Principles of Communicable Diseases Epidemiology-L-2/23-24

Prof Dr Najlaa Fawzi

LEARNING OBJECTIVES

-Describe the different means of portal of exit and entry

-Illustrate with examples the different modes of transmission of communicable Diseases

-Identify important disease vectors
- Define host and types of resistance related to infection.

Portal of exit

Portal of exit is the path by which an agent leaves the source host.

The portal of exit usually corresponds to the site at which the agent is localized.

Pathogens often leave hosts in materials the body secretes or excretes.

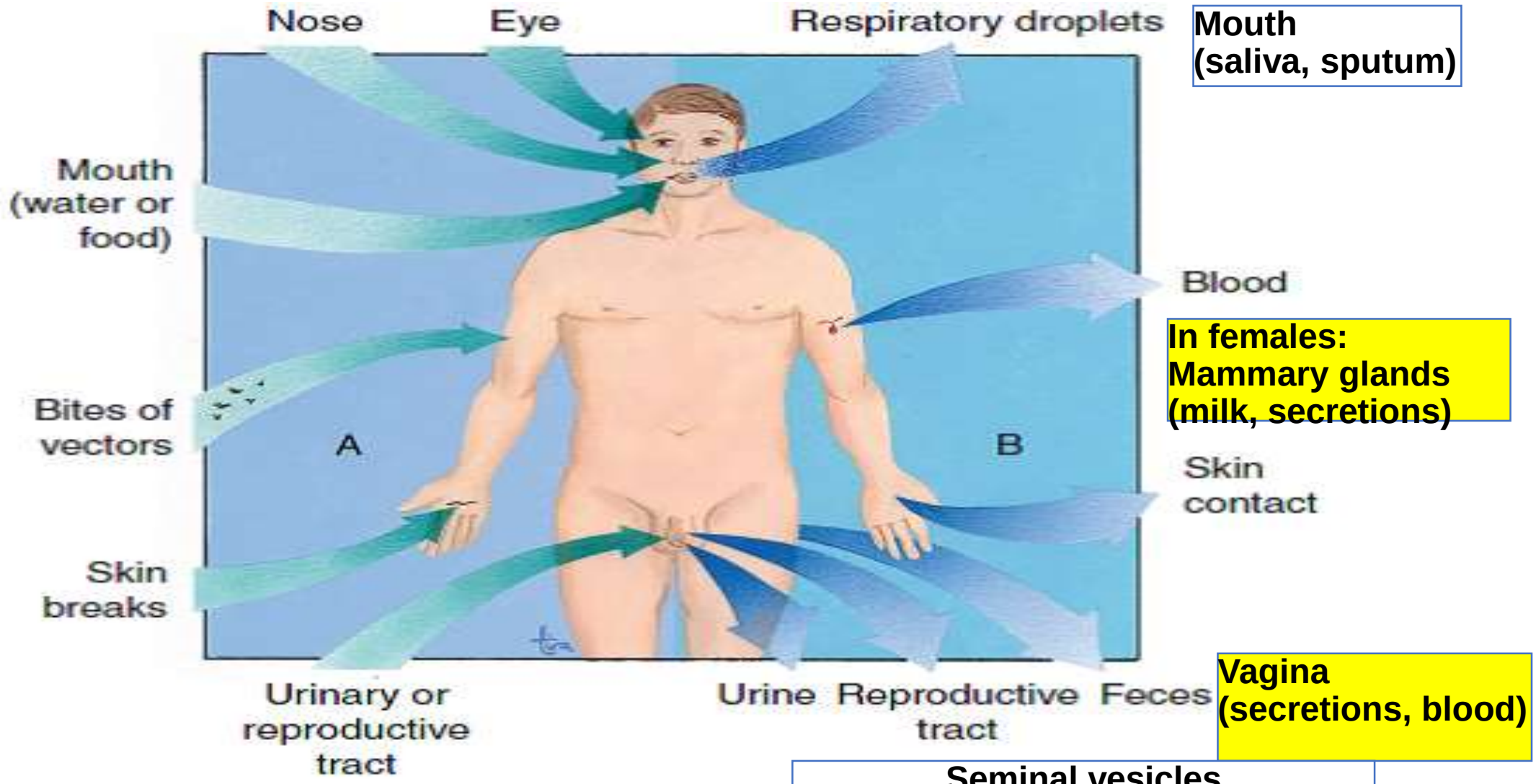


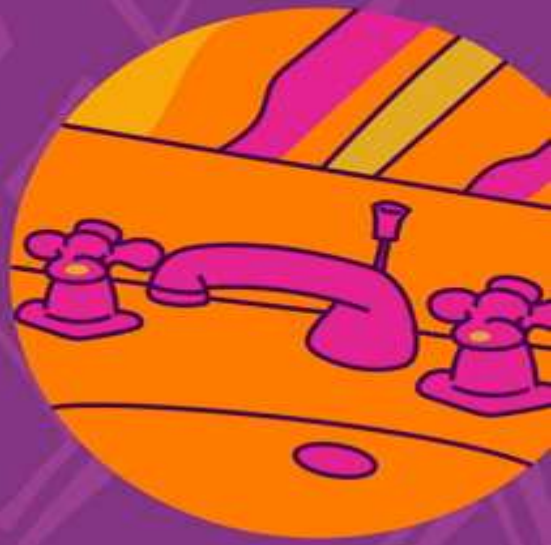
Figure 22–1 (A) Portals of entry. (B) Portals of exit.

Modes of transmission

Droplets

Airborne

Direct contact



Indirect conta

Waterborne

Foodborne

Vector-borne

Modes of transmission

An infectious agent may be transmitted from its natural reservoir to a susceptible host in different ways.
There are different classifications for modes of transmission.

WHY Its IMPORTANT?

Understanding the mode of transmission for a given disease is vital for developing methods to prevent the spread of disease.

