

Epidemiology

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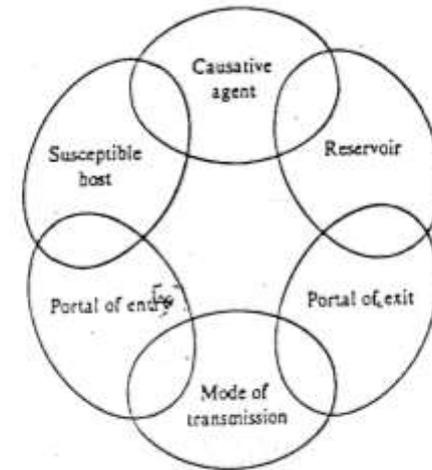


FIGURE 1.2 The chain of infection. Components of the infectious disease process.

Infectious process

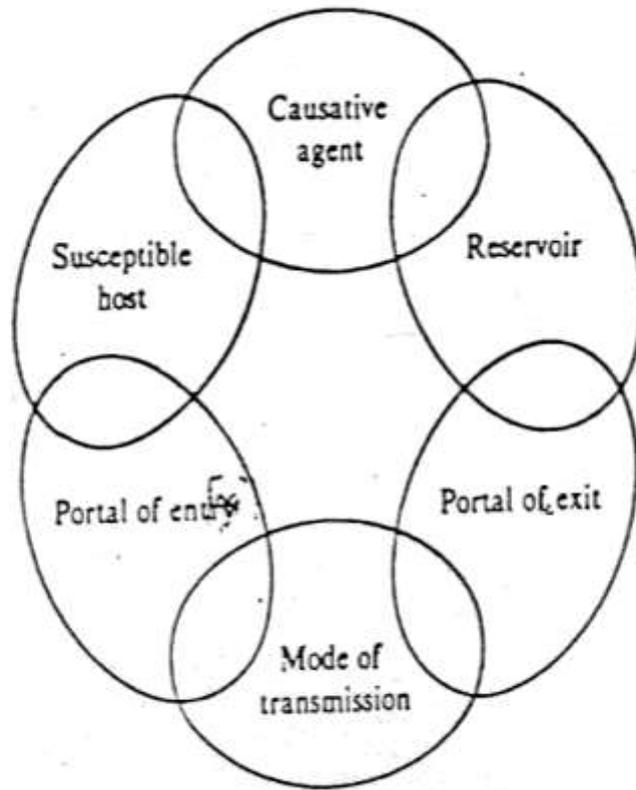


FIGURE 1.2 The chain of infection. Components of the infectious disease process.

(4) MODES OF TRANSMISSION

Modes Of Transmission

- ❑ Different ways, the transmitted from the reservoir or source of infection to **a susceptible** individual
 - ❖ depending upon the:
 - **infectious agent**,
 - **portal of entry** and
 - the **local ecological conditions**.
 - ❖ infectious disease may transmitted **by**
 - **only one route**, *e.g., typhoid fever* **by** **vehicle** transmission others which may be
 - **transmitted by several routes** *e.g., AIDS, salmonellosis, hepatitis B, brucellosis, Q fever*
 - ❖ **The multiple transmission routes enhance the survival of the infectious agent.**



The mode of transmission of infectious diseases may be classified as

A Direct Transmission

1. **Direct contact**
2. **Droplet infection**
4. **Inoculation into skin or mucosa**
5. **Transplacental (vertical.**

B Indirect Transmission

1. **Vehicle-borne**
2. **Vector-borne**
 - a. **Mechanical**
 - b. **Biological**
3. **Air-borne**
 - a. **Droplet nuclei**
 - b. **Dust**
4. **Fomite-borne**
5. **Unclean hands & fingers**

(1) *Direct contact :*

- ❖ Infection may be transmitted by direct contact from skin to skin, mucosa to mucosa, or mucosa to skin of the same or another person.
- This implies **Direct** and essentially **immediate transfer** of infectious agents from the **reservoir** or **source** to a **susceptible** individual
- **without an intermediate** agency without a third object
e.g., skin-to-skin contact as by touching, kissing or sexual intercourse.
- **Direct** contact not only **Reduces the period** for which the organism will have to survive outside the human host **but** also **Ensures a larger dose of infection.**
- ✓ *Diseases transmitted by direct contact include **STI** and **AIDS**, **leprosy**, skin and **eye infections**.*

