بسم الله الرحمن الرحيم

Epidemiology

L II

11-10-2023

Prof DR. Waqar Al – Kubaisy

Epidemiology

L II

11-10-2023

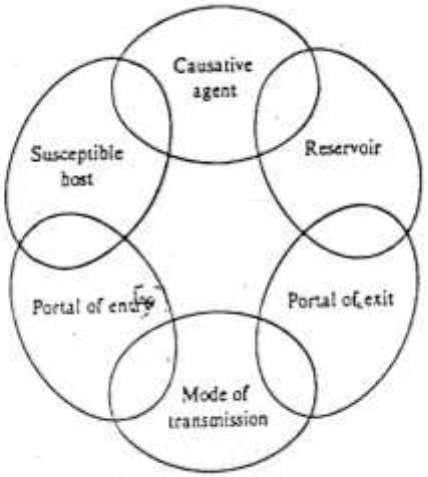


FIGURE 1.2 The chain of infection. Components of the infectious disease process.

Infectious process

- Definitions related to infectious disease epidemiology
- Requisites for Perpetuation of Communicable Diseases

Definitions related to infectious disease epidemiology

- ✓ Health
- ✓ *Infection*
- ✓ Pathogenesis:
- ✓ *Contamination*
- ✓ Infestation
- ✓ Communicable Disease: (CD)
- ✓ Non- Communicable Disease (NCD)
- ✓ Contagious Disease
- ✓ *Host*
- ✓ *Epidemic*
- ✓ "Outbreak *Sporadic*
- ✓ *Endemic*
- ✓ *Pandemic*
- ✓ *Nosocomial Infection*
- ✓ *Opportunistic Infection*
- ✓ *Iatrogenic (Physician-induced) Disease*
- ✓ *Eradication*

Contamination

- The presence, multiplication and development
- of an infectious agent on a body surface; or an
- inanimate article. clothes, beddings, toys, surgical instruments or water, milk and food.

Infestation

- Lodgement, development and reproduction of arthropods on the surface of the body of persons or animals or in the clothing, e.g., lice, itch mite.

- Also to describe invasion of the gut by parasitic worms, e.g. ascariasis.

Host

Health
Infection
Pathogenesis:
Contamination
Infestation
CD
NCD
Contagious
Disease
Host

- A person or animal, including birds and arthropods, that affords living or lodgement to an infectious agent under natural conditions.
- *Obligate* host ,means the only host, e.g., man in measles and typhoid fever.
- *Definitive* (primary) hosts; Hosts in which the parasite attains (achieves, accomplishes) maturity or passes its sexual stage For example, human tapeworm makes use of human as its definitive host.
- *Intermediate* (secondary) hosts: those in which the parasite is in a larval or asexual states
  a host in which a parasite passes one or more of its asexual stages; usually designated first and second, if there is more than one.
- *Transport* host is one that is used until the appropriate one definitive host reached, but is not necessary to completion of the life cycle of the parasite, not undergo development.

Health
Infection
Pathogenesis:
Contamination
Infestation
CD
NCD
Contagious
Disease
Host

❑ Forms of diseases According to Communicability

❑ Communicable disease:

❖ it is an infectious disease due to a specific infectious agent, or its toxic products.

➢ capable of being directly or indirectly transmitted

➢ from man to man, animal to animal, or from the

➢ environment (through air, dust, soil, water, food, etc.) to man or animal that can be transmitted. e.g..: *influenza*

❑ **Non-Communicable disease:** it is an infectious disease that can not be transmitted. e.g.: *appendicitis, peritonitis*

❑ **Contagious disease:** part of communicable disease, transmitted by direct contact between reservoir and host. e.g. *scabies, trachoma, STD and leprosy.*

Forms of Disease Occurrence

Epidemic
"Outbreak *Sporadic*
Endemic
Pandemic
Nosocomial Infection
Opportunistic Infection
Iatrogenic (Physician-induced) Disease
Eradication

- ***Epidemic*** (Epi upon; demos = people).
  - The "**unusual**" **occurrence in a community or region, of a disease, specific health-related behaviour** (e.g., **smoking**) or other **health related events** (**e.g. traffic accidents**) **clearly**
  - in **excess** of "**expected occurrence**
- **Covers the communicable and non-communicable diseases (e.g., CHD, lung cancer**

The **key words in the definition of an epidemic are :**

in excess of "expected occurrence".