There are three modes of pathogen transmission:

- ✓ **Contact transmission**
  - **Direct**
  - **indirect**
  - **Droplet**
- ✓ **Vehicle transmission**
  - **Airborne**
  - **waterborne**
  - **Foodborne**
  - **Blood borne**
- ✓ **Vector transmission**
  - **Biological**
  - **mechanical**

Single & multiple modes of transmission:

some infectious diseases spread by one means only :

- **Meningococcal meningitis – droplet infection**
- **Cholera, Typhoid – ingestion infection**
- **Malaria – arthropod borne infection**
- **Tetanus, rabies – contact infection**

❑ **Some infectious diseases spread by more than one means which maybe either is equally important, or one mean gets the upper hand, while the others are also important or rare.**

- **Poliomyelitis: respiratory &ingestion infection**
- **Brucellosis: ingestion infection (mainly), inhalation & contact (occasionally)**

Coronavirus infection (COVID-19)
Modes of transmission

1 Through **respiratory droplets**

2 Contact with **contaminated surfaces**

3 **Direct contact** with infected people

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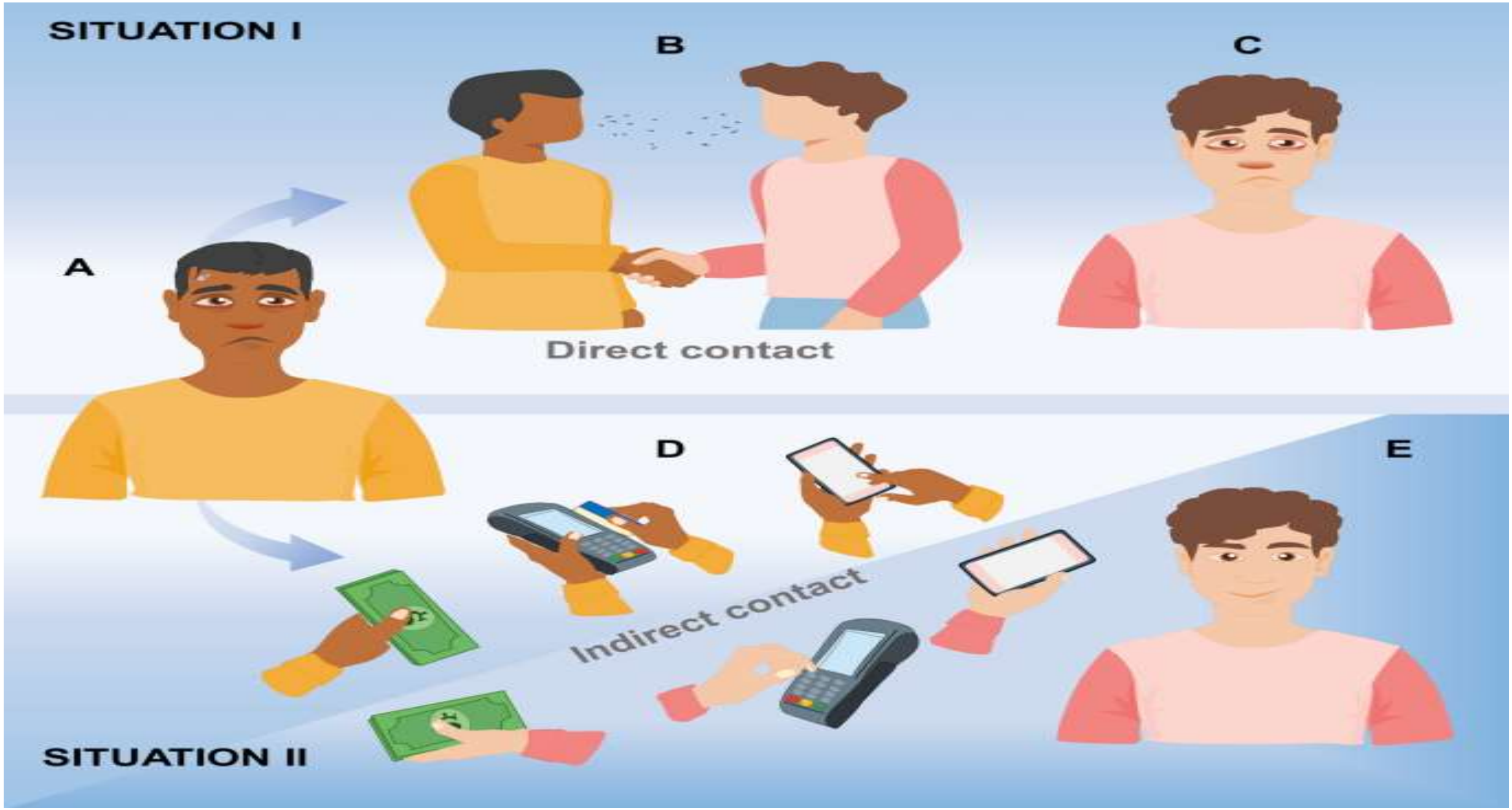

SITUATION I
B
C
A
Direct contact
D
E
Indirect contact
SITUATION II

Contact Transmission

A host is exposed to infectious agents by making contact with the agent or items contaminated with the pathogen so it can reach a portal of entry into the host.

There are three types of contact transmission:

- **Direct contact**
- **Indirect contact**
- **Droplet**

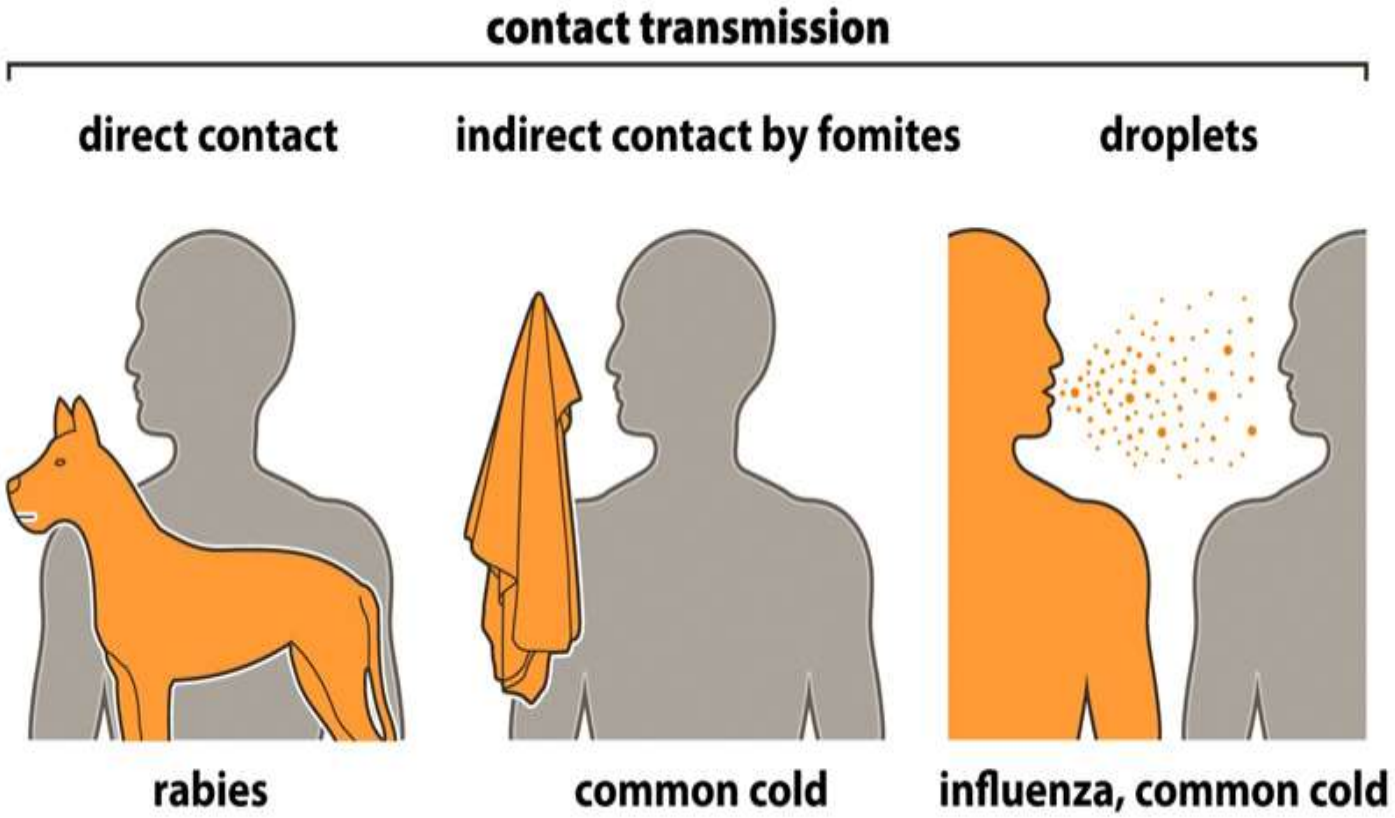


Figure 6.1 Microbiology: A Clinical Approach (© Garland Science)

There is no intermediary between infected and uninfected individuals.

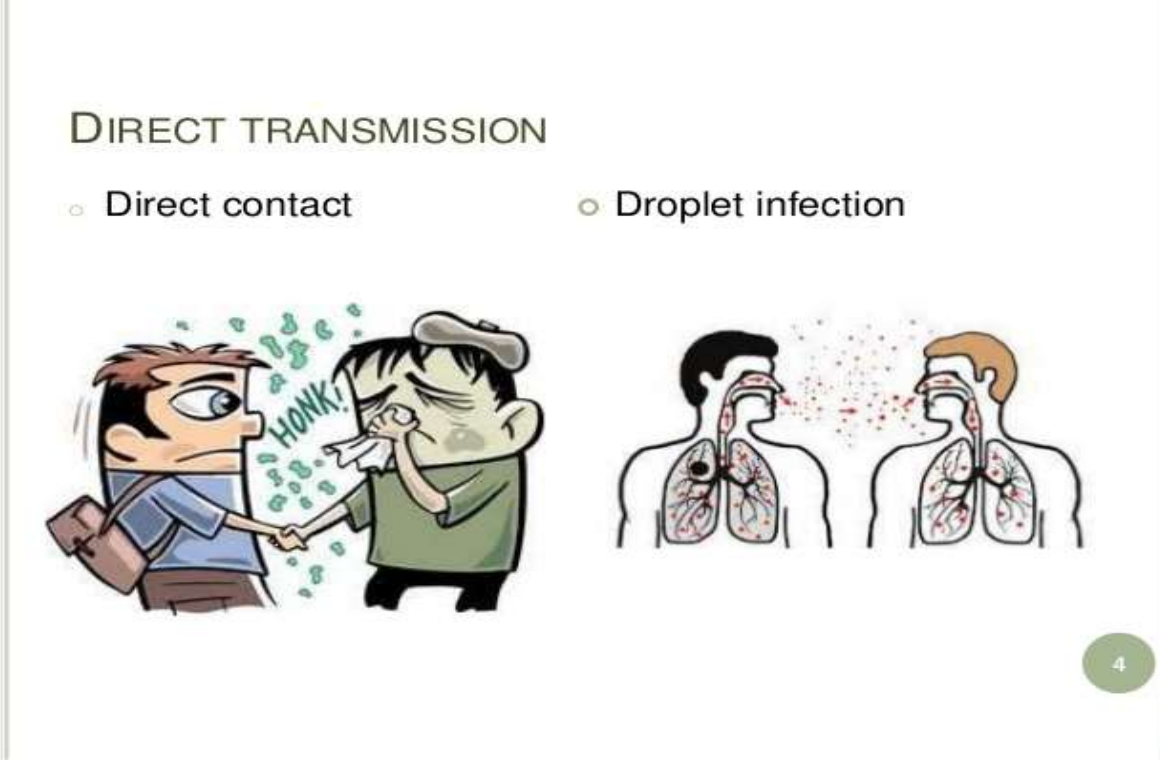
It includes such things as touching, kissing, and sexual interactions.

Diseases transmitted through direct contact include:

Staphylococcal infections

Mononucleosis

Sexually transmitted diseases.



Direct contact can be categorized as

- **Vertical**
- **Horizontal**
- **Droplet transmission**

Vertical direct contact transmission occurs when pathogens are transmitted from mother to child during pregnancy, birth, or breastfeeding.

Horizontal direct contact transmission

Often, contact between mucous membranes is required for entry of the pathogen into the new host, although skin-to-skin contact can lead to mucous membrane contact if the new host subsequently touches a mucous membrane.

- **Contact transmission may also be site-specific; for example, some diseases can be transmitted by sexual contact but not by other forms of contact.**
- **AIDS and gonorrhea are spread from person to person by direct contact.**
- **Direct contact also refers to contact with soil or vegetation harboring infectious organisms. Hookworm is spread by direct contact with contaminated soil.**

Direct droplet transmission

When an individual coughs or sneezes, small droplets of mucus that may contain pathogens are ejected.

- ✓ **Droplets traditionally defined as > 5 µm(microns) .**

- ✓ **This leads to direct droplet transmission, which refers to droplet transmission of a pathogen to a new host over distances of one meter or less.**
- ✓ **A wide variety of diseases are transmitted by droplets, including influenza and many forms of pneumonia.**

- ❑ **Pertussis ,meningococcal and Covid -19 infection are examples of diseases transmitted from an infectious patient to a susceptible host by droplet spread.**

- ❑ **Transmission over distances greater than one meter is called airborne transmission.**

