

Epidemiology of communicable diseases

Definition of basic terms:

Communicable disease: An illness due to specific infectious agent or its toxic products which develops through transmission of that agent or its toxic products from a reservoir to a susceptible host either directly or indirectly.

Contagious disease - capable of spreading from one person to another

Incubation period:

The interval between exposure and first clinical manifestation.

The time between exposure and *first case* is the **minimum incubation period**,

The time between exposure and the last case, **maximum incubation period**.

Communicable period

The time interval during which an agent may be transferred directly and indirectly from a host to another (not necessarily of same species).

Reservoir: Any human beings, animals, plants, arthropods, soil or inanimate matter in which an infectious agent normally lives and multiplies and from which it passes to a new host.

For example, soil may harbor agents that causes tetanus, anthrax.

Some diseases with human reservoirs are:

- Most bacterial and viral respiratory diseases
- HIV/AIDS/Sexually Transmitted Infections (STIs), measles, typhoid etc

Mode of transmission:

The way disease agents are transmitted from the source of infection to new hosts.

Direct mode of transmission

If a certain person gets infected *in the presence of* the reservoir, i.e. the organism jumps from one host to another without any intervening period, then the transmission is said to be direct.

1. **Person to person contact**—The organism spreads by contact with breached epithelium. Contrary to what people think, most sexually transmitted diseases can also be transmitted by any kind of contact which involves an epithelial breach.

2. **Droplets**—Droplets microparticles of respiratory secretions, which, when coughed or sneezed out, are blasted into air with high velocity and inhaled by anybody nearby. Most respiratory infections (influenza, diphtheria, tuberculosis) are spread by droplets. Such infections are difficult to control in an overcrowded population

3. **Contact with soil**—contact may be deliberate (putting soil or cow dung over the cord stumps of newborns, which introduces the tetanus bacilli) or accidental (carrying out deliveries over an unclean surface, which has the same effect); farmers who walk bare feet in open field are infested by hookworms through their feet.

4. **Inoculation in anybody fluid**—This gives the organism the most direct access to circulatory system. For example, hepatitis B and HIV are secreted in all body fluids, and if the body fluids of a patient (blood/ serum/ CF/ saliva/ semen/ vaginal secretion) come in contact with anybody fluid of a healthy person (through epithelial abrasions), he gets infected.

5. **Transplacental**—The blood of fetus and mother are separated throughout the pregnancy except during labor, when the two get mixed, and some organisms can infect the fetus from mothers blood during this period (HIV, hepatitis B). However, some organisms can cross the placental barrier in early pregnancy resulting in fetal malformation or abortion (rubella, cytomegalovirus, chickenpox).

Indirect mode of transmission

Indirect transmission implies a stage of *external survival* of the agent between two hosts, so that it can infect a person sometime after the reservoir is gone from the site.

Thus the factors which control indirect transmission are:

1. Viability of the agent—How long can it survive without any host to sustain it?
2. Virulence of agent—How dangerous can it still remain after the period of external survival?
3. Environment—Is the environment suitable for survival of the organism?

The methods of indirect transmission are as follows.

1- Vehicle

Inanimate objects carrying the organism around (i.e. water, food, blood). Often a vehicle is responsible for a **point source epidemic**, for example, a certain contaminated water source causing diarrhea in everybody who drank it.

2- Vectors

An intermediate organism which transports a micro-organism between two hosts.

Examples include

- Man—*mosquitoes*—man (malaria)
- Rat—*flea*—man (plague)
- Man—*sand fly*—man (kala-azar).

Mechanical vectors: carry the agent, and are in no way *essential* for the organism to carry out its life cycle, e.g flies are *mechanical* vectors.

Biological vectors : harbor a part of the life cycle of organism inside them, rather than just carry it e.g *mosquitoes*.

3- Airborne route

A -*Droplet nuclei* are (the residue of dried droplets that may remain suspended in the air for long periods, may be blown over great distances, and are easily inhaled into the lungs and exhaled).

e.g

the droplets sneezed out by an influenza patient into his bed, remains infective and the virus take the airborne rout when the droplets have dried out.

B - Dust carries with it the Streptococcus bacilli, fungal spores, and tuberculosis bacilli; because dust is a frequent cause of nosocomial infections, hospitals advise wet mopping of the floors rather than dusting with a broomstick.

4- Fomites

Fomites are any inanimate object except food and water (like clothes, utensils and personal belongings of a patient) that bear germs and spread the disease.

5- Fingers

The importance of clean hands can not be overstated

Carrier:

An infected person who harbors a specific infectious agent in the absence of clinical features. It acts as a source of infection to others. Carriers may be incubatory, convalescent or chronic.

Three elements have to occur leading to the carrier state:

- The presence of the disease agent in the body.
- The absence of recognizable symptoms and signs of disease.
- The shedding of disease agent in the discharge or excretions.

The general strategies to control communicable diseases:

1. Elimination of source of infection by effective detection and treatment of cases and carriers or dealing with any other source.
2. Interruption of transmission pathways, for example by the destruction of intermediate hosts, destruction of breeding sites and purification of water.
3. Improvement of host resistance or immunity against infection as for example by immunization