- **There is no agreement on what constitutes a significant excess** USA , cholera is not normally present in the population. Therefore, **even one case of cholera would constitute a "potential" epidemic** in US.

But in. **India** For cholera to be considered as an epidemic, **hundreds** of cases

- **"Outbreak"** for a small, usually **localized epidemic** affecting certain large numbers or a group in the community, e.g. outbreak of food poisoning in an institution.

Sporadic

- The word sporadic means **scattered about.**
  - **The cases occur irregularly, haphazardly from time to**
  - **time, and generally infrequently**
  - The cases are **so few** and **separated widely**
  - **in space and time** that they show
  - **little or no connection with each other,**
  - **nor** a **recognizable common source of infection**, e.g., polio, tetanus, herpes-zoster and meningococcal meningitis.
- A **sporadic disease may be the starting point of an epidemic when conditions are favourable for its spread.**

Many zoonotic diseases are characterised by sporadic transmission to man

Epidemic
"Outbreak *Sporadic*
Endemic
Pandemic
Nosocomial Infection
Opportunistic Infection
Iatrogenic (Physician-induced) Disease
Eradication

Endemic

(En=in; demos=people).

- It refers to the constant or permanently
- presence of a disease or infectious agent within a given geographic area or population group or community
- all the time,

e.g. bilharziasis in Egypt

Pandemic

- An epidemic usually affecting a large proportion of the
- population, affecting countries sequentially (at the same time) occurring over a wide geographic area such as a section of a nation, the entire nation, a continent or the world

e.g., COVID 19 , H1N1

Epidemic
"Outbreak *Sporadic*
Endemic
Pandemic
Nosocomial Infection
Opportunistic Infection
Iatrogenic (Physician-induced)
Disease
Eradication

❑ *Nosocomial Infection*

- Nosocomial (**hospital acquired**) **infection is an**
- **infection originating in a patient while in a hospital or other health care facility.**
- It denotes a new disorder (**unrelated to the patient's primary condition**) associated with being in a hospital.
- **it was not present or incubating at the time of**
- **admission or the residual of an infection acquired during a previous admission.**
- **It includes infections acquired in the hospital but appearing after discharge, and also such**
- **infections among the staff of the facility.**
- Examples include **infection of surgical wounds, hepatitis B, C** and **urinary tract infections**.

Epidemic
"Outbreak *Sporadic*
Endemic
Pandemic
Nosocomial Infection
Opportunistic Infection
Iatrogenic (Physician-induced) Disease
Eradication

Opportunistic Infection

Infection by an organism(s) that takes the opportunity provided by a defect in host defence to infect the host and hence cause disease.

Eg. Herpes *simplex, Cytomegalovirus, Toxoplasma,* AIDS). M. *tuberculosis,*

Iatrogenic (Physician-induced) Disease

- It is any adverse consequence resulting from a physician's professional or other health professionals activity whether **preventive,** ???,
- **diagnostic or** ???,
- **therapeutic** procedure ???, **that causes impairment, handicap, disability or death**

Reactions to contrast media injected intravenously or intra-arterially may be mild, moderate or severe, and some are potentially fatal. Intravascular contrast media may have a nephrotoxic reaction.

Epidemic
"Outbreak *Sporadic*
Endemic
Pandemic
Nosocomial Infection
Opportunistic Infection
Iatrogenic (Physician-induced) Disease
Eradication

Eradication

- Termination of all transmission of infection by
- extermination of the infectious agent.
- It implies that disease will no longer occur in a population
- Termination of infection from the whole world

- To-date, only one disease has been eradicated, that is smallpox.
- to our present knowledge, diseases which are amenable to eradication are measles, diphtheria, polio

Period of communicability:

the time during which the infectious agent could be transmitted directly or indirectly from the reservoir to a susceptible host

Requisites for Perpetuation of Communicable Diseases (The Cycle Of Infection

1. Presence of the **microbiologic agent.**
2. Presence of a **reservoir and source.**
3. An **outlet (portal of exit)** from reservoir.
4. A suitable **mode of transmission.**
5. An **inlet (portal of entry).**
6. A **susceptible host**.

