



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

Epidemiology

L II NEW

8-10-2024



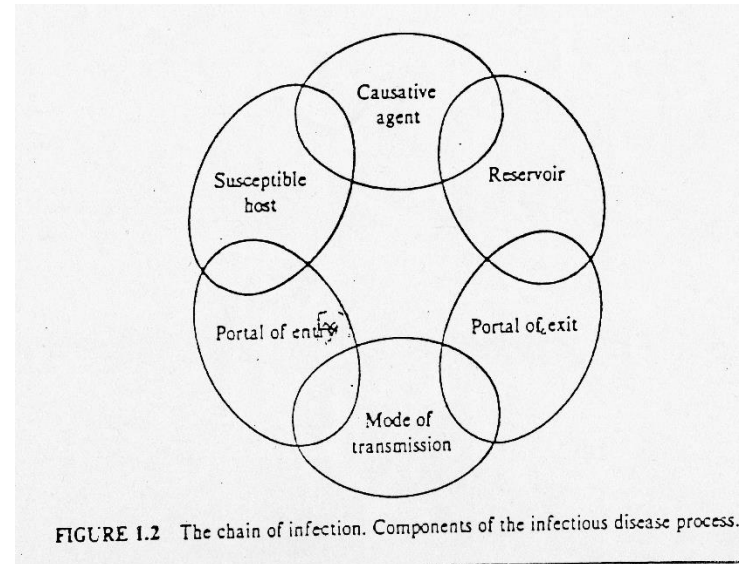
السلام عليكم ورحمة الله وبركاته

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Epidemiology

L II

11-10-2023



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

- 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, .

□ 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.

Epidemic
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□ *Endemic*

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

(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

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□ *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,

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□ 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.

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□ *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

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

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**.

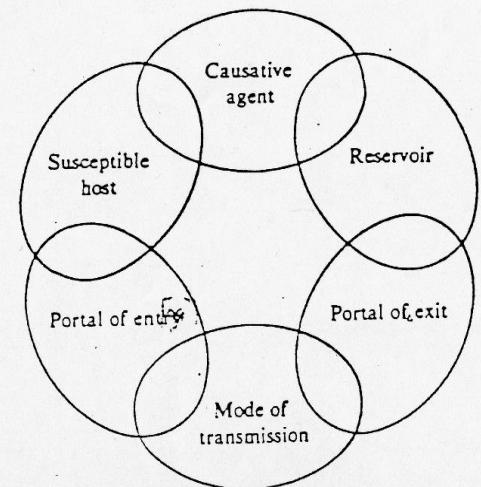


FIGURE 1.2 The chain of infection. Components of the infectious disease process.

