

Communicable Diseases Epidemiology

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Original Content | **Titles** | Additional Notes | **Important**

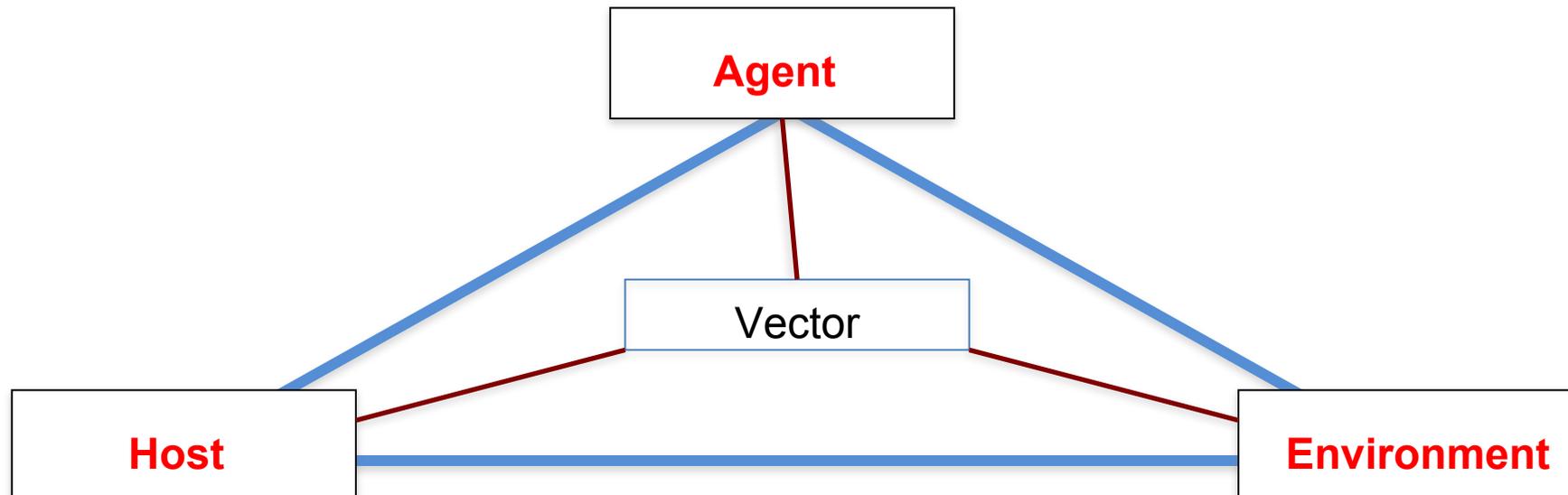
LEARNING OBJECTIVES

- Define communicable disease, control, elimination and eradication.
- Draw the cycle of infection.
- Give examples of different types of infectious agents associated with diseases in humans.
- List the types of reservoir of infection.
- Classify carriers and to explain their public health importance in disease transmission.
- Illustrate with examples the different modes of transmission of communicable diseases.
- Define incubation period.
- Classify and differentiate between the types of immunity.
- Outline the measures for the prevention and control of communicable diseases.

