Microbiology: Concepts and Applications
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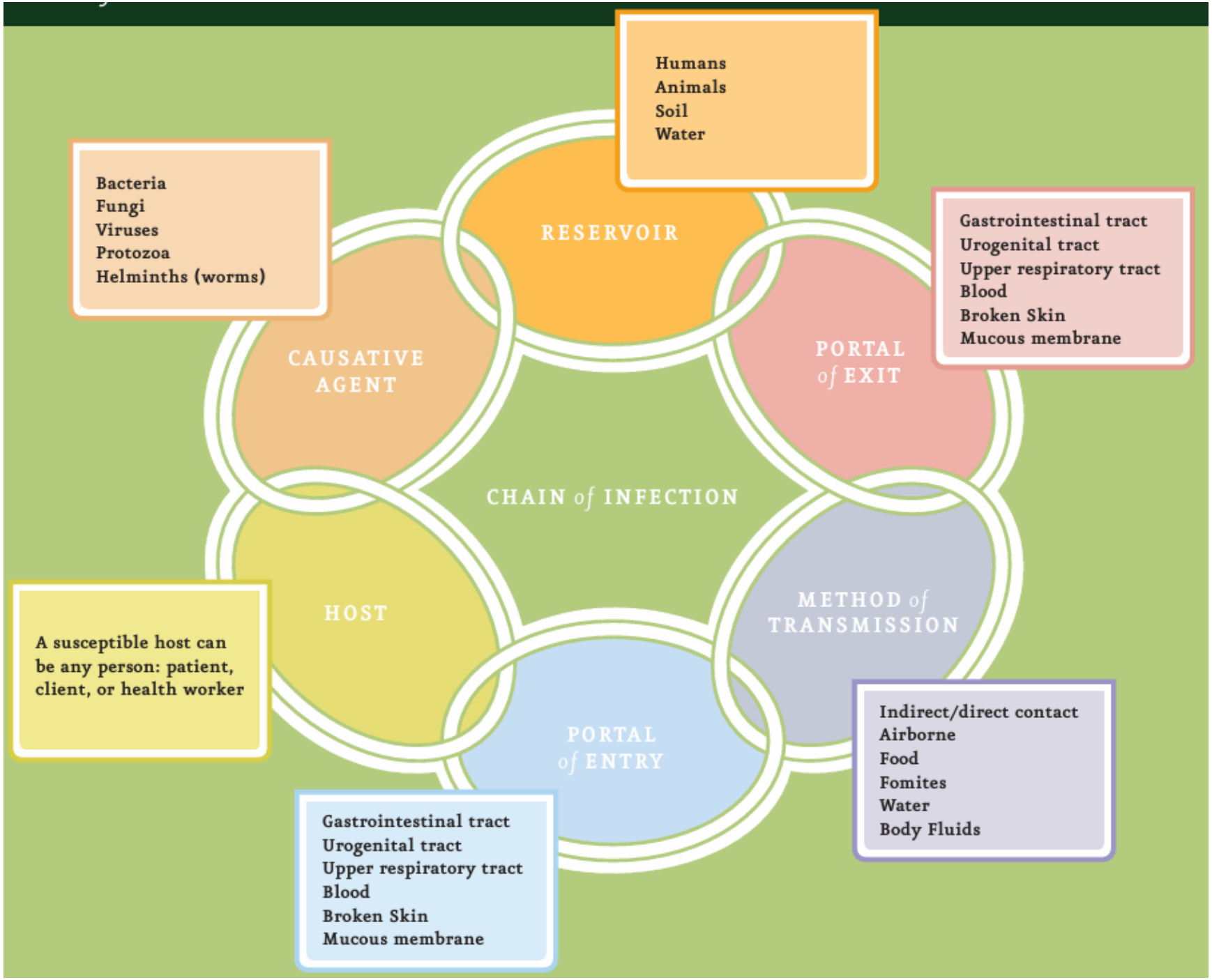
To be a pathogen, it is must:

- **Gain entry** to the host.
- **Colonise** the host's tissues.
- **Resist** the host's defences
- **Damage** the host's tissues.

