Epidemiology

L 2

8-10-26

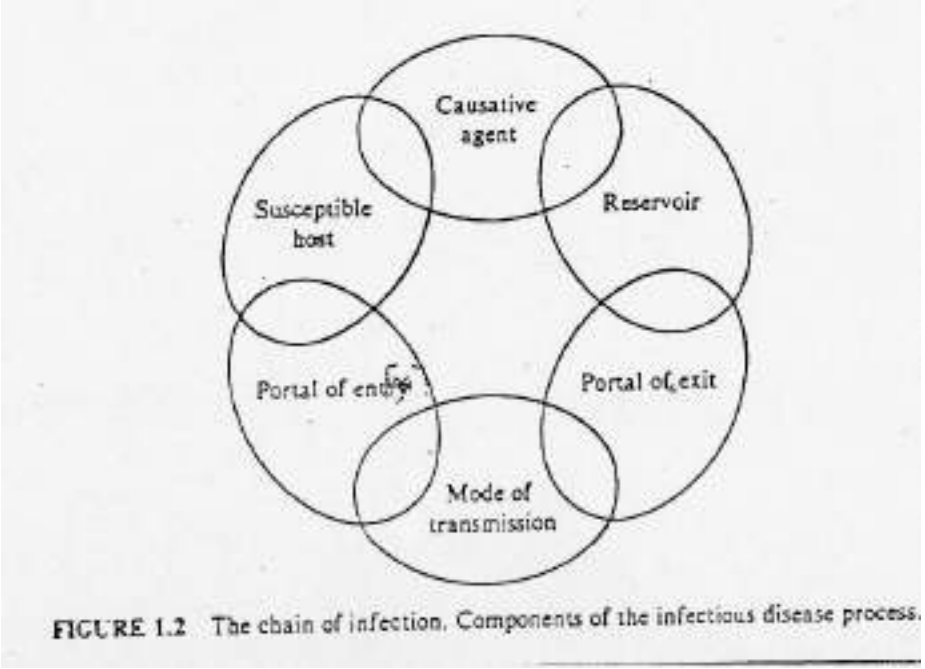


FIGURE 1.2 The chain of infection. Components of the infectious disease process.

Infectious process

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

Definitions related to infectious disease epidemiology

- ~~*Health*~~
- ~~*Infection*~~ entry and development and/or multiplication of an infectious agent
- ~~**Pathogenesis:**~~ End result of agent host interaction
- *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

- A person or animal, including birds and arthropods, that affords living or lodgement to an infectious agent under natural conditions.

1. *Obligate* host ,means the only host, e.g., man in measles and typhoid fever.
2. *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.
3. *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.
4. *Transport host is one that is used until the appropriate one definitive host reached*

❑ 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 (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.**

❑ *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

❑ *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**.

❑ *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.

❑ *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**.