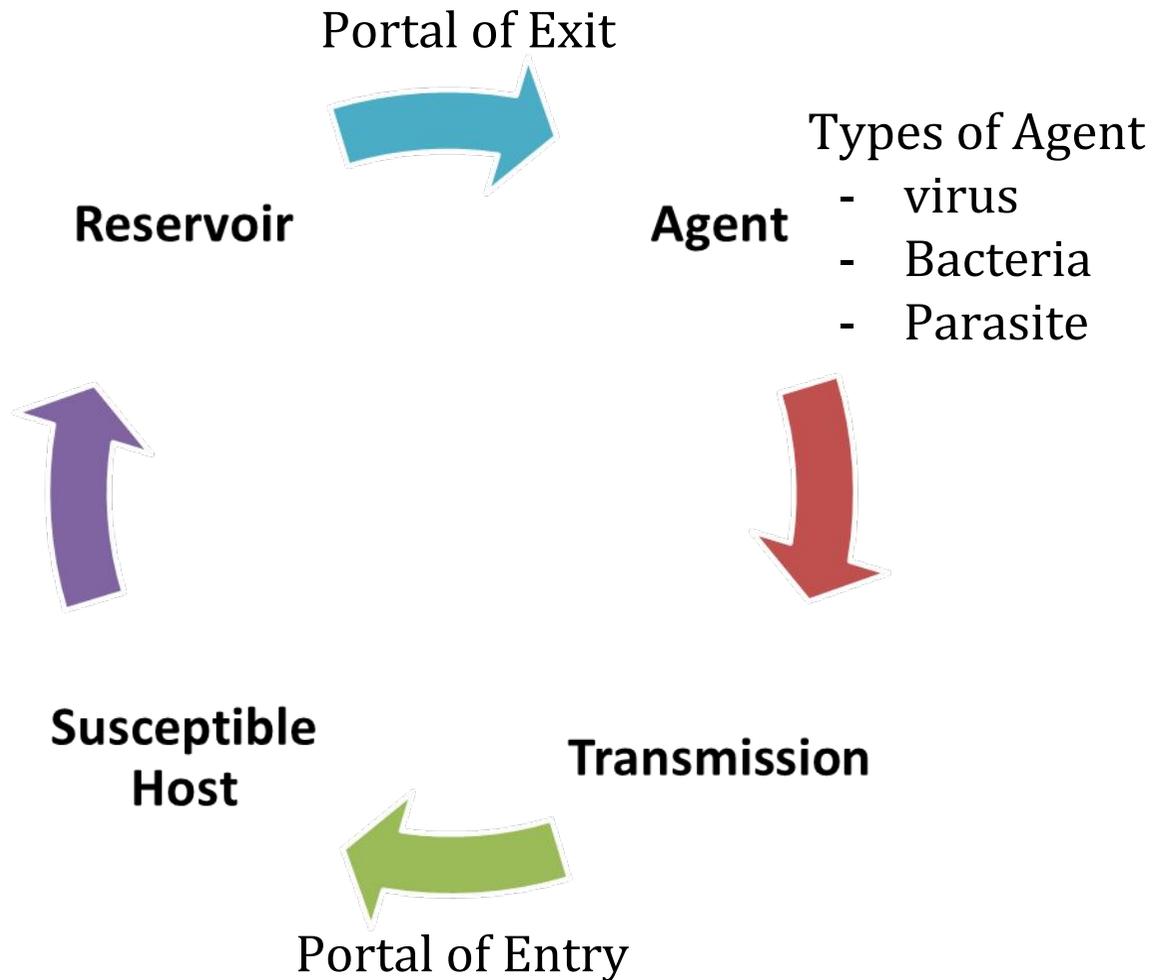
WHAT IS A COMMUNICABLE DISEASE?

It is an illness caused by an infectious agent or its toxic product that is transmitted from an infected person, animal or inanimate source to a susceptible host.

EPIDEMIOLOGIC TRIAD



CYCLE OF INFECTION



In order for a disease to occur, there should be an interaction between all these factors.

For example, in order for Malaria to occur we need Plasmodium (Infectious agent) + Mosquito (Environment dependant creature) + Human (Host). If Plasmodium was in the air with the absence of mosquitos, human will not acquire the infection.

Why is it important for us to know that?

Because when we try to control a disease, we need to breakdown these connections; weather between agent and environment, environment and host, or host and agent. This could be applied on noncommunicable diseases as well when you replace the infectious agents with risk factors.

THE RESERVOIR

- It is the habitat where the infective agent survives grows and multiplies in such a manner that it can be transmitted to a susceptible host.
- Carrier = person with inapparent infection that transmit the disease to others.

Reservoir of infection can be:

- **Human reservoir** => case or carrier

Salmonella can be carried in the gallbladder of an asymptomatic host and transmitted to others with feco-orally (feces → hands contamination → oral entry → infection).

- **Animal reservoir** => case or carrier

Coronavirus can be carried in asymptomatic camels and transmitted to humans with contact.

- **Environmental reservoir:**

- Water => e.g. legionnaire's disease (Atypical Pneumonia caused by Legionella bacteria).
- Soil => e.g. Botulism, Tetanus (Neurological diseases caused by Clostridium bacteria).
- Plants

- **Combination of these types**

THE AGENT

Mechanisms of which an agent produces disease (pathogenesis) are the following:

- **Invasiveness:** ability of the organisms to invade the tissues and multiply.
- **Toxigenicity:** ability of the organism to produce toxins.
 - **Exotoxins:** (released by living organisms): Heat labile; highly immunogenic and converted to antigen or toxoid by formalin, heat and acid.
 - **Endotoxins:** (released after disintegration of the organism): Heat stable, poorly immunogenic and not converted to toxoid.

CONT... THE AGENT

Pathogenicity: The power of an infectious agent to produce disease.