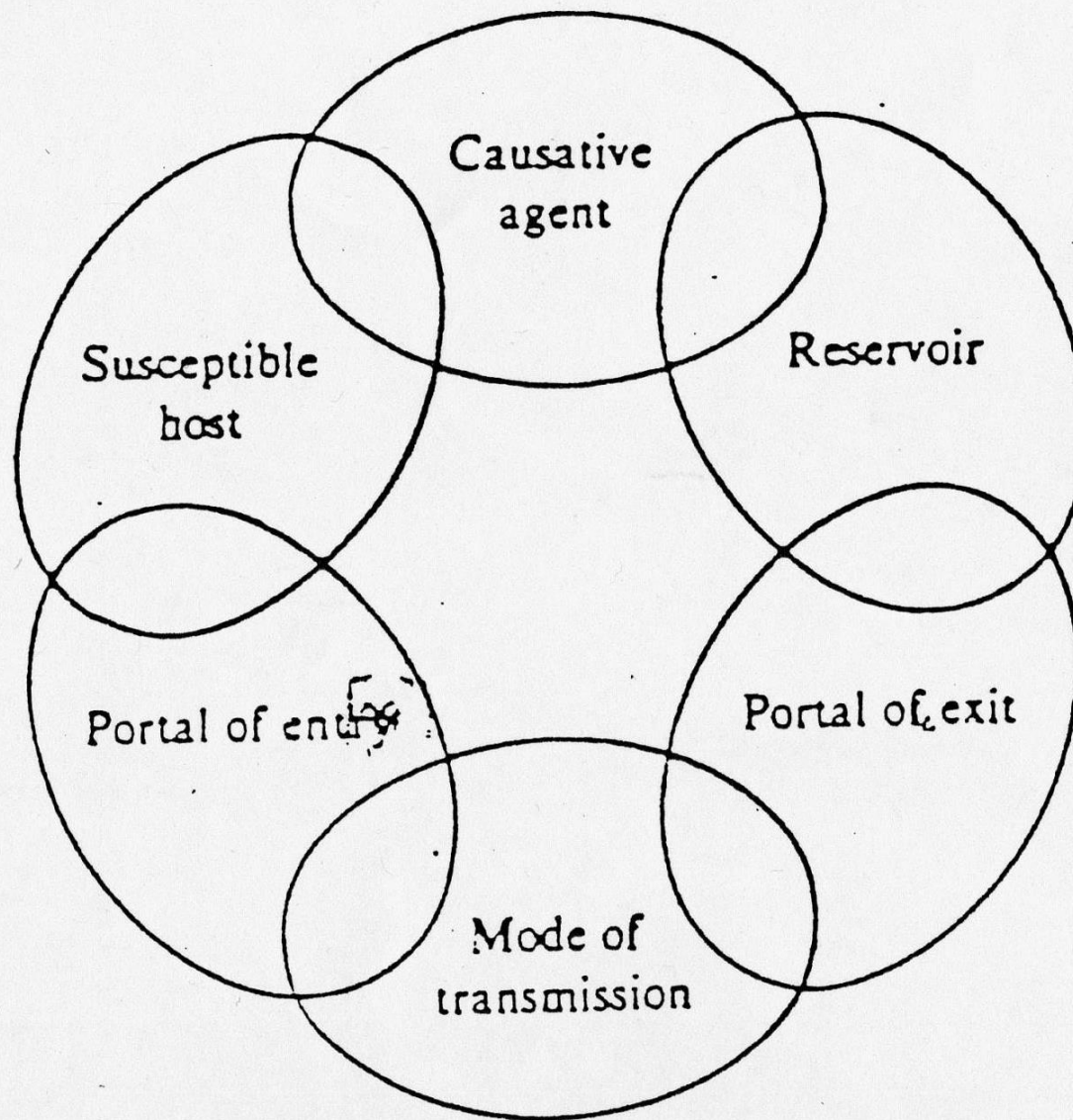


FIGURE 1.2 The chain of infection. Components of the infectious disease process.

Disease Agent



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□ Biological Agents

These are living agents of disease,



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

Rickettsia, (typhus)

Fungi, : (Candida)



➤ **Bacteria**, Cocci (staphylococci, streptococci,etc)

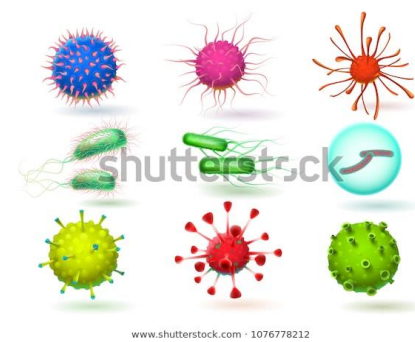
➤ **Bacilli** (diphtheria, salmonella, shigella....etc)

➤ **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)

Mechanisms of disease
production

- 1) Invasiveness
- 2) Toxicity:
- 3) Hypersensitivity

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.

- 1) Invasiveness
- 2) Toxicity:
- 3) Hypersensitivity

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 (inoculum)
- 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.

□ 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** = $\frac{\text{No. of deaths from a certain disease}}{\text{No. of cases from that disease}} \times 100$

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 (inoculum)

Tissue selectivity (tropism)

Host specificity

Spore formation

Viability of the organism

Susceptibility of the pathogen to chemotherapy.

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
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ii. Antigenic power of micro-organism:

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

□ It can be 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 gonorrhoea*)

□ 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 (inoculum)
Tissue selectivity (tropism)
Host specificity
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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 (inoculum)

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
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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-organism
Antigenic power of micro-organism
Period of and ease of communicability
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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

Thank You

Sources and reservoir

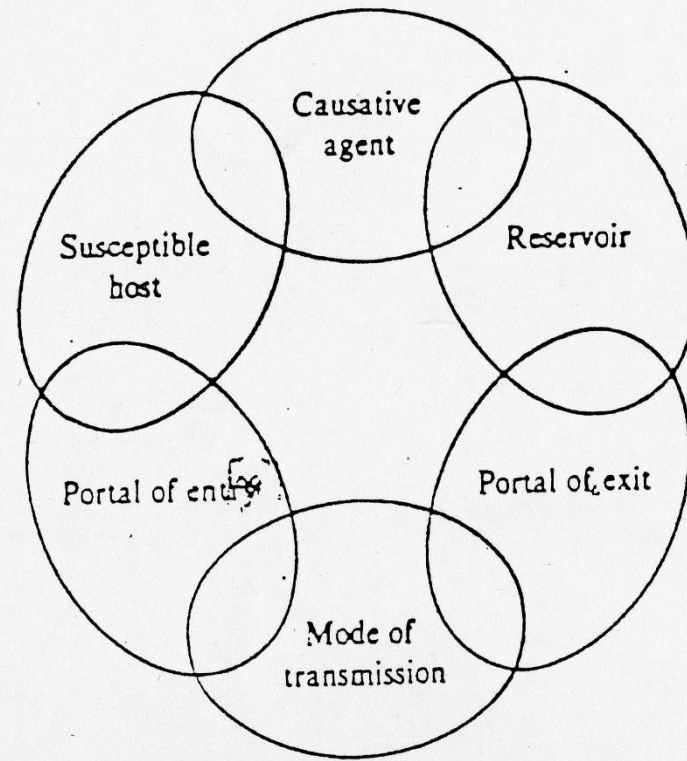


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(2) RESERVOIR OF INFECTION