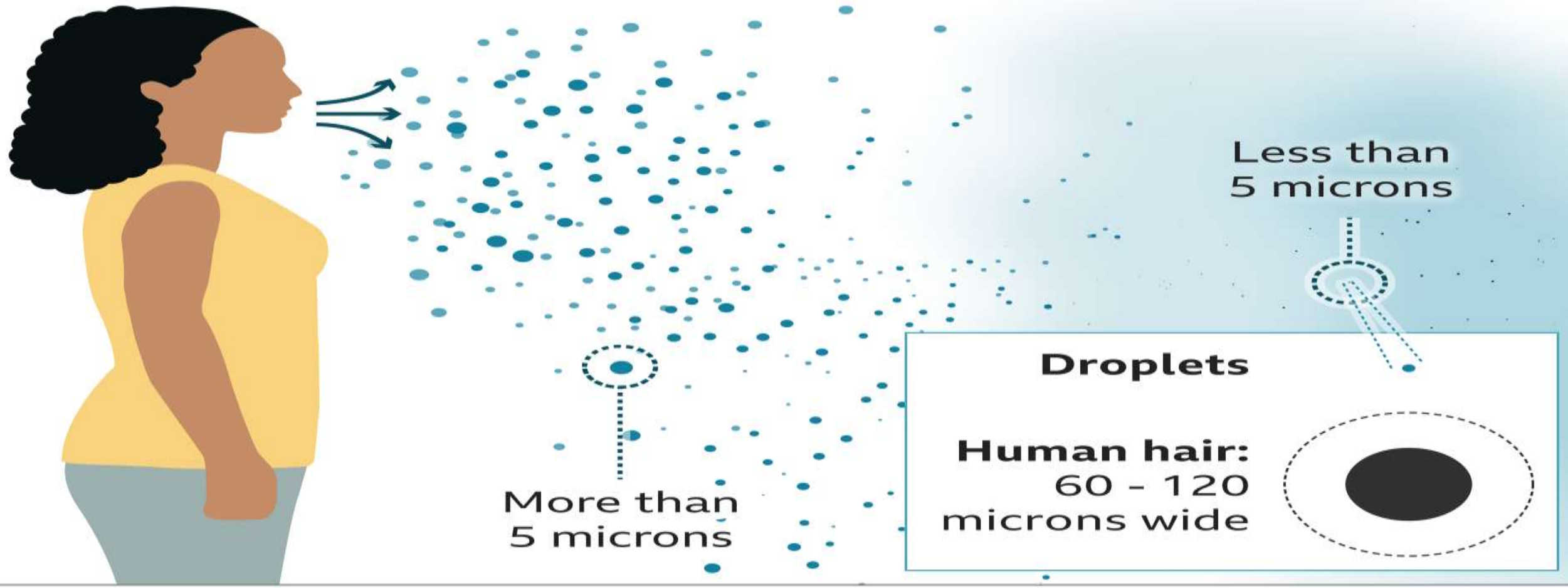
The difference between droplet and airborne transmission

Droplet transmission

Coughs and sneezes can spread droplets of saliva and mucus

Airborne transmission

Tiny particles, possibly produced by talking, are suspended in the air for longer and travel further



Source: WHO

Indirect transmission

Indirect transmission holds a variety of mechanisms including the traditional 5Fs " flies, fingers, fomites , food , and fluid.

Nonliving intermediates that act as the agents of transmission by indirect contact are referred to as fomites, vehicles for transmission.

Indirect contact is often facilitated when unclean hands contaminate surfaces and objects that are then passed around other people.

For instance, stethoscopes are common objects that spread infectious agents in hospitals and doctor's offices.

Fomite

A fomite is an object or surface that is capable of transmitting disease and infectious agents. Fomites can also be referred to as passive vectors.

Fomites can include pens, phones, work surfaces, countertops, tabletops, toys , and doorknobs.

Essential requirement

The infectious agents must be capable of surviving outside the human host in the external environment and retain its basic properties of pathogenesis and virulence till it finds new host.

Factors determining external survivability of disease agent:

- ✓ **Characteristics of the agent**
- ✓ **Non-living object**
- ✓ **Influence of environmental factors like temp and humidity**

- ✓ **Drug resistance**


CONTACT
TRANSMISSION
DROPLET
TRANSMISSION
AIRBORNE
TRANSMISSION

Vehicle- borne Transmission

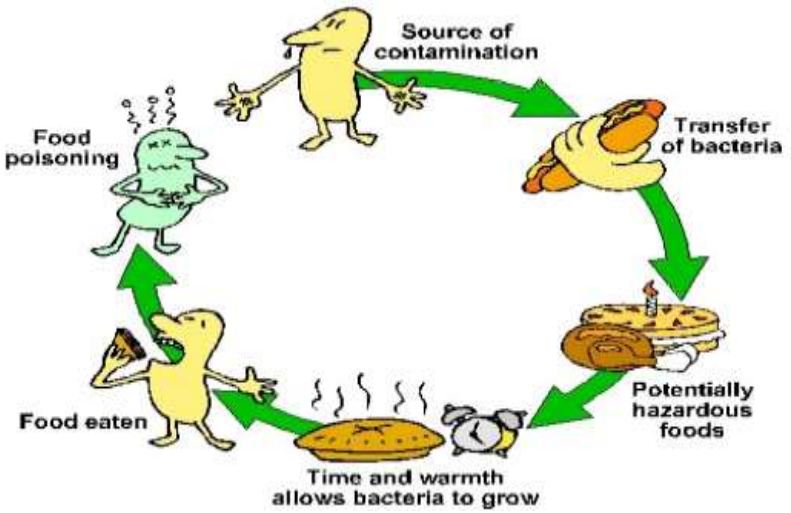
Figure 6.3 Microbiology: A Clinical Approach (© Garland Science)

Vehicle- borne Transmission

The term vehicle transmission refers to the transmission of pathogens through vehicles such as water, food, blood, and air.

Epidemiological Features of Vehicle Transmission

1. **If the dose of contamination is heavy, the outbreak may be explosive**
2. **Cases are initially confined to those who are exposed to the contaminated vehicle, in some infections**
3. **The distance travelled by the infectious agent may be great, e.g., outbreaks of food poisoning**
4. **It is not always possible to isolate the infectious agent in the incriminated vehicle, e.g., typhoid bacilli in contaminated water**
5. **When the vehicle is controlled or withdrawn, the epidemic subsides, e.g., epidemics of cholera**
6. **The common source of infection is often traceable**



Waterborne disease remains a serious problem in many regions throughout the world. The World Health Organization (WHO) estimates that contaminated drinking water is responsible for more than 500,000 deaths each year.
Similarly, food contaminated through poor handling or storage can lead to foodborne transmission of disease

- **The infectious agent may have multiplied or developed in the vehicle before being transmitted; or only passively transmitted in the vehicle.**

Examples :

- **Diseases transmitted by water and food acute Diarrhea , typhoid fever, cholera, Hepatitis A , food Poisoning& intestinal parasites .**
- **Disease transmitted by blood : Hepatitis B, C**

Airborne transmission occurs when infectious agents are carried by dust or droplet nuclei suspended in air.

- Airborne dust includes material that has settled on surfaces and become resuspended by air currents as well as infectious particles blown from the soil by the wind.

- Airborne Transmission via aerosols (airborne particles <5μm) that contain organisms in droplet nuclei or in dusts.

