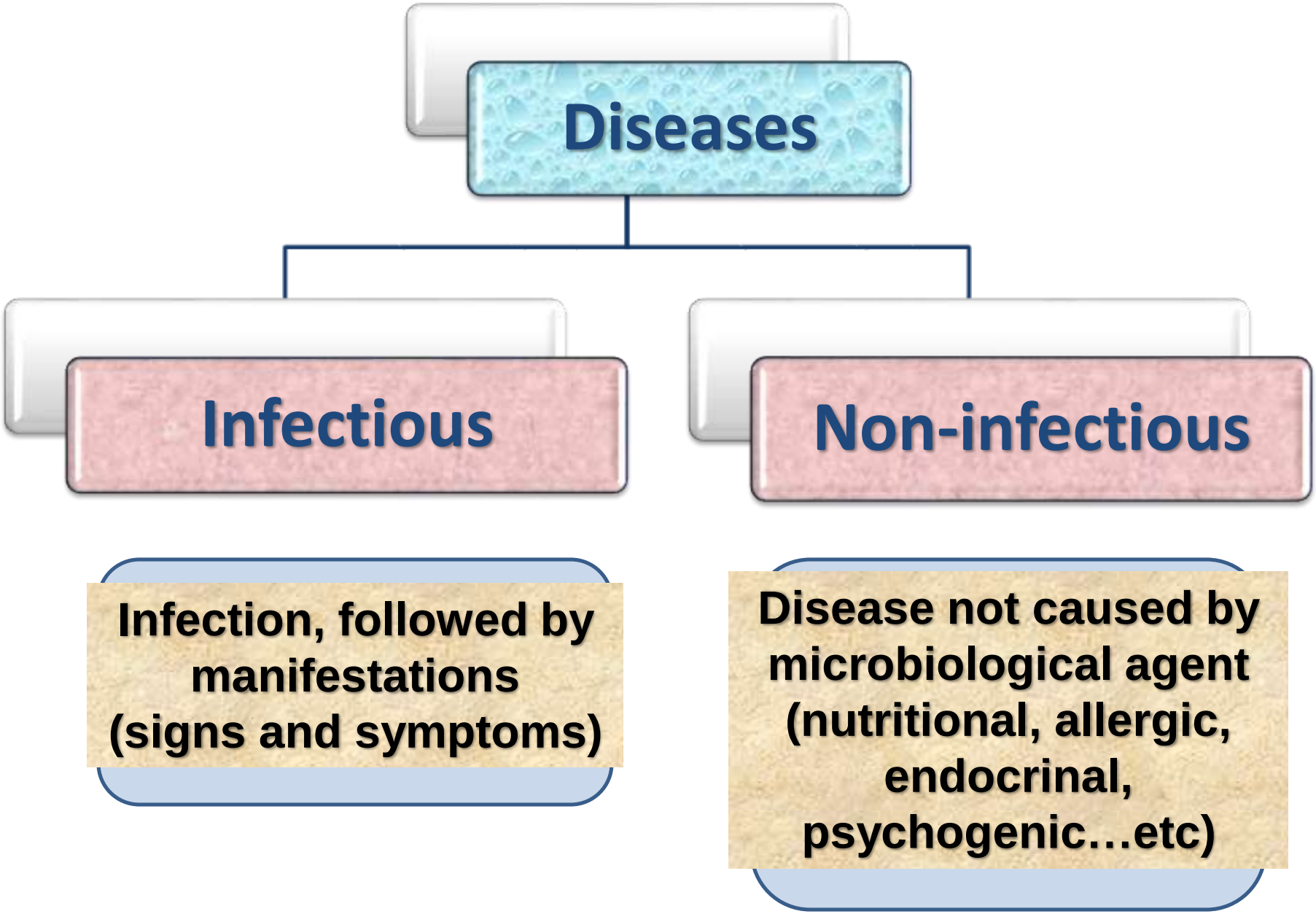
Infectious process I

Contents

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


Diseases
Infectious
Non-infectious
Infection, followed by manifestations (signs and symptoms)
Disease not caused by microbiological agent (nutritional, allergic, endocrinal, psychogenic…etc)

- **Infectious disease epidemiology is a fundamental part of the whole of epidemiology.**

Studying of communicable diseases??

(a) **by the discovery of "new" infections, and**
(b) changes in the pattern of communicable diseases,
(c) some chronic diseases may have an infective origin.??

- **The development of vaccines and /or antibiotics was not followed, by the virtual (**practical, functional), **disappearance of infectious disease.**

- **Therefore it's prevention and control needs epidemiological knowledge and experience .**

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

Health

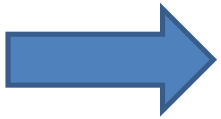
(WHO definition)

It is the state of complete physical, mental and social well being, and not merely the absence of disease or infirmity.

- **Any deviation from normal health is called Disease**

Infection

- **The entry and development and/or multiplication of an infectious agent in the body of man or animals.**
- Also It is the **body responds** to
- **defend itself against the invader**, **either in the form of an**
  - **immune response** or
  - **disease.**
- **An infection does not always cause illness.**



Health
Infection
Pathogenesis:
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Host

The outcome of infection depends on:

1. **Host resistance (immunity)**
2. **Microbiological agent characters (invasiveness, toxicity& Virulence)**

- **There are several levels of infection :**
  - **Colonization** *(e.g., S. aureus in skin and normal nasopharynx)*
  - **Subclinical** or clinically **unapparent** ***infection*** (e.g., polio);
  - **Latent infection** (e.g. TB)
  - **Clinical infection** or manifest

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Pathogenesis:

- **End result of agent host interaction:**
  - Agent **fails to lodge(**inhabit **)** resulting in **No Infection**
  - Agent lodges **without causing illness** resulting in **subclinical infection** (silent or latent)
  - Agent lodges with **frank illness** resulting in **Disease**

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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
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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 state

  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**.
- .