Virulence: Ability to produce severe pathological reaction. Measured by the ratio of clinical to subclinical disease and case fatality rate.

Dose of infection (inoculum): High probability of severe disease with higher dose of infection.

Viability of the organism (resistance): Ability of the organism to live outside the body.

Spore formation: Maintain viability for a long period in unfavorable environmental conditions.

Antigenic power of the organism: Ability to stimulate the immune system to produce antibodies or antitoxin with subsequent immunity. Measured by the second attack frequency.

Ease of communicability: is measured by the secondary attack rate, which is the number of secondary cases, occurring within the range of incubation period following exposure to a primary case expressed as a percentage of susceptible.

THE MODE OF TRANSMISSION

1. Direct Transmission

- **Direct contact**
 - Skin-to-skin.
 - E.g. STDs.
- **Droplet spread**
 - Spray with droplet over a few feet.
 - E.g. Pertussis (Whooping cough caused by *Bordetella pertussis*).

2. Indirect Transmission

- **Airborne**
 - Droplet nuclei or dust suspended in air. (Infected person doesn't need to be present at the time of transmission like droplet spread.)
 - E.g. TB.
- **Vehicle**
 - Food, water, biological products (like feces), or fomites (objects that carry infection, like clothes, utensils, and furniture).
- **Vector**
 - Insects (like Malaria).
 - May support growth or change to the agent.

INCUBATION PERIOD

It is the period between the entry of the organism and the appearance of the first symptom of the disease.

Knowledge of the incubation period is important for:

- Surveillance and quarantine in some diseases.
- Application of preventive measures to abort or modify the attack.
- Identification of the source of infection.

When we acknowledge the incubation period of highly infectious and dangerous diseases like TB, we limit the number of transmissions from asymptomatic hosts by applying preventive procedures early on (e.g. isolation).

THE PORTAL OF ENTRY AND EXIT

- **Portal of entry:** is the path by which the infectious agent enters that host.
- **Portal of exit:** is the path by which the infectious agent exits the infected host.

These could be any part of the body:

- Skin (Direct contact) => Scabies, Fungal, Staph.
- Mucous membrane => HBV, STDs.
- Respiratory tract => Rhinovirus, EBV.
- Gastrointestinal tract => E-coli, Enteric virus, HAV.
- Genitourinary tract => Gonorrhoea, Syphilis.
- Blood => HIV, HCV, HBV, Malaria.

THE HOST

A host is a person or other living animal, that affords living conditions suitable for the growth of an infectious agent

Susceptibility to infection is universal but susceptibility to disease depends on:

- 1- Immunity.
- 2- Dietary and nutritional factors.
- 3- Genetic factors.

For the sake of public health, we will only address the immunity.

IMMUNITY

Types of Immunity

Natural

- Natural resistance of the body offered by skin, mucous membranes, gastric acidity, respiratory cilia.

Acquired

- Passive: acquired through transferred antibodies from mother to infant (natural) or by administration of immunoglobulin or anti-sera (artificial).
- Active: post infection immunity (natural) or following vaccination (artificial).

Passive: immunoglobulins were introduced to your body from natural external resources e.g. breast milk or artificial external resources e.g. injections (like post-exposure prophylactic immunoglobulin for HBV).

Active: your own immune system have made its own immunoglobulins as a protective mechanism against artificial antigens (vaccines) or natural antigens (infection).