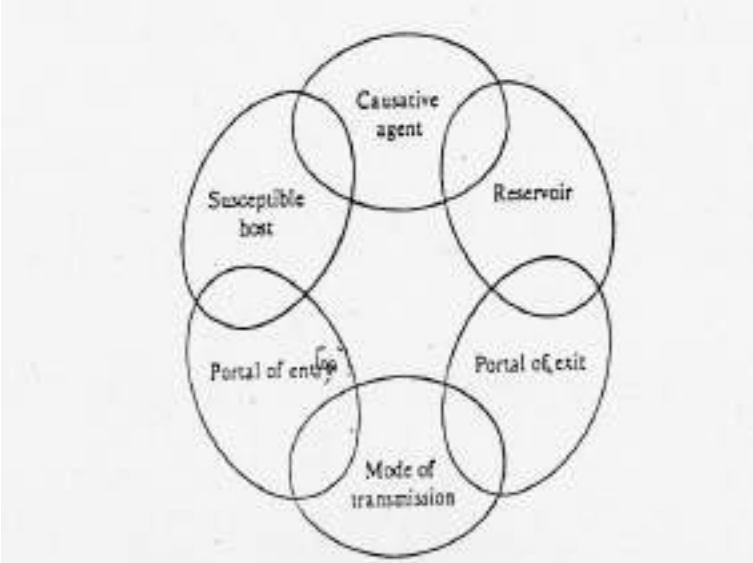
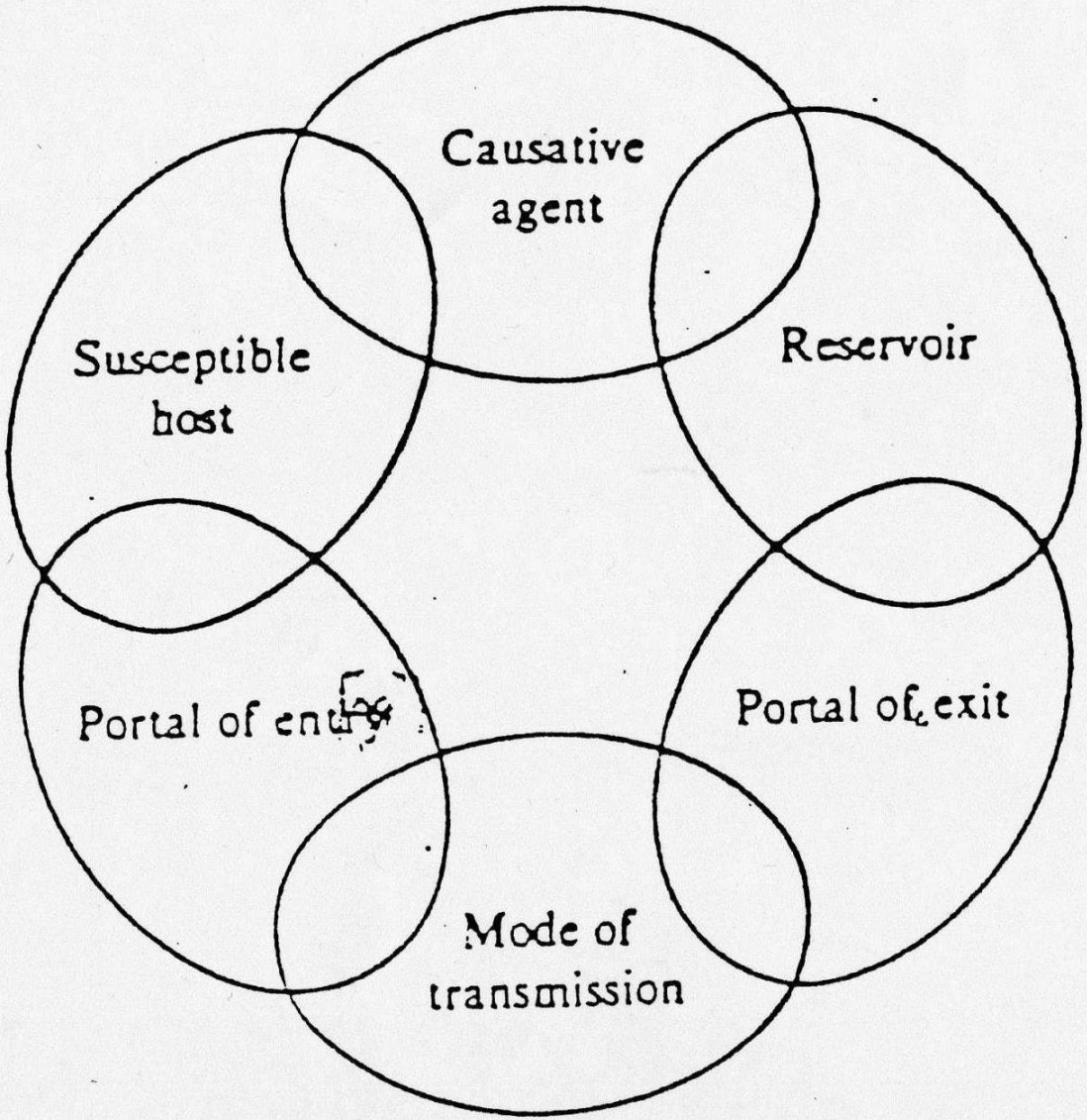


FIGURE 1.2 The chain of infection. Components of the infectious disease process.



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Disease Agent

❑ 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 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:

1. **Infectivity:** this is the ability of an infectious agent to invade and multiply (produce infection) in a host;
2. **Pathogenicity:** this is the ability to induce clinically apparent illness, and
3. **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:

1. **Pathogenicity and virulence of micro-organism.**
2. **Antigenic power of micro-organism**
3. **Period of and ease of communicability**
4. **Dose of infection (inoculums)**
5. **Tissue selectivity (tropism)**
6. **Host specificity**
7. **Spore formation**
8. **Viability of the organism**
9. **Susceptibility of the pathogen to chemotherapy**

Pathogenicity and virulence of micro-organism.