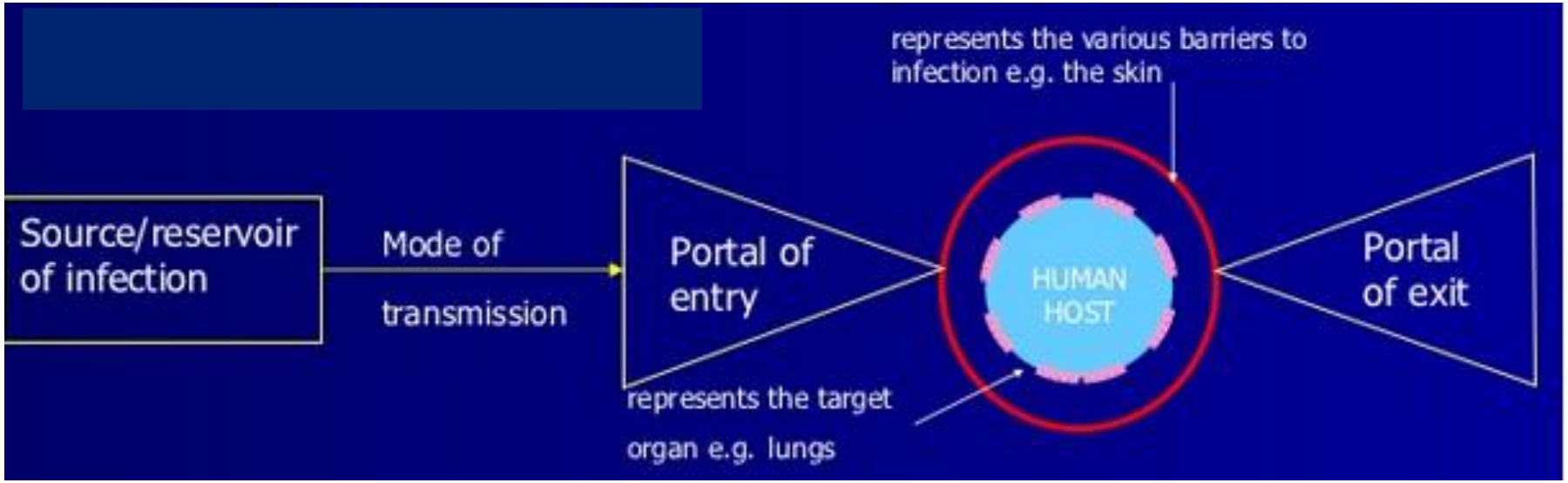
Chain of infection



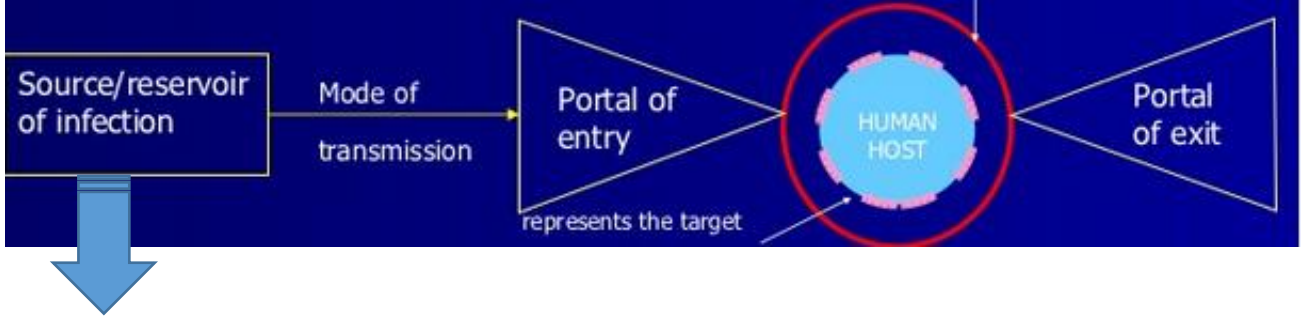
How infections spread/ occur

Three main components that play an important role in successful transmission of microbial disease –

- Reservoir
- Mode of transmission
- Susceptible host



Source /reservoir of infection



The source of infection: It is defined as the person, animal, object or substances from which an infectious agent passes or is disseminated from the host.