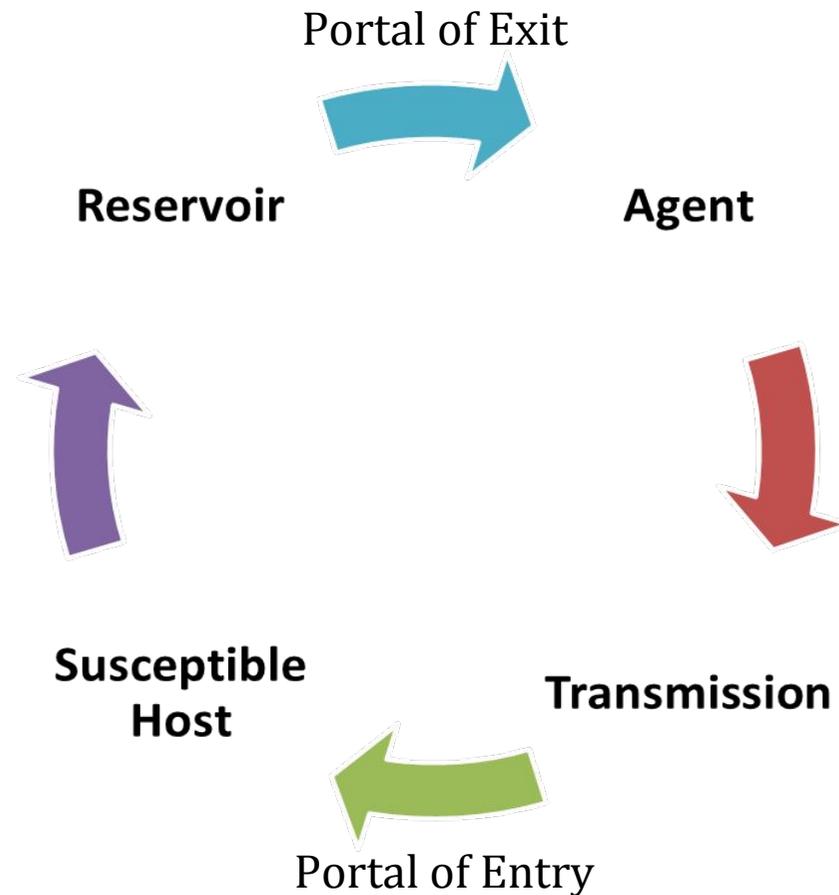
TRANSMISSION OF A COMMUNICABLE DISEASE PREREQUISITES

The six prerequisites for the transmission of communicable diseases are:

1. Presence of reservoir for infection.
2. Presence of microbiological agent.
3. Portal of exit through which the microbiological agent leaves the reservoir.
4. Mode of transmission.
5. Portal of entry (inlet) through which the microbiological enters the host.
6. Presence of susceptible host.

PREVENTION AND CONTROL OF COMMUNICABLE DISEASES

We Need to Break the Cycle



DEFINITIONS

Control

Activities conducted to bring a disease or a health problem at a very low level till it becomes no longer a public health problem.

Elimination

Termination of all modes of transmission to a reduction of the incidence of the disease to the zero in a confined or specific geographic locality as a result of deliberate efforts yet, continued intervention methods are required.

E.g. Poliovirus is almost never seen in KSA, however it still exists in humanity.

Eradication

Termination of all modes of transmission of infection by extermination of the infectious agent.

E.g. smallpox does not exist in humanity anymore, it only exists in the laboratory.

MEASURES THAT DIRECTED TO THE AGENT

Sterilization, disinfection, and proper treatment of infected individuals to kill the agent at its source.

MEASURES DIRECTED TO THE RESERVOIR

Cases: Case finding, reporting to the local health authority in order to apply the appropriate control measures for contact and the environment, isolation (strict isolation or discharge/body fluid isolation) for the whole period of communicability and treatment, surveillance for the longest incubation period.

Carriers: Identification of carriers in the community, treatment and exclusion from work till the organism is eliminated especially if food handlers or working with children. Its cost effectiveness depends on the proportion of carrier in the community as well as the sensitivity of their occupation.

Animal reservoir: Adequate animal husbandry, immunization of animals (if vaccine is available), treatment of infected animals and killing if treatment is not feasible.

MEASURES DIRECTED TOWARDS BREAKING TRANSMISSION

- Isolation if indicated => to interrupt direct transmission.
- Decontamination of fomites => vehicle transmission.
- Promote hand washing => prevent feco-oral transmission.
- Modify ventilation and air pressure => prevent airborne transmission.
- Control vector population => control vector-borne transmission.
- **Environment:** sanitation of water, food, proper sewage handling.

Measures Directed towards Protecting Portal of Entry

- Using bed-nets (against mosquitoes).
- Wearing masks and gowns to prevent entry of infected body secretions or droplets through skin or mucous membranes.
- Covering skin and using insect repellents.

MEASURES DIRECTED TO THE HOST

- Health education.
- Adequate personal hygiene.
- Sound nutrition.
- Immunization.
- Chemoprophylaxis.

What is the Benefit of Complete Immunization in the Community?

Complete immunization coverage can help prevent the agent from reaching a susceptible host.

Herd immunity:

When you immunize a good amount of people (measured with numbers) in the population, you actually make sure that the likelihood of those who are not immunized to acquire the disease is very low.

- State of immunity within the community.
- If a high proportion of individuals in the community are resistant to an agent, then susceptible people will also be protected by the resistant majority.
- The level of susceptibility increases as new infants are born, an epidemic will develop after accumulation of susceptible.
- It could be produced artificially by immunization, or naturally after infection.

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