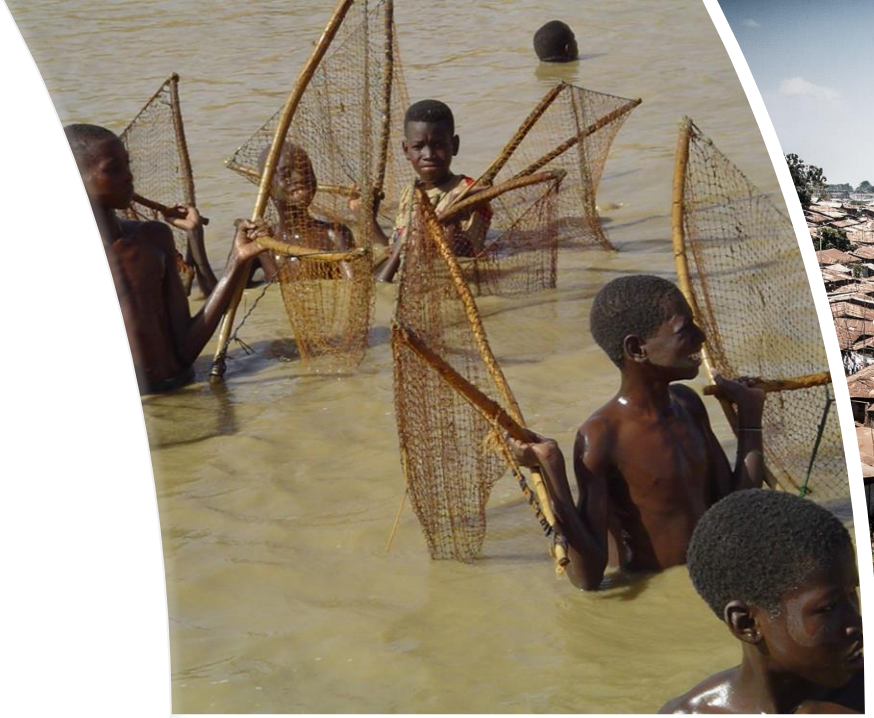
2. Host

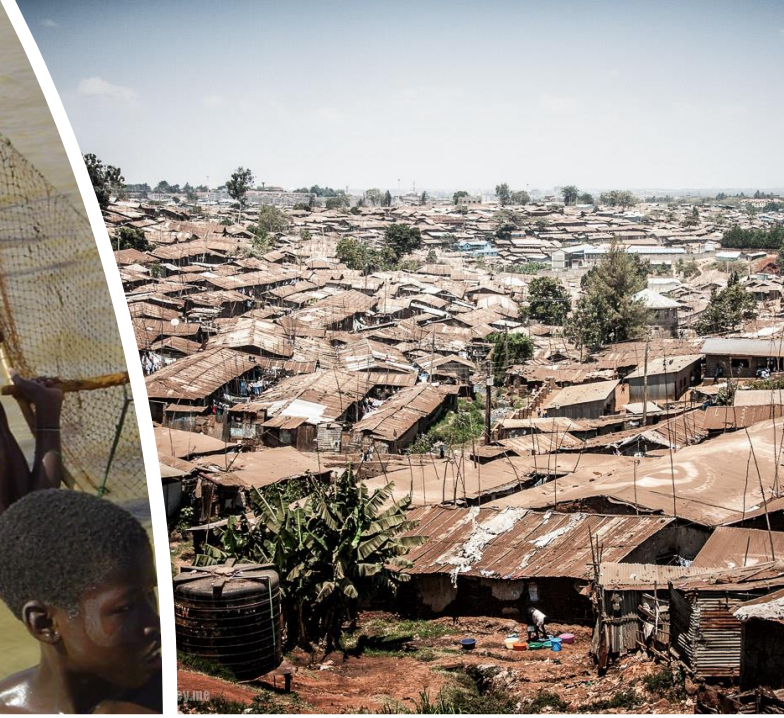
Demographic	• Age, sex, race, etc.
Biological	• Blood group, genetic factor, etc.
Lifestyle	• Personality, smoking, drug, alcohol, etc.
Social and economic	• Occupation, marital status, neighborhood, etc.