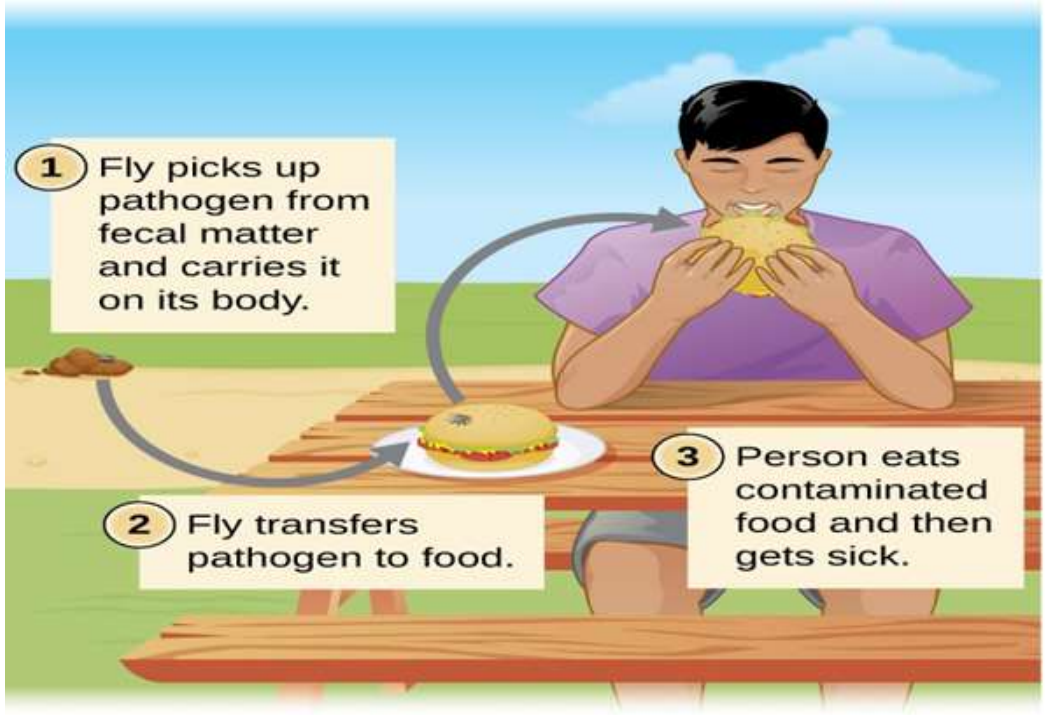
- In contrast to droplets that fall to the ground within a few feet, droplet nuclei may remain suspended in the air for long periods of time and may be blown over great distances.

- **Measles, for example, has occurred in children who came into a physician's office after a child with measles had left, because the measles virus remained suspended in the air.**

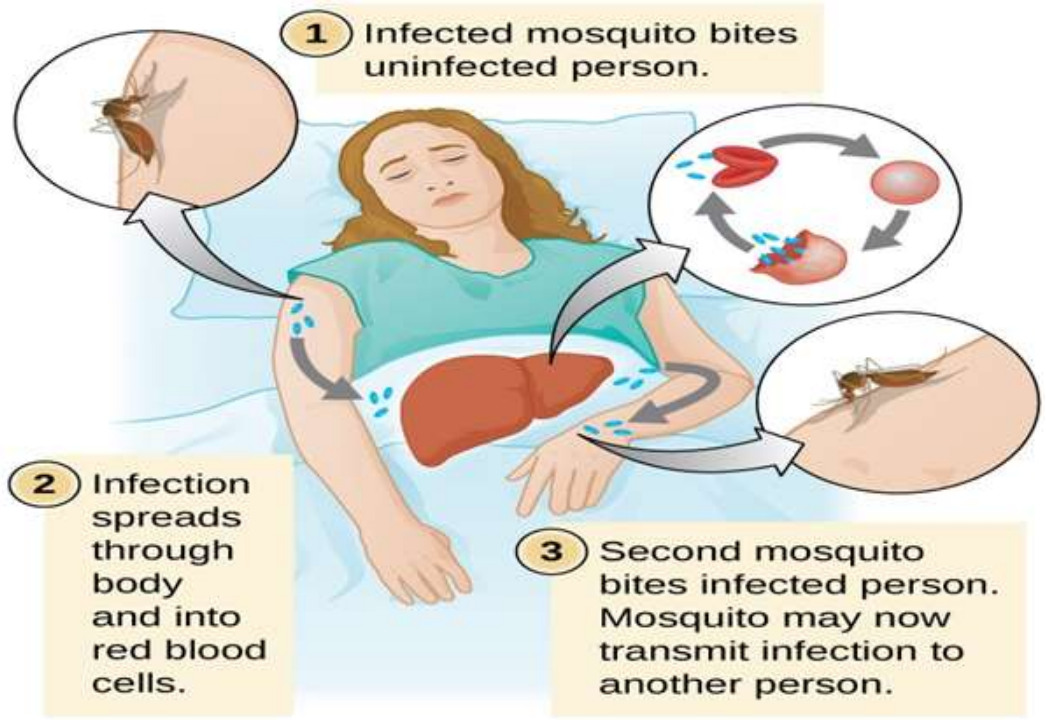
Special ventilation systems are required to prevent airborne transmission

Vector Transmission

VECTOR : vector is defined as an arthropod or any living carrier (e.g., snail) that transports an infectious agent to a susceptible individual.



(a)



(b)

The factors which influence the ability of vectors to transmit disease are:

1-Host feeding preferences

2-Infectivity, that is ability to transmit the disease agent

3-Susceptibility, that is ability to become infected

4-Survival rate of vectors in the environment

5-Domesticity, that is degree of association with man

6-Suitable environmental factors.

Based on the Methods in which vectors are involved in the transmission and propagation of parasites involves

Diseases can be transmitted by a mechanical or biological vector, an animal (typically an arthropod) that carries the disease from one host to another.