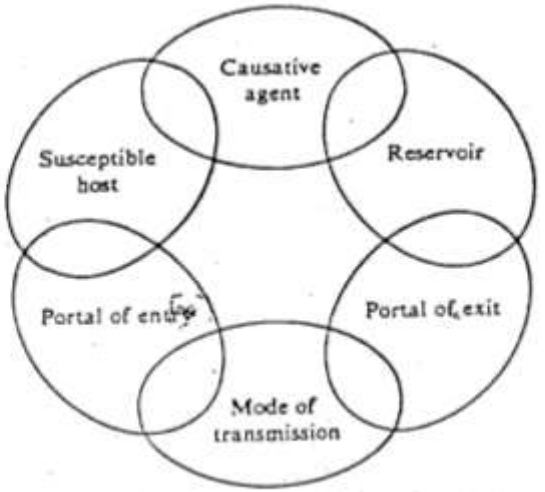


FIGURE 1.2 The chain of infection. Components of the infectious disease process.

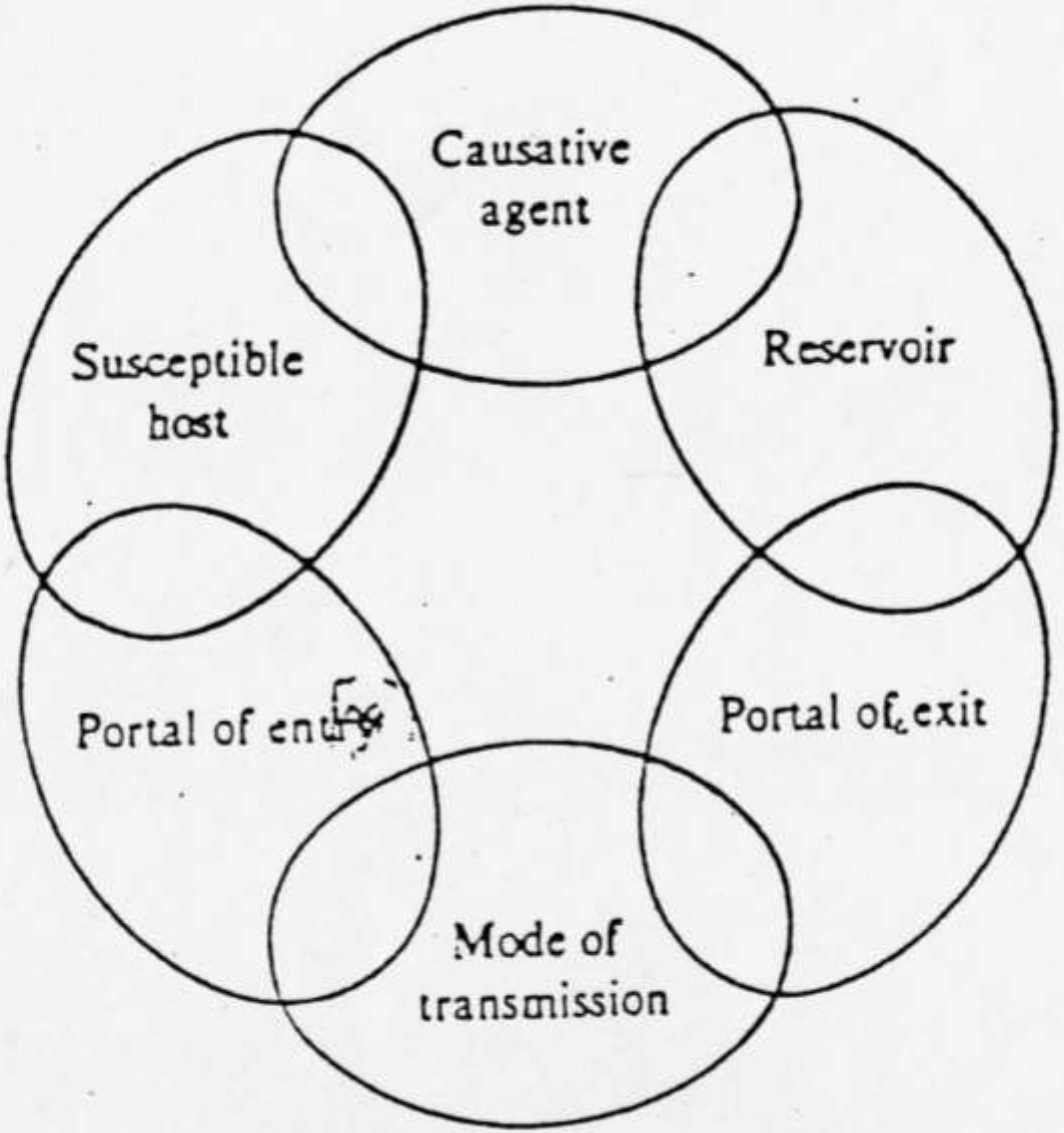
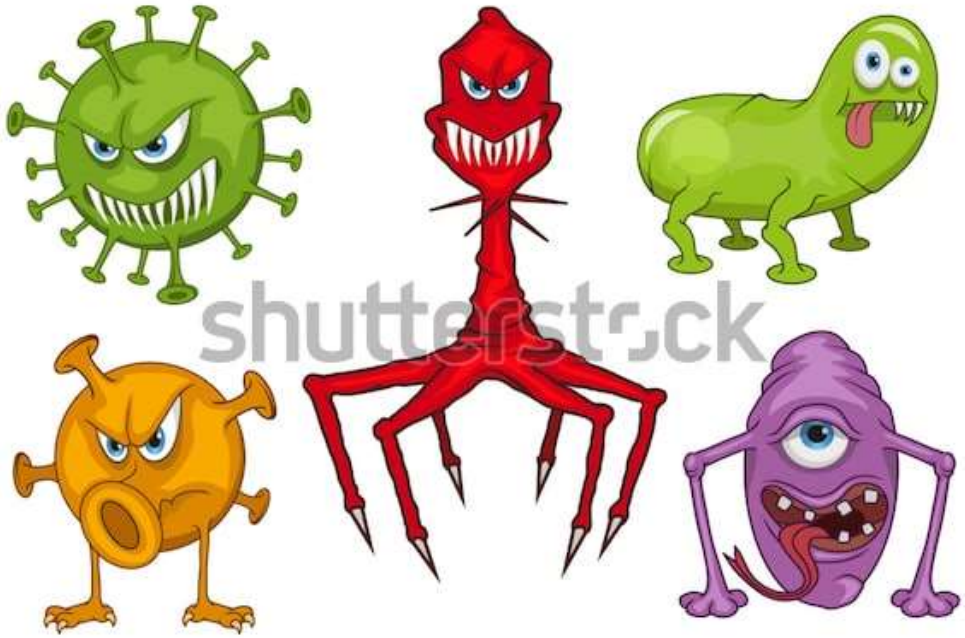