Susceptibility

- Not Infected
- Not immune
  - Immunity: sterilizing, partial, cross, and waning immunity
- Can be infected when exposed
- Population at risk

3. Environment: Physical environment

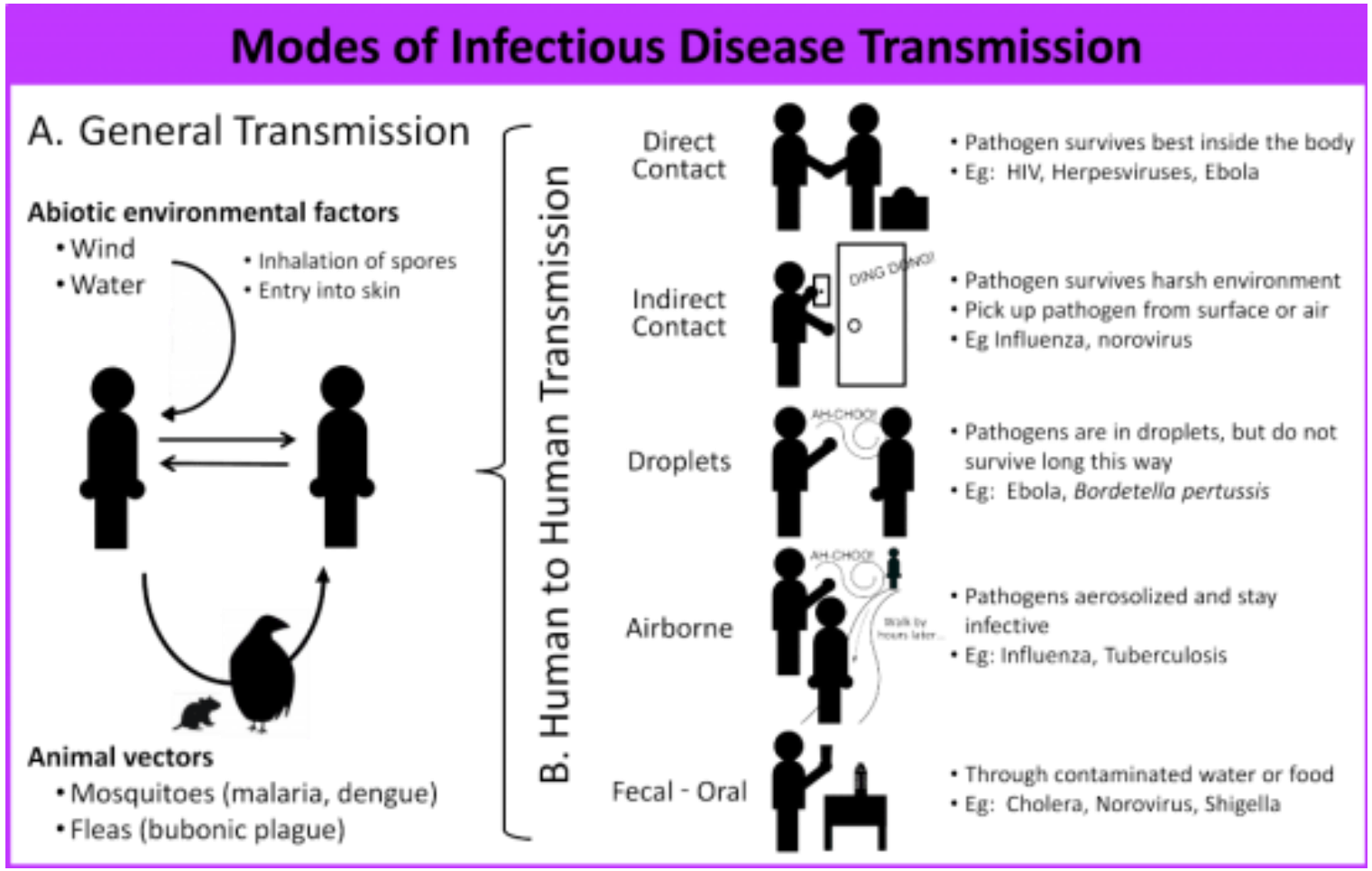




Other environments

- Biological
- Social

Transmission



Source: https://sitn.hms.harvard.edu/flash/special-edition-on-infectious-disease/2014/an-introduction-to-infectious-disease/

Can you think of any control measures that target these?