- **Fleas**
- **Ticks**
- **Flies**
- **Lice**
- **Mosquitoes**

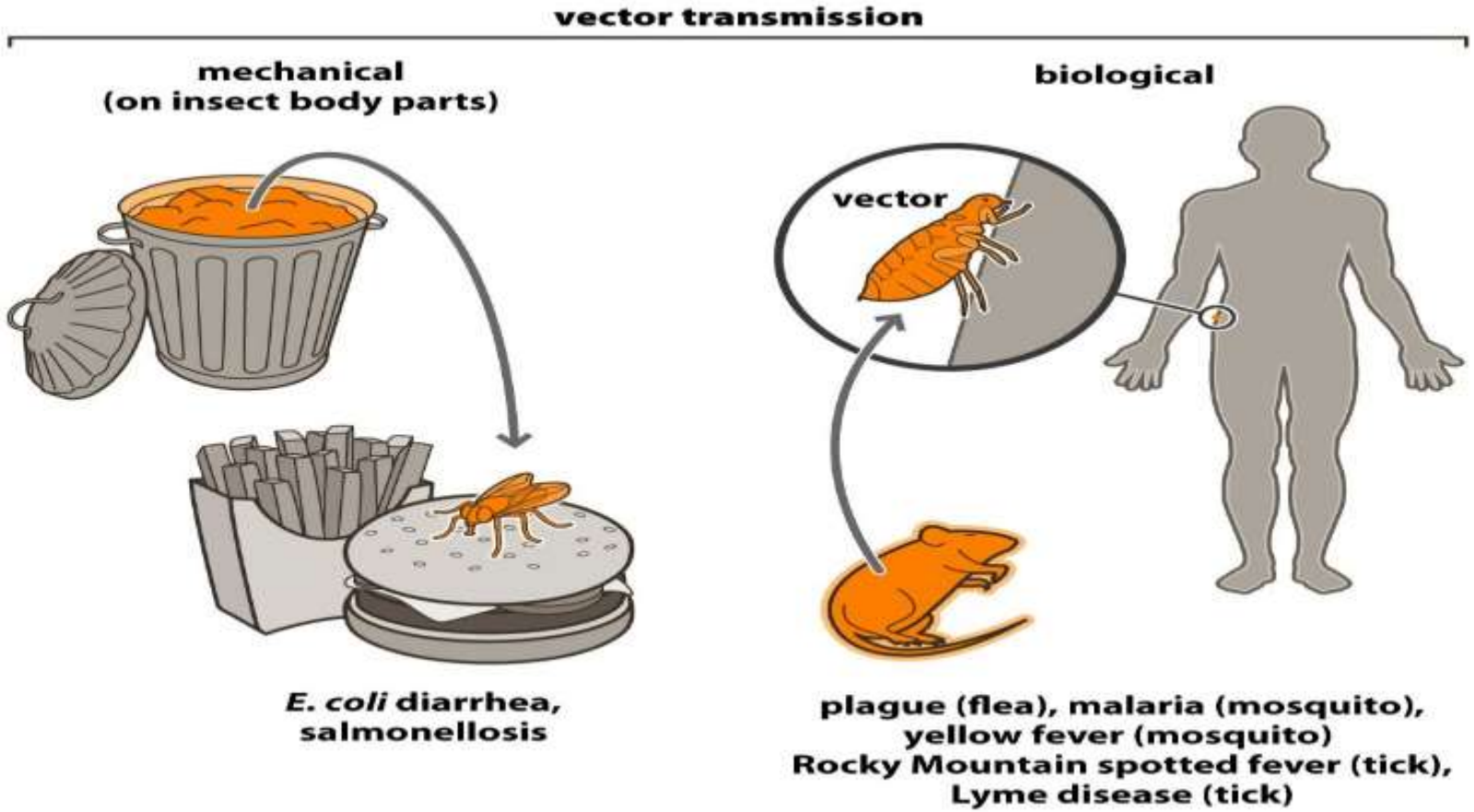


Figure 6.4 Microbiology: A Clinical Approach (© Garland Science)

Mechanical transmission

Is facilitated by a mechanical vector, an animal that carries a pathogen from one host to another without being infected itself. For example, a fly may land on fecal matter and later transmit bacteria from the feces to food that it lands on; a human eating the food may then become infected by the bacteria, resulting in a case of diarrhea or dysentery.

Biological transmission

Occurs when the pathogen reproduces within a biological vector that transmits the pathogen from one host to another.

Biological insect vectors include mosquitoes, which transmit malaria and other diseases, and lice, which transmit typhus.

There are also important non-arthropod vectors of disease, including mammals and birds.

Various species of mammals can transmit rabies to humans, usually by means of a bite that transmits the rabies virus.

Chickens and other domestic poultry can transmit avian influenza to humans through direct or indirect contact with avian influenza virus A shed in the birds' saliva, mucous, and feces.

Portal of entry

The portal of entry refers to the manner in which a pathogen enters a susceptible host.

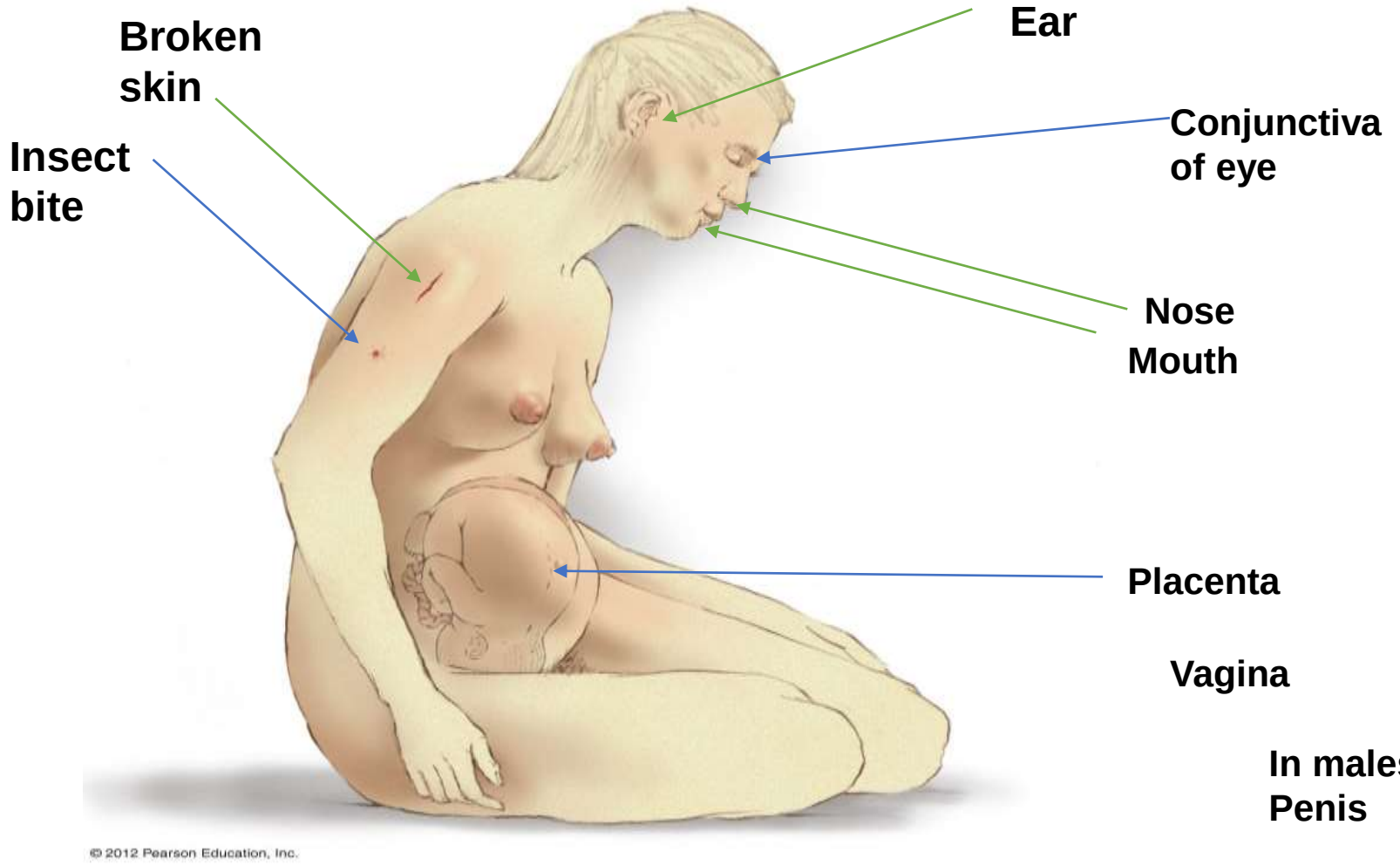
The portal of entry must provide access to tissues in which the pathogen can multiply or a toxin can act.