It is of types:

SOURCE	DESCRIPTION	EXAMPLES
Exogeneous source	The source of infection is from outside host's body.	Human, animals, insect, food, water
Endogeneous source	The source of infection is the normal flora present in the human body.	E.Coli present as normal flora of the intestine may cause urinary tract infection in same host

Homologous – It is applied when another member of the same species is victim.

Examples – Man – *V.cholerae*

Heterologous – When the infections is derived from a reservoir other than man as for animal, bird infected with salmonella.

Carrier of pathogen

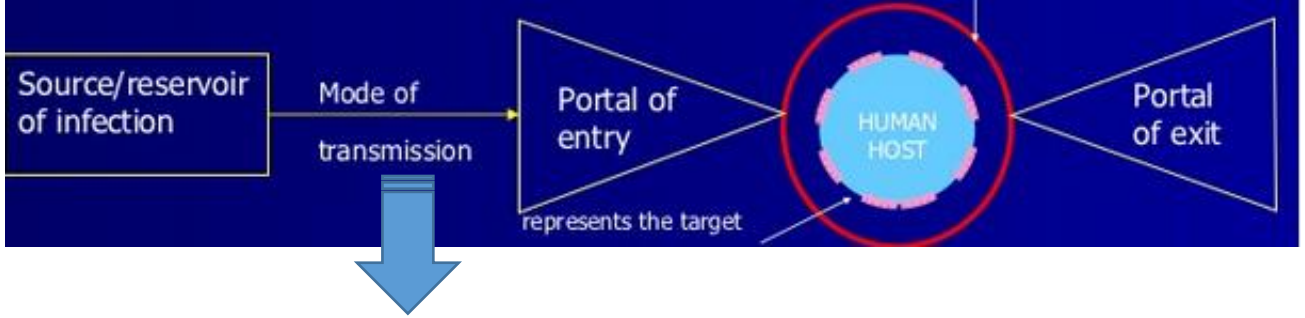
Infected individual and source for others

Active carrier

Convalescent carrier

Healthy carrier/Asymptomatic carrier

Incubator carrier



Mode of transmission

Microbes can be transmitted by:

Direct contact – person to person

Horizontal **(among individuals of the same generation)**

• Kissing • Sexual intercourse • Sneezing less than 1 metre • Touching

Vertical (mothers to their offspring)

• Placenta • Breast milk

Indirect contact

Vehicle borne

• Air/dust • Food • Water • Fomites

Vector borne

• Internal • External

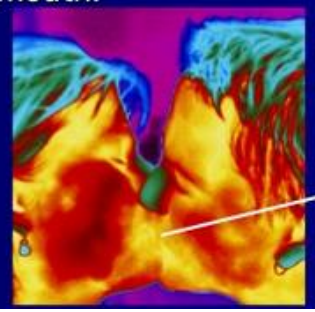
https://courses.lumenlearning.com/suny-microbiology/chapter/modes-of-disease-transmission/

https://www.news-medical.net/health/Modes-of-Transmission.aspx

Direct contact – person to person
Example: cold sore

Horizontal – kissing

- Herpes simplex virus causes cold sores.
- Initial infection occurs through direct skin contact when the secretions from another person's cold sore, containing the virus particles, come into contact with cells of the skin around the mouth.



A couple kissing.

Cold sores on lip and mouth

Direct contact – person to person
Example: syphilis

Horizontal – sexual intercourse

- The bacterium *Treponema pallidum* causes syphilis.
- The bacterium enters the body through very tiny cuts on the skin or mucous membranes when there is contact with an infected person or their bodily fluids.

Interlocking gender symbols representing sexually transmitted diseases.

Direct contact – person to person
Example: SARS

Horizontal – sneezing closer than 1 metre

- SARS - associated coronavirus causes severe acute respiratory syndrome (SARS)
- SARS is transmitted when an infected person coughs or sneezes infectious droplets onto a nearby person.
- The droplets land on another person's face or hands, and become introduced to the nose or mouth.

Jets of droplets erupt from a man's nose as he sneezes.