- Agent
- Host
- Environment
- Transmission

Breaking the chain:

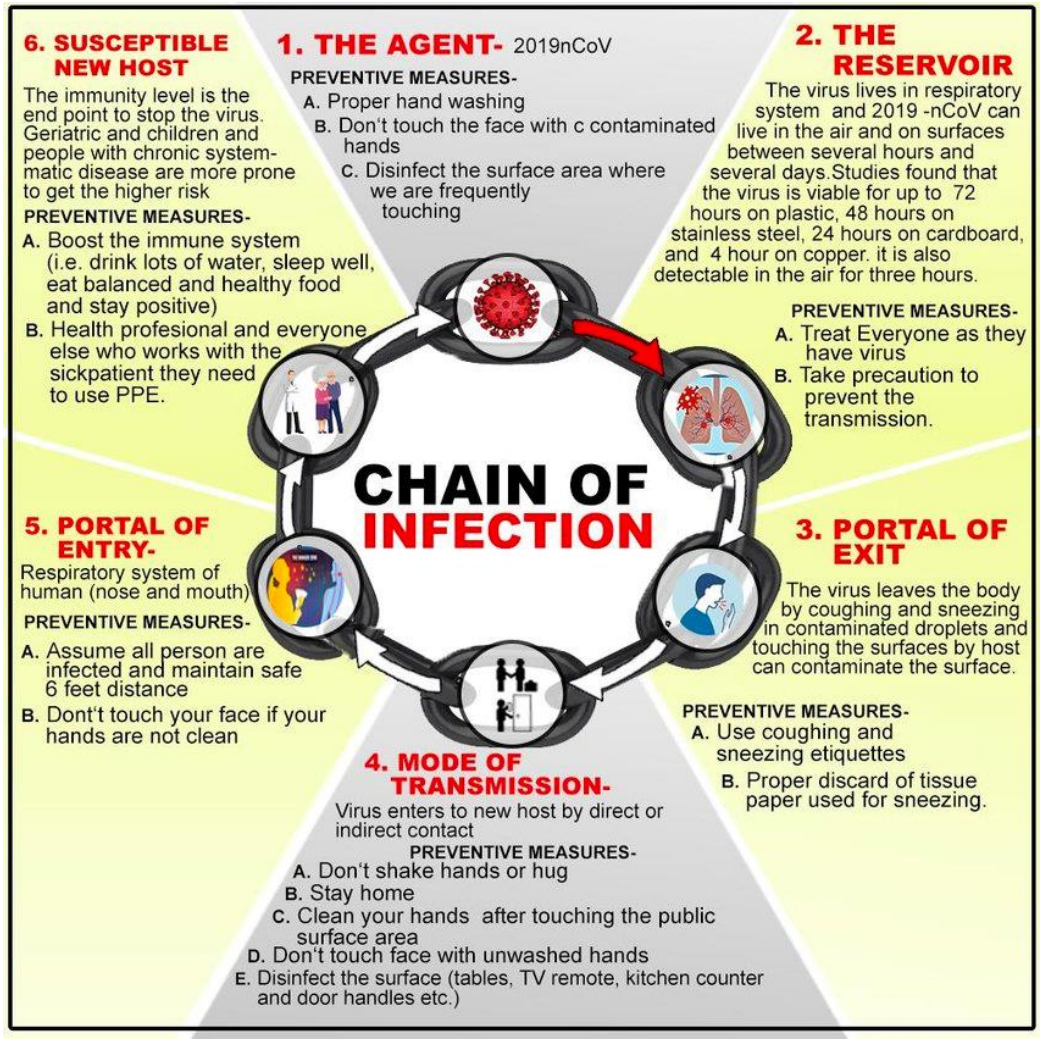


Figure from Chain of Infection for COVID-19 by Ravi Rau Dangi

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References

- CDC Principles of epidemiology
- The Principles of disease elimination and eradication