(2) *Droplet infection* :

- This is **direct projection** of a spray of **droplets** of **saliva** & **nasopharyngeal secretions** during **coughing**, **sneezing**, **spitting** **speaking** and, **talking** into the surrounding atmosphere.
- The expelled droplets may hit **directly** the **conjunctiva**, or respiratory mucosa or skin of a **close contact**.
- ❖ Particles of **≥ 10 mm** in diameter are filtered off by nose.
- ❖ Those **≤ 5 mm** can penetrate deeply and reach the **alveoli**.
- **The droplet** spread is usually, limited to
 - ❖ a **distance of 30-60 cm** between source and host.
- **droplets**, which may **contain millions of bacteria & viruses**
 - ❖ **can be a source** of infection to others.
- The potential for droplet spread is increased in conditions of
 - **close proximity**, **overcrowding** and **lack of ventilation**
- Diseases transmitted by droplet spread include many respiratory infections common cold, diphtheria, whooping cough, TB, meningococcal meningitis, etc.

(3) Inoculation into skin or mucosa :

The disease agent may be **inoculated directly** into the **skin** or **mucosa** e.g., **rabies virus by dog bite, hepatitis**

4) Transplacental (or vertical) transmission In-utero passage

Disease agents can be transmitted **transplacentally** .

This is a direct transmission.

*Examples include the so-called **TORCH** agents*

*(**Toxoplasma gondii, Rubella Virus, Cytomegalo virus and Herpes Virus**), varicella virus, syphilis, hepatitis B,C, and AIDS.*

❖ **In these** cases, the disease agent **produces malformations** of the embryo by disturbing its development.

B Indirect *Transmission*

- This embraces a variety of mechanisms including the traditional
- 5 F's - "flies, fingers, fomites, food and fluid".
- ❖ **An essential requirement** for indirect transmission is that
 - the infectious agent 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 a new host.** This **depends upon the :**
 - 1) characteristics of the agent,
 - 2) inanimate object and
 - 3) influence of environmental factors such as temperature & humidity.
 - 4) If the disease agent acquires drug resistance, it will further facilitate its spread.
- **Indirect transmission** can occur in a variety of settings :



Indirect transmission

1 Vehicle-borne

- ❖ It implies transmission of the infectious agent through the
- ❖ agency of **water, food** (including raw vegetables, fruits, milk and milk products), ice, **blood, serum, plasma** or
- ❖ **other biological** products such as tissues and **organs**.
- ❖ of these **Water & Food** are the **most frequent** vehicles of transmission, because they are used by everyone.

□ **The infectious agent**

- ❖ may have **multiplied or developed** in the vehicle (e.g., *S. aureus* in food) before being transmitted; or
- ❖ **only passively transmitted** in the vehicle (e.g., HAV in water).



Cont. ..Vehicle-borne

- ❖ Diseases transmitted by water and food include chiefly infections of the alimentary tract, *e.g., acute diarrhoeas, typhoid fever, cholera, polio, hepatitis A, food poisoning and intestinal parasites.*
- ❖ Those transmitted by blood include *hepatitis B,C, malaria, syphilis, brucellosis, infectious mononucleosis and cytomegalovirus infection .*
- ❖ **Organ transplantation** may result in the introduction of the disease agent such as cytomegalovirus in association with kidney transplants.



Epidemiological Features of Vehicle Transmission are :

- 1) if the dose of contamination is **heavy**, the **outbreak** may be **explosive** as in the case of cholera and hepatitis A epidemics
- 2) **cases are initially** confined to those who are **exposed** to the contaminated vehicle, in some infections
- 3) **when secondary** cases occur, the primary case may be obscured
- 4) **the distance travelled** by the infectious agent may be **great**, e.g., outbreaks of food poisoning
- 5) it is **not** always possible to **isolate the infectious** agent in the incriminated vehicle, e.g., typhoid bacilli in contaminated water
- 6) **when** the vehicle is **controlled** or **withdrawn**, the **epidemic subsides**, e.g., epidemics of cholera, and
- 7) **the common source** of infection is often **traceable**.