FIGURE 1.2 The chain of infection. Components of the infectious disease process.

Disease Agent



www.shutterstock.com · 1069205186

www.shutterstock.com · 1164529879

Disease Agent

- It is the **first** link in the chain of disease transmission
- **Defined as** a substance, **living** or **non-living**, or a force, **tangible** or **intangible**, the **excessive** presence or relative **lack of** which may **initiate or perpetuate a disease process**.
- A disease may have a **single agent**, a number of independent **alternative agents** or a complex of **two or more factors** whose combined presence is **essential for the development of the disease**
- Disease agents may be classified broadly into groups :

1. ***Biological* agents,** >>>>>>>>>>>>

❑ Biological Agents

These **are living agents of disease**,

Viruses, **hepatitis** viruses, influenza, mumps, measles….etc)

Rickettsia, (typhus)

Fungi, : (Candida)

- Bacteria, Cocci (staphylococci, streptococci, ….etc)
- Bacilli (diphtheria, salmonella, shigella….etc)
- Spirochetes (syphilis, borrelia….etc)
- **Protozoa** Entamoeba

These agents exhibit certain "host-related" biological properties such as:

(i) infectivity: this is the ability of an infectious agent to invade and multiply (produce infection) in a host;

(ii) pathogenicity: this is the ability to induce clinically apparent illness, and

(iii) virulence: this is defined as the proportion of clinical cases resulting in severe clinical manifestations

The case fatality rate is one way of measuring virulence

Mechanisms of disease production (pathogenesis)

1) Invasiveness
2) Toxicity:
   - Endo-toxin
   - Exo-toxin
3) Hypersensitivity

1) Invasiveness:

The ability of the organisms to **invade** the tissues **and multiply.**

Each organism has the ability of invasiveness and toxicity

(e.g. Treponema palidum, typhoid organisms **have a high power of invasiveness** but **they have low toxicity**)

2) Toxicity: Exo-toxin:

- released by **living** organisms.
- **Destroyed** rapidly by heat (above 60 °C)
- Highly **immunogenic** and
- converted to antigenic **non toxic toxoid** by formalin, heat and acid.
- **Diffusible**, do not produce fever

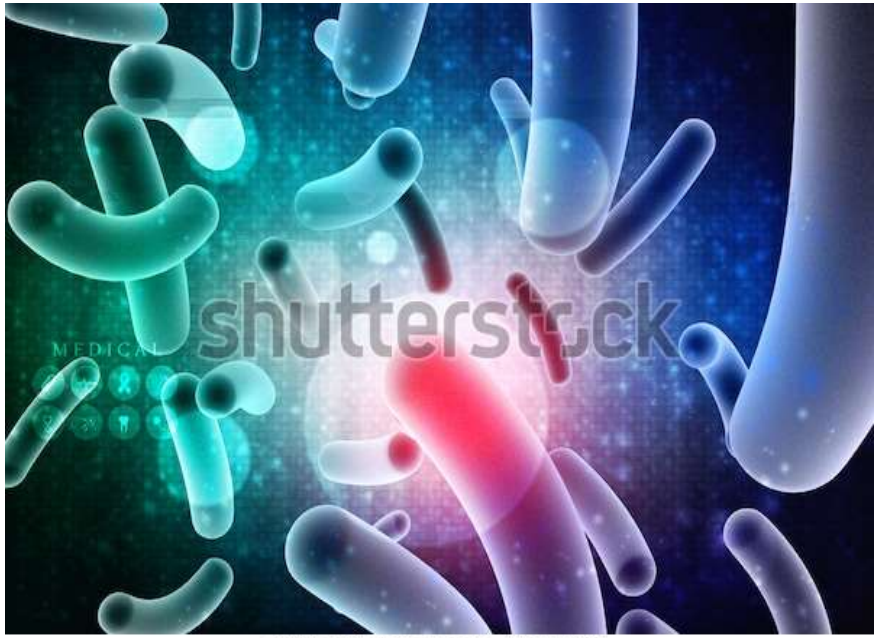
e.g. (Neurotoxins of tetanus and botulism, erythro-genic toxins of scarlet fever)

Endo-toxin:

- Released after **disintegration** of micro-organisms
- **Highly** stable (withstand heat above 60 °C)
- **Weakly** immunogenic
- Not converted to toxoid
- **Usually** produce patho-physiologic effects as fever, leucopenia, hypotension, hypoglycemia and shock.

3) Hypersensitivity:

It is an **allergic state of the host** following exposure **to certain antigens of** micro-organisms E.g. **mycobacterium tuberculosis**), **whereby subsequent exposure results in a disease state**.



Outcome of infection depends on:

I. Pathogenicity and virulence of micro-organism.

II. Antigenic power of micro-organism

III. Period of and ease of communicability

IV. Dose of infection (inoculums)

v. Tissue selectivity (tropism)

vi. Host specificity

vii. Spore formation

viii. Viability of the organism

ix. Susceptibility of the pathogen to chemotherapy.

Pathogenicity and virulence of micro-organism.

Outcome of infection depends on:
Pathogenicity and virulence of micro-organism.
Antigenic power of micro-organism
Period of and ease of communicability
Dose of infection (inoculums)
Tissue selectivity (tropism)
Host specificity
Spore formation
Viability of the organism
Susceptibility of the pathogen to chemotherapy.

Pathogenicity

ability of the organism to produce specific **clinical reaction after infection,** (does not refer to the severity of the reaction).

Virulence

ability of the organism to **produce severe pathological reaction**, it refers to **severity of** the reaction.

Pathogenicity and virulence of micro-organism can be measured by:

- Ratio of **clinical to sub-clinical cases**
- Case fatality rate = $\frac{\text{No. of deaths from a certain disease}}{\text{No. Of cases from that disease}} \times 100$

Pathogenicity and virulence of micro-organism.
Antigenic power of micro-organism
Period of and ease of communicability
Dose of infection (inoculums)
Tissue selectivity (tropism)
Host specificity
Spore formation
Viability of the organism
Susceptibility of the pathogen to chemotherapy.

ii. Antigenic power of micro-organism:

The **ability** to initiate the **development of antibodies or antitoxin** and associated immunity.