Often, infectious agents use the same portal to enter a new host that they used to exit the source host.

For example, influenza virus exits the respiratory tract of the source host and enters the respiratory tract of the new host.
In contrast, many pathogens that cause gastroenteritis follow a so-called "fecal-oral" route because they exit the source host in feces, are carried on inadequately washed hands to a vehicle such as food, water, or utensil, and enter a new host through the mouth.

Other portals of entry include the skin (hookworm), mucous membranes (syphilis), and blood (hepatitis B&C, human immunodeficiency virus).

Routes of entry for invading pathogens



Susceptible Host

The final link in the chain of infection is a susceptible host.

The host is the person or animal infected by the pathogen.

A person or animal lacking sufficient resistance to a particular pathogenic agent to prevent disease if or when exposed.

Occurrence of infection and its outcome are in part determined by host factors.

The importance of the host in the transmission cycle is its roles as both reservoir and source of pathogens.

Why an individual may have more than one attack of a particular infectious disease?

True second attack due to agent or host factors

❖ Agent Factors

1-Causative agent has several antigenic Sero - types, streptococcus haemolyticus.

2-With organisms characterized by antigenic changes, shift and drift of influenza virus.

3-in pulmonary TB and other diseases , where treated cases ,
(by specific chemotherapy) is not cured, but becomes inactive & may be exposed to reactivation under adverse predisposing conditions

4-cases having impaired or deficient immune response :
*** acquired by sever malnutrition, or under immune suppression therapy.**
***genetic agammaglobulinemia, or hypo gamma globulinemia**

HERD IMMUNITY

Herd immunity', also known as 'population immunity', is the indirect protection from an infectious disease that happens when a population is immune either through vaccination or immunity developed through previous infection.

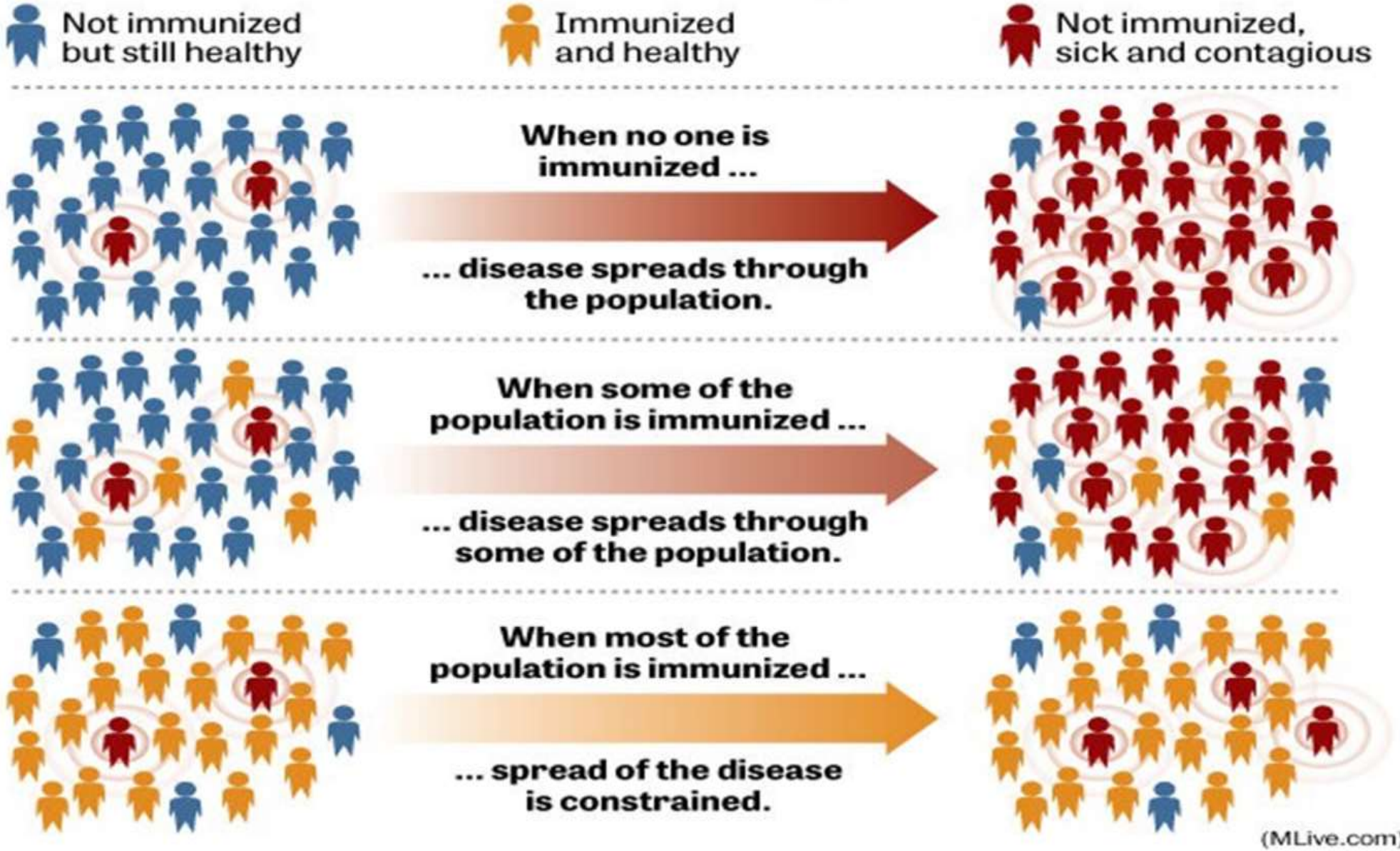
WHO supports achieving 'herd immunity' through vaccination, not by allowing a disease to spread through any segment of the population, as this would result in unnecessary cases and deaths.