2. Vector-borne

❑ In infectious disease epidemiology,

❑ **Vector** is **defined** as

❖ an **arthropod** or **any living carrier** (e.g., snail) that

❖ **transports** an infectious agent to a susceptible individual.

❑ **Transmission by a vector** may be

❖ **Mechanical** or

❖ **Biological**.

❖ In the **Biological** case, the **disease agent** passes through a **developmental** cycle or **multiplication** in the vector.



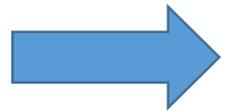
Propagative,



Cyclo-propagative,



Cyclo-developmental



(a) Mechanical transmission :

The infectious agent is mechanically transported

- ❖ by a crawling or flying arthropod
- through **soiling of its feet** or proboscis; or
- by passage of organisms through its **gastrointestinal tract** and **passively excreted**.
- ❖ There is **no development or multiplication** of the infectious agent on or within the vector.

(b) Biological transmission :

- ❖ The infectious agent **undergoing replication or development or both in vector and**
- ❖ **requires an incubation period** before vector can transmit. **(extrinsic incubation period)**

□ Biological transmission is **of three types :**



Biological transmission is of three types :

Con. ...Vector-borne

(i) Propagative :

The agent **merely multiplies** in vector, but **no change** in form, e.g., plague bacilli in rat fleas.

(ii) Cyclo-propagative :

The **agent changes in form and number**, e.g., malaria parasites in mosquito.

(iii) Cyclo-developmental :

The disease agent undergoes **only development** but **no multiplication**, e.g., microfilaria in mosquito.

Trans ovarian transmission

when the infectious agent is **transmitted vertically** from the infected female to her progeny(offspring) in the vector,

Factors influencing the ability of vectors to transmit disease are :

- (a) host feeding preferences
- (b) infectivity, that is ability to transmit the disease agent
- (c) susceptibility, that is ability to become infected
- (d) survival rate of vectors in the environment
- (e) domesticity, that is degree of association with man, and
- (f) suitable environmental factors.

Seasonal occurrence of some diseases (e.g., malaria) may be related to **intense breeding** and thereby greater **density** of the insect vector during certain periods of the year.

3. Airborne

Droplet nuclei:

- ❖ "Droplet nuclei" are a type of particles implicated (related) in the spread of airborne infection.
- ❖ are tiny particles (1-10 microns range) that represent the dried residue of droplets .
- ❖ They may be formed by evaporation of droplets coughed or sneezed into the air or
- ❖ Droplet nuclei may remain airborne for long periods of time,
- ❖ some retaining and others losing infectivity or virulence.
- ❖ They not only keep floating in the air but may be disseminated by air currents from the point of their origin.
- ❖ Particles in the 1-5 micron range are liable to be easily drawn into the alveoli of the lungs & may be retained there.
- ❖ Diseases spread by droplet nuclei include TB, influenza, measles, Q fever and many respiratory infections.

(2) Dust :

- Some of **the larger droplets** which are expelled
 - during talking, coughing or sneezing, **settle down by** their
 - sheer weight on the **floor, carpets**, furniture, clothes, bedding, linen and other objects
 - in the immediate environment **and**
 - **become part of the dust.**
 - Some of them (e.g., tubercle bacilli) **may survive in the**
 - dust for **considerable periods under** optimum conditions
 - of temperature and moisture.
- ❑ **Airborne dust is primarily inhaled**, but may
- **settle on uncovered food and milk.**
 - *This type of transmission is most common in hospital acquired (nosocomial) infection*

4. Fomite-borne

- Fomites (singular; fomes) are **inanimate articles** or substances other than water or food **contaminated** by the infectious **discharges** from a patient and
- Capable of **harbouring** and **transferring** the infectious agent to a healthy person.