❑ 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= No. of deaths from a certain disease X 100**
  No. of cases from that disease

ii. Antigenic power of micro-organism:

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

- **It can measured by:**
  - **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.**

iii. Period and ease of communicability

- Can be measured by the 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.

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

viii. Spore formation

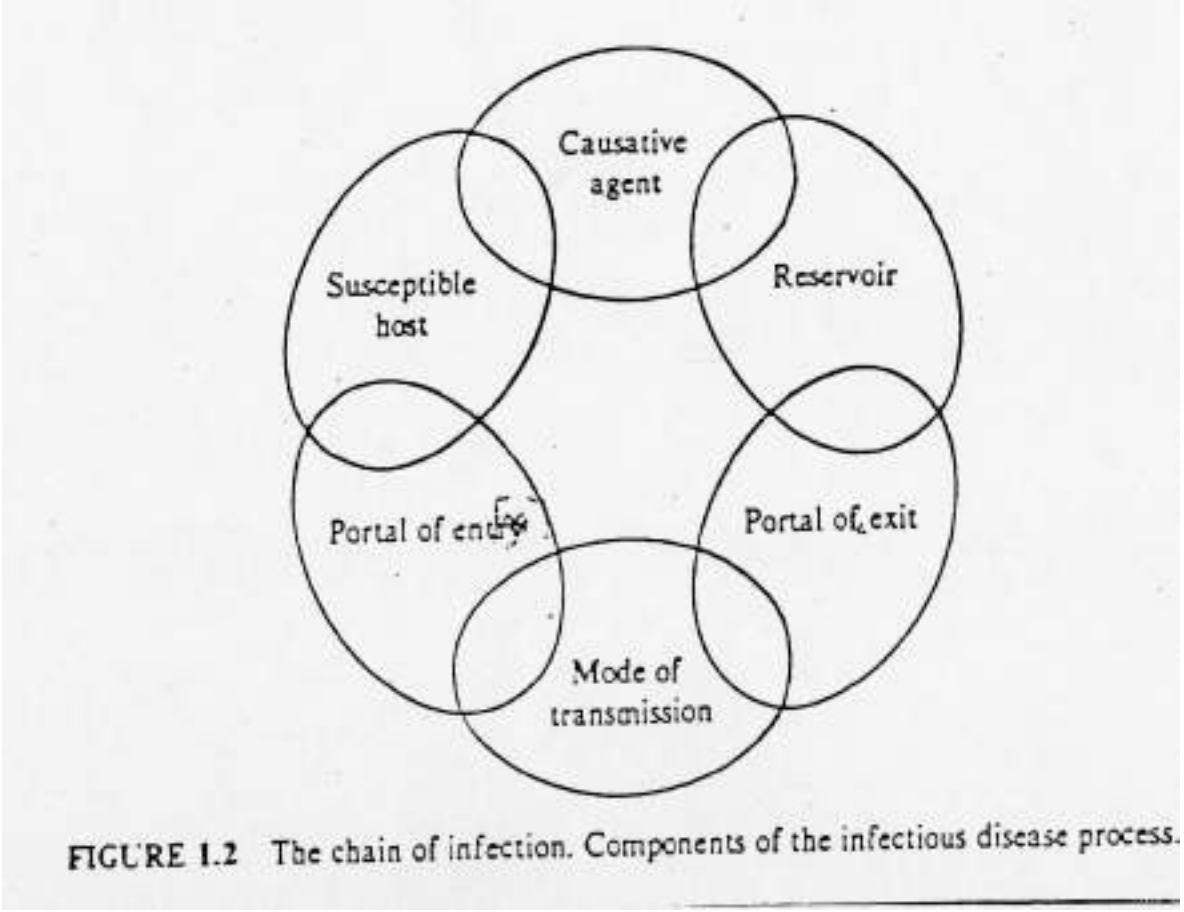
The ability of some bacteria to change to a resistant form under unsuitable conditions and these **spores remains viable for long periods.**

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.

Sources and reservoir



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(2) RESERVOIR OF INFECTION