Direct contact – person to person
Example: gastroenteritis

Horizontal – touching (faecal-oral route)

- Norwalk virus causes a type of gastroenteritis.
- Norwalk virus is found in the faeces or vomit of infected people. It is highly contagious.
- Infection occurs by having direct contact with another person who is infected and not maintaining good hygiene e.g. washing hands.

Human hand contaminated

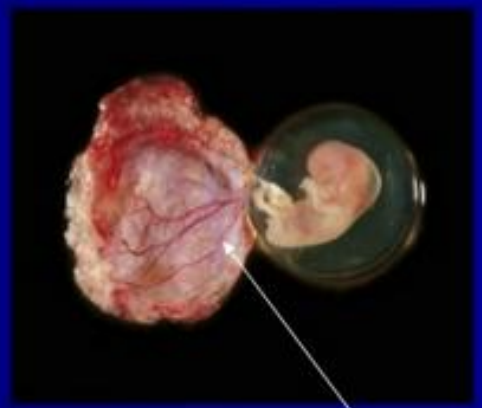
Rota virous, Noro virus, Campylobacter etc cause gastroenteritis

Direct contact – person to person

Example: German measles

Vertical across the placenta or via breast milk

- Rubella virus causes German measles.
- When infection occurs during pregnancy the virus crosses the placenta in the blood leading to infection of the fetus.
- The virus can affect all the organs of the developing fetus.
- The risk to the baby is highest in the first 3 months – up to 85% of babies are affected if infected during this period.



Eight week old fetus attached to its placenta by the umbilical cord.

Indirect contact – vehicle borne
Example: tuberculosis (TB)

Air/dust

- The bacterium *Mycobacterium tuberculosis* causes tuberculosis (TB).
- TB is spread from person to person through the air.
- When a person with active TB coughs or sneezes, droplets loaded with the infectious organism are propelled into the air.
- The moisture evaporates from these particles to leave droplet nuclei that can remain airborne for days and spread long distances.
- The *Mycobacterium* has a waxy coat, which protects it from drying out allowing it to survive for many months in the air and dust.

Indirect contact – vehicle borne
Example: cryptosporidiosis

Via water

- The parasitic protozoan called *Cryptosporidium parvum* causes a gut infection called cryptosporidiosis.
- *C. parvum* has a complex life cycle, which it completes in one host, in this case the human.
- The infective stage, the oocyst, (spore) is excreted in the faeces of infected humans or animals.
- It is spread by drinking contaminated water.

Indirect contact – vehicle borne
Example: food poisoning

Via food

- The bacterium *Campylobacter jejuni* causes a type of food poisoning.
- *C. jejuni* lives in the gut of many warm-blooded animals, particularly chickens, as part of their normal body flora.
- The infection is transmitted to humans by eating contaminated food especially poultry and milk.

Campylobacter jejuni bacterium.

Indirect contact – vehicle borne
Example: athlete's foot

Fomite - a non-living object that can carry disease-causing organisms.

Close-up of athlete's foot infection.

- The fungus *Trichophyton* that causes athlete's foot can be spread indirectly through towels, changing room floors etc.
- The fungus thrives in the damp warm environment found between the toes.
- The skin between the fourth and fifth toe is usually affected first. A flaky itchy red rash develops. The skin becomes cracked and sore and small blisters may appear.
- If the infection is left untreated it can spread to other parts of the body.

Indirect contact – vector borne
Example: malaria

Internal – biological

- Malaria is a vector-borne disease caused by a single celled protozoan parasite called *Plasmodium*, which is transmitted by mosquitoes.
- The primary vector for malaria is the mosquito *Anopheles gambiae*.
- Only female mosquitoes transmit malaria when they feed on the human host's blood.

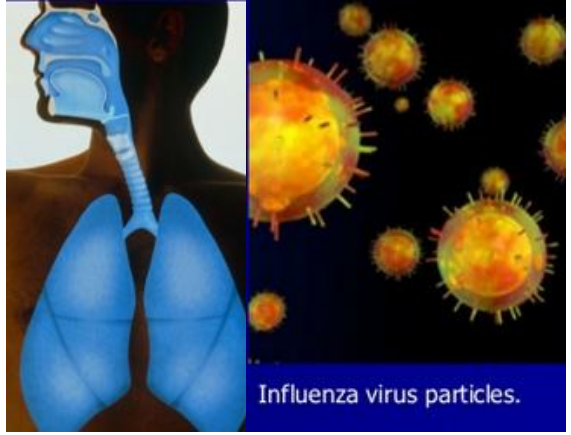
A. gambiae feeding on human blood.