☐ Fomites include *soiled clothes, towels, linen, handkerchiefs, cups, spoons, pencils, books, toys, drinking glasses, door handles, taps, lavatory chains, syringes, instruments and surgical dressings.*

☐ **The fomites** play an **important role in indirect** infection. Diseases transmitted by *fomites include diphtheria, typhoid fever, bacillary dysentery, hepatitis A, eye and skin infections*

5. Unclean hands and fingers

- ❖ Hands are the **most common medium** by which pathogenic agents are **transferred to food** from the **skin, nose, bowel**, etc as well as from other foods.
- ❖ **The transmission takes place both**
- ❖ **directly (hand-to-mouth) and**
- ❖ **indirectly.**
- ❖ *Examples include staphylococcal and streptococcal infections, typhoid fever, dysentery, hepatitis A and intestinal parasites.*
- ❖ **Unclean hands** and fingers imply lack of **personal hygiene.**
- ❖ Lack of personal hygiene coupled with **poor sanitation**

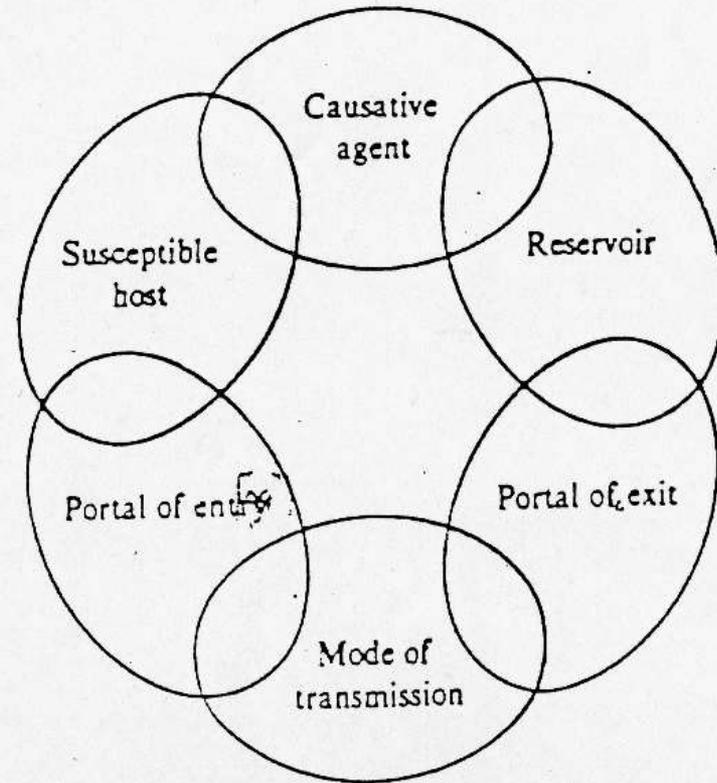


FIGURE 1.2 The chain of infection. Components of the infectious disease process.

(5) PORTALS OF ENTRY TO NEW HOST

THE CYCLE OF INFECTION)

(5) PORTALS OF ENTRY TO NEW HOST

- ❖ Respiratory tract
- ❖ Gastro-intestinal tract
- ❖ Genito-urinary tract
- ❖ **Skin** and mucous membranes through:
 - Affecting its layers
 - Affecting its layers then passing to
 - **cause systemic infection**
- ❖ Piercing skin through inoculation by:
 - Insects
 - During blood letting
- ❖ Trans-placental



Note

Some pathogens have:

- **One portal** of entry to new host.
- **Two or more portals** of exit from reservoir.

Examples:

Poliomyelitis viruses.

Salmonella typhi.

❑ Time between entrance and start of manifestations is called **incubation period**

❑ **Definition of incubation period:**

Interval between time of contact and entry of agent and onset of illness

❑ Intrinsic incubation period

Interval between **infection** of a susceptible person or animal and **appearance of symptoms** or signs of disease caused by infecting pathogen

❑ Extrinsic incubation period:

Period between that time when **vector gets infected** and time vector **becomes infective**

❑ **Variation in range** and **duration of** incubation period depends on:

- Resistance of host
- Dosage and virulence of agent
- Type of agent with regard to toxin production
- Route of infection inside body

Thank You

Thank You

SUSCEPTIBLE HOST