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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.***

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

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.**

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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 occurring worldwide crossing international boundaries,
- affecting a large proportion of the population,
- affecting countries sequentially (at the same time) occurring over a wide geographic area such 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**.

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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. Radioisotopes are safe except in pregnant mothers or in new-born

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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)

Chain of infection

Chain of event

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**.

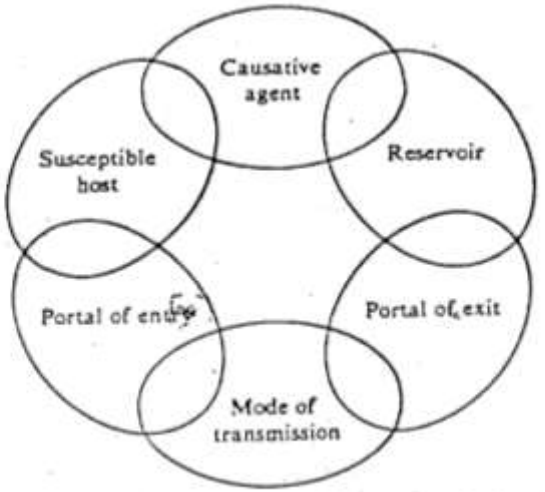
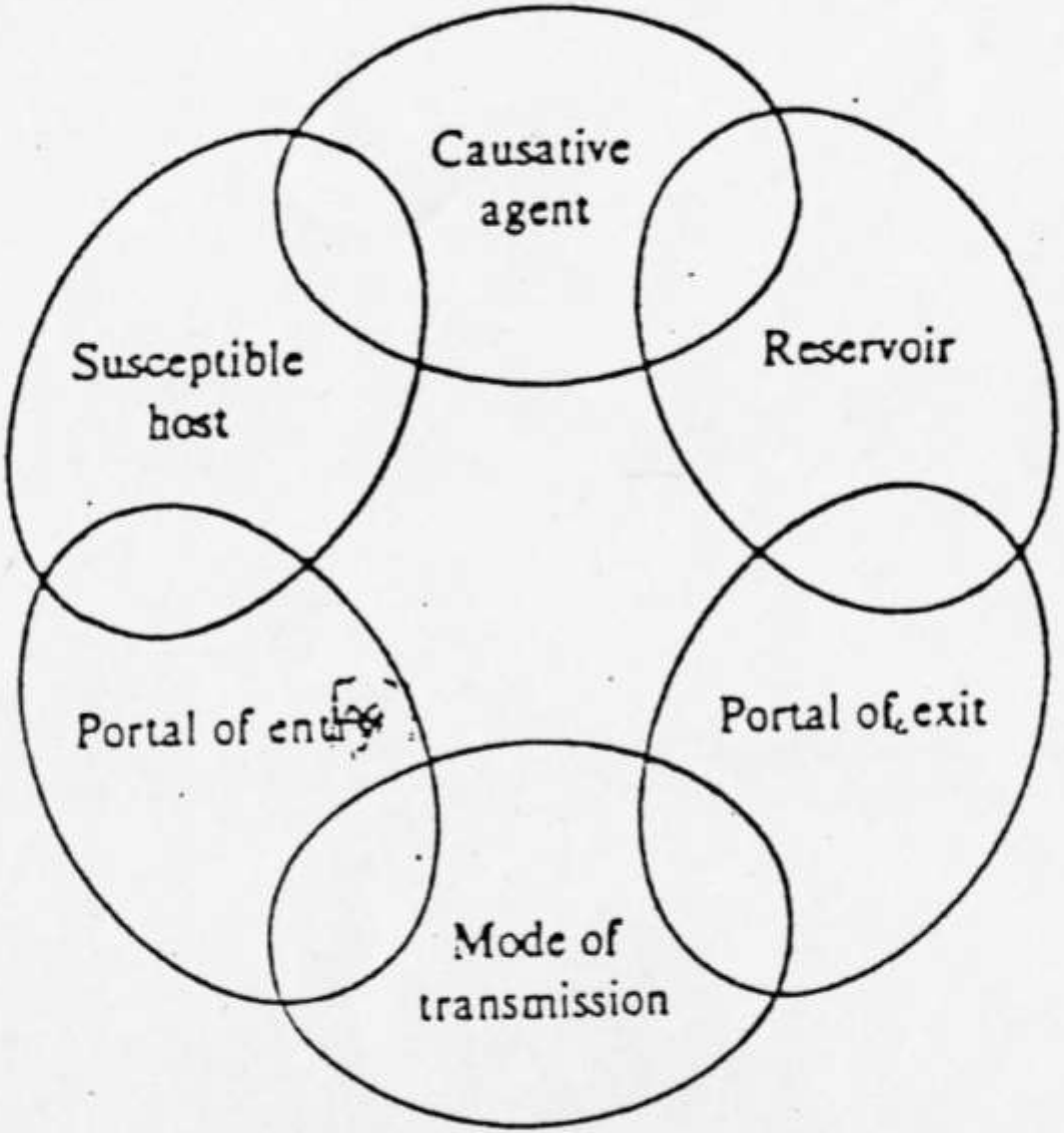


FIGURE 1.2 The chain of infection. Components of the infectious disease process.



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