Indirect contact – vector borne
Example: bacterial dysentery

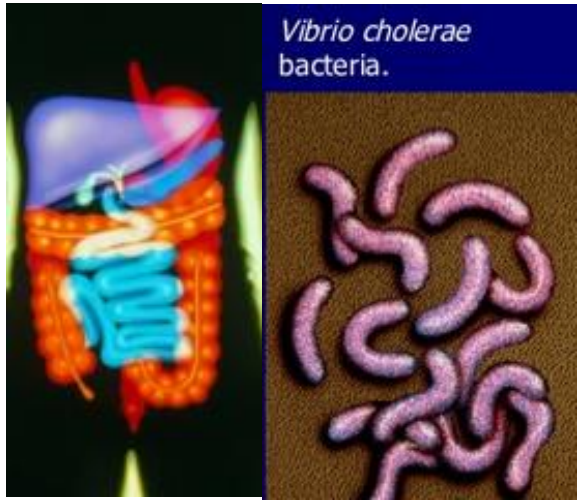
External – mechanical

- The bacterium *Shigella* causes a type bacterial dysentery.
- Flies can spread *Shigella* when they carry infected faecal matter on their feet to drinking water or food.
- Symptoms can vary from mild diarrhoea through to a more severe disease with watery or bloody diarrhoea, fever, stomach cramps and vomiting.

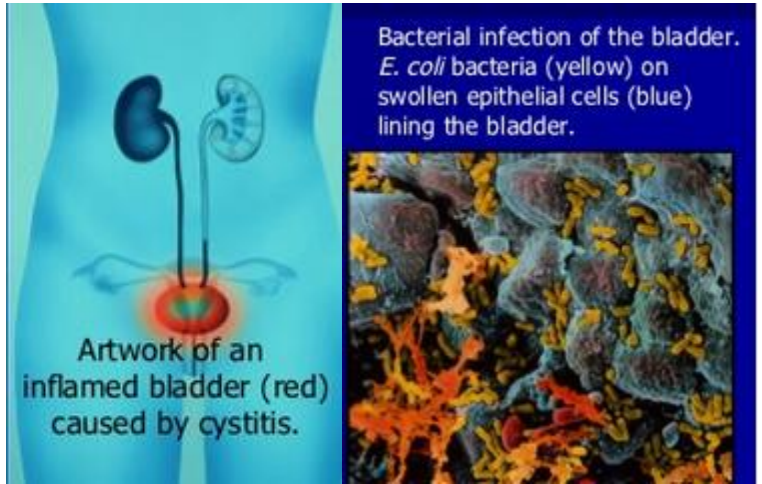
Common house flies feeding.



Influenza virus particles.

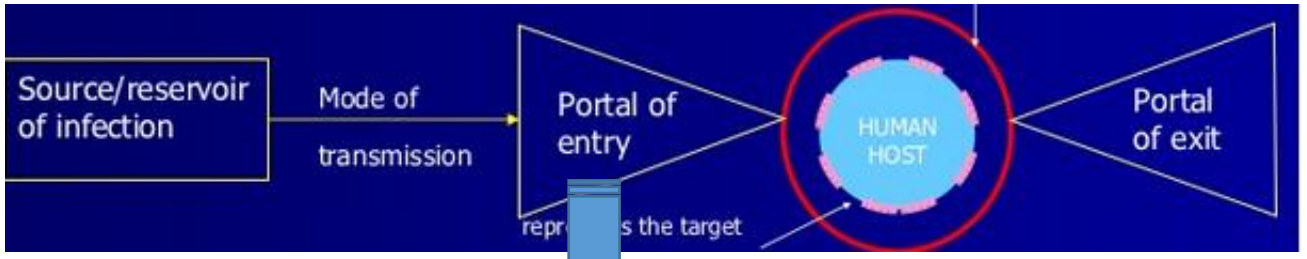


Vibrio cholerae bacteria.