- **It can measured be:**
  - **Second attack frequency**
  - **Age specific attack rate**
- In certain diseases **second attacks** are **rarely recorded** (***measles, mumps, chickenpox***)
- In other diseases **re-infection occurs** (***common cold, upper respiratory diseases, syphilis and gonorrhea***)

- **In diseases caused by micro-organisms of high antigenic power (measles), there is a drop of the attack rate after young age.**

Pathogenicity and virulence of micro-organism.
Antigenic power of micro-organism
Period of and ease of communicability
Dose of infection (inoculums)
Tissue selectivity (tropism)
Host specificity
Spore formation
Viability of the organism
Susceptibility of the pathogen to chemotherapy.

iii. Period and ease of communicability

- Can be measured by the Secondary attack rate =

Secondary attack rate =

$$\frac{\text{No. of secondary cases occurring within the accepted incubation period following exposure to a primary case}}{\text{No. of exposed susceptible}} \times 100$$

iv. Dose of infection (inoculums)

The **higher the dose** of infection **the more** liability of having an **apparent illness** and the **severe** will be the disease.

Pathogenicity and virulence of micro-organism.
Antigenic power of micro-organism
Period of and ease of communicability
Dose of infection (inoculums)
Tissue selectivity (tropism)
Host specificity
Spore formation
Viability of the organism
Susceptibility of the pathogen to chemotherapy.

v. Tissue selectivity (tropism):

- **It is the inherent capacity of the**
- **micro-organisms to invade particular type of tissue.**
- **It is the factor that gives each disease its particular signs and symptoms.**

vi. Host specificity:

Some pathogens infect **man only** as in relapsing fever.

Others infect **only animals.**

Some others infect **both man and animal** as in zoonotic diseases.

vii. Susceptibility of the pathogens to chemotherapy:

The degree of sensitivity to antibiotics differs from one pathogen to the other and even from one strain of a pathogen to another

Pathogenicity and virulence of micro-orga
Antigenic power of micro-organism
Period of and ease of communicability
Dose of infection (inoculums)
Tissue selectivity (tropism)
Host specificity
Spore formation
Viability of the organism
Susceptibility of the pathogen to chemothe

viii. Spore formation

The ability of some bacteria to change to a resistant form under unsuitable conditions and these **spores remains viable for long periods.**

When spores get the chance of coming into contact with a susceptible host under favorable conditions, they change to **vegetative forms and cause the disease**

(***e.g. tetanus and anthrax)***

ix. Viability of the organism (resistance of the organism)

The **ability to live outside the body**

the **longer the duration** the **more the chance to come into contact to new hosts** transmitting the disease to them.

Thank You

Sources and reservoir

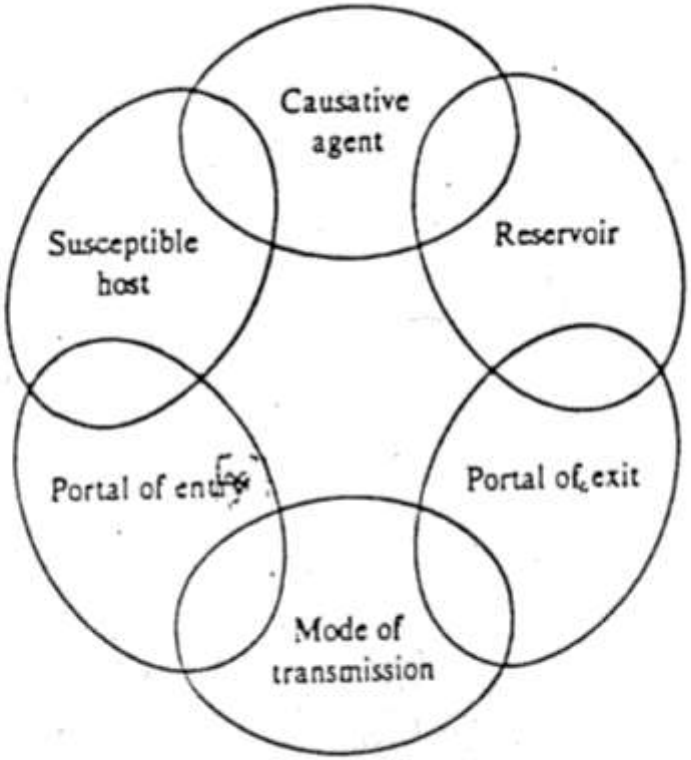


FIGURE 1.2 The chain of infection. Components of the infectious disease process.

(2) RESERVOIR OF INFECTION