Herd immunity (or community immunity) describes a form of immunity that occurs when the vaccination of a significant portion of a population (or herd) provides a measure of protection for individuals who have not developed immunity.

The greater the proportion of individuals who are resistant, the smaller the probability that a susceptible individual will come into contact with an infectious individual

WHY DOES MY CHOICE MATTER TO OTHERS?

It matters because of the concept of "herd immunity." Here's how it works:



Herd immunity can effectively stop the spread of disease in the community. It is particularly crucial for protecting people who cannot be vaccinated.
These include children who are too young to be vaccinated, people with immune system problems, and those who are too ill to receive vaccines (such as some cancer patients).

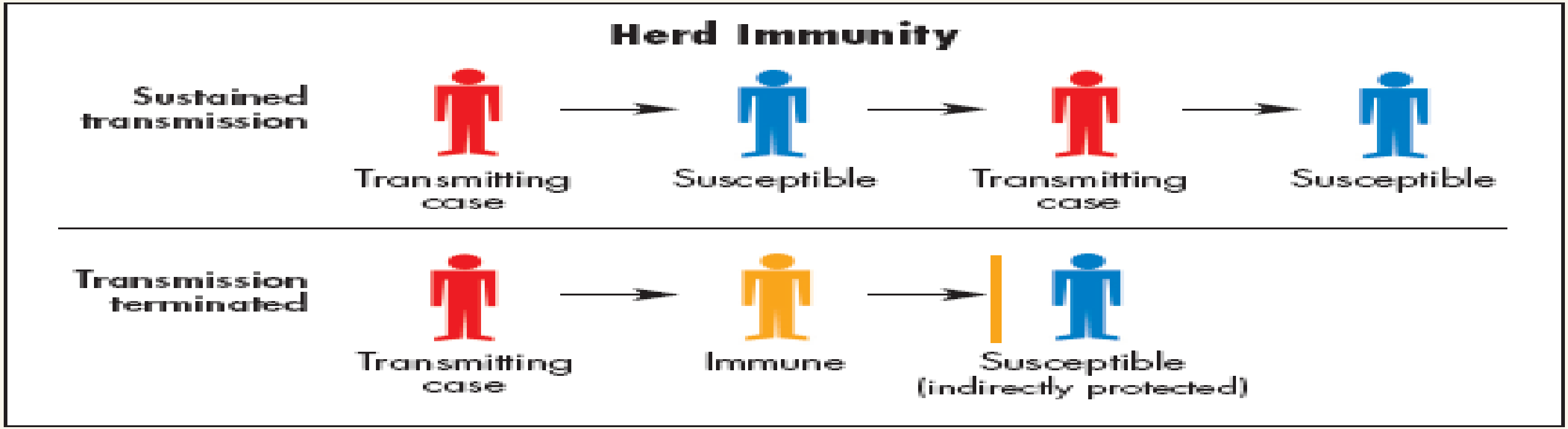


Figure — The principle underlying herd immunity is that the presence of enough immune persons in a community interrupts the transmission of an infectious agent, thereby providing indirect protection for unimmunized (or "susceptible") persons.

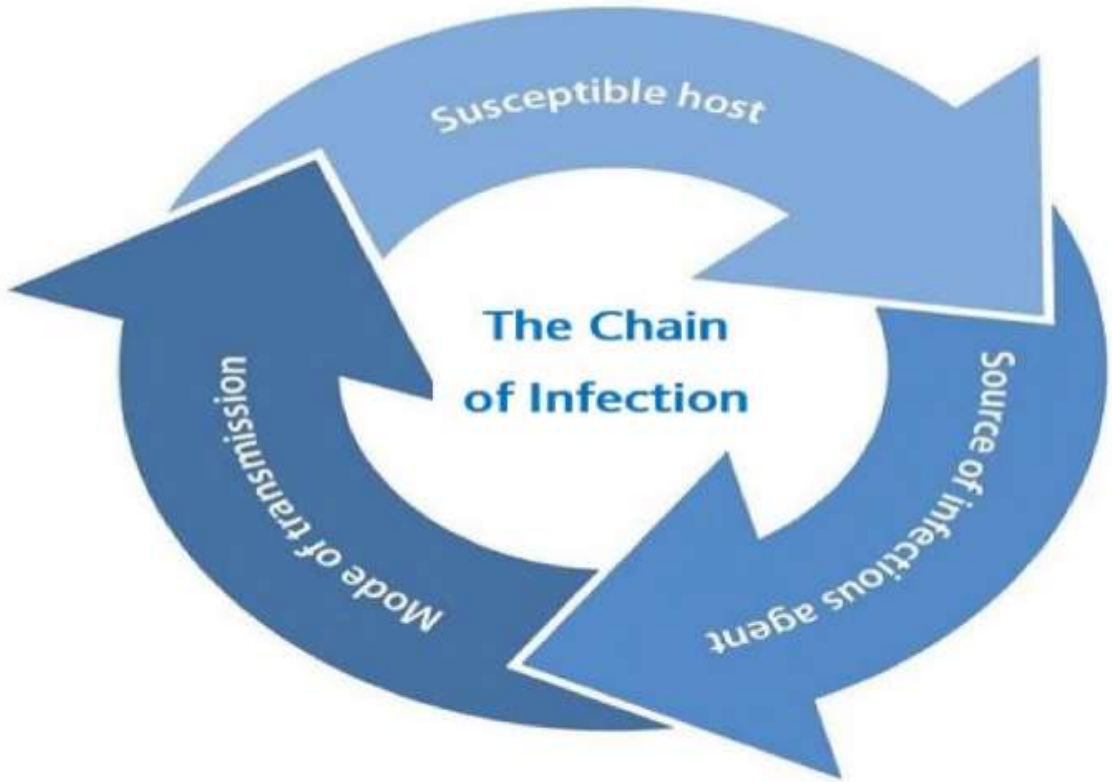
Herd immunity generally applies only to diseases that are contagious.
It does not apply to diseases such as tetanus (which is infectious, but is not contagious), where the vaccine protects only the vaccinated person from disease.

People who depend on herd immunity

Some people in the community rely on herd immunity to protect them. These groups are particularly vulnerable to disease, but often cannot safely receive vaccines:

- **People without a fully-working immune system, including those without a working spleen**
- **People on chemotherapy treatment whose immune system is weakened**
- **People with HIV**
- **Newborn babies who are too young to be vaccinated**
- **Elderly people**
- **Many of those who are very ill in hospital**

ANY QUESTION ?



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