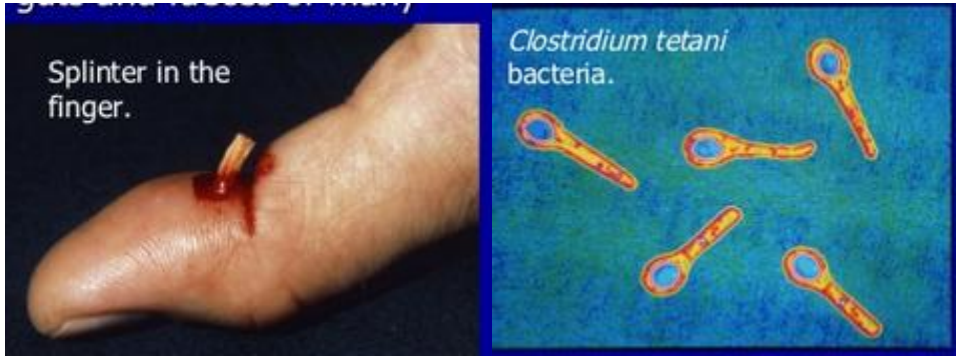
Artwork of an inflamed bladder (red) caused by cystitis.

Bacterial infection of the bladder. *E. coli* bacteria (yellow) on swollen epithelial cells (blue) lining the bladder.



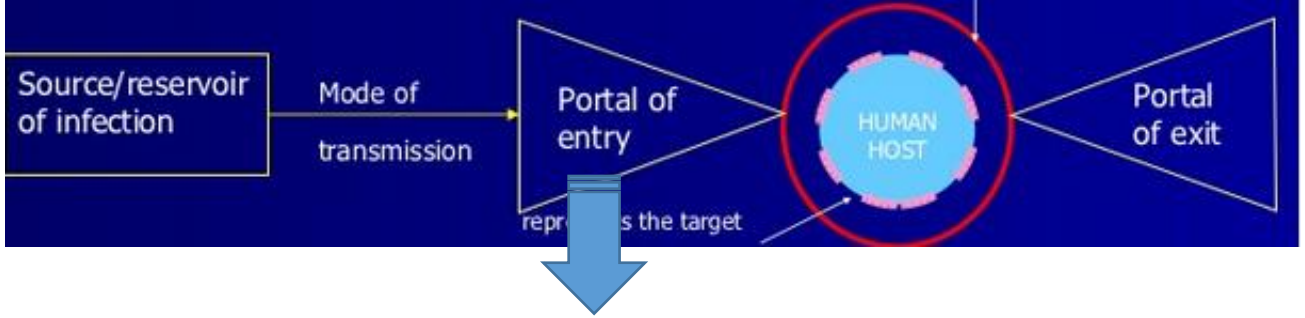
Portals of entry

- To cause an infection, microbes must enter our bodies.
- The site at which they enter is known as the portal of entry.
- Microbes can enter the body through the four sites listed below
  - Respiratory tract (mouth and nose) e.g. Influenza virus
  - Gastrointestinal tract (mouth oral cavity) e.g. *Vibrio cholerae*
  - Urogenital tract e.g. *Escherichia coli*
  - Breaks in the skin surface e.g. *Clostridium tetani*



Splinter in the finger.

Clostridium tetani bacteria.



ROUTE OF ENTRY OF MICROBIAL PATHOGEN

PORTAL OF ENTRY	BACTERIA	VIRUS	FUNGUS
Skin and mucous membrane	*Clostridium tetani Leptospira*	*Hepatitis B virus, HIV*	*Dermatophytes*
Respiratory tract	*Streptococcus pneumoniae, Neisseria meningitidis, Mycobacterium tuberculosis.*	*Rhinovirus, Respiratory syncytical virus, Influenza virus*	*Cryptococcus neoformans, Histoplasma capsulatum*
Gastro-intestinal tract	*Shigella sp, salmonella sp,Vibrio sp.*	*Hepatiis A or E virus, Polio virus*	*Candida albicans*
Genital tract	*Neisseria gonorrhoea, Treponema pallidum .*	*HIV, Human papilloma virus .*	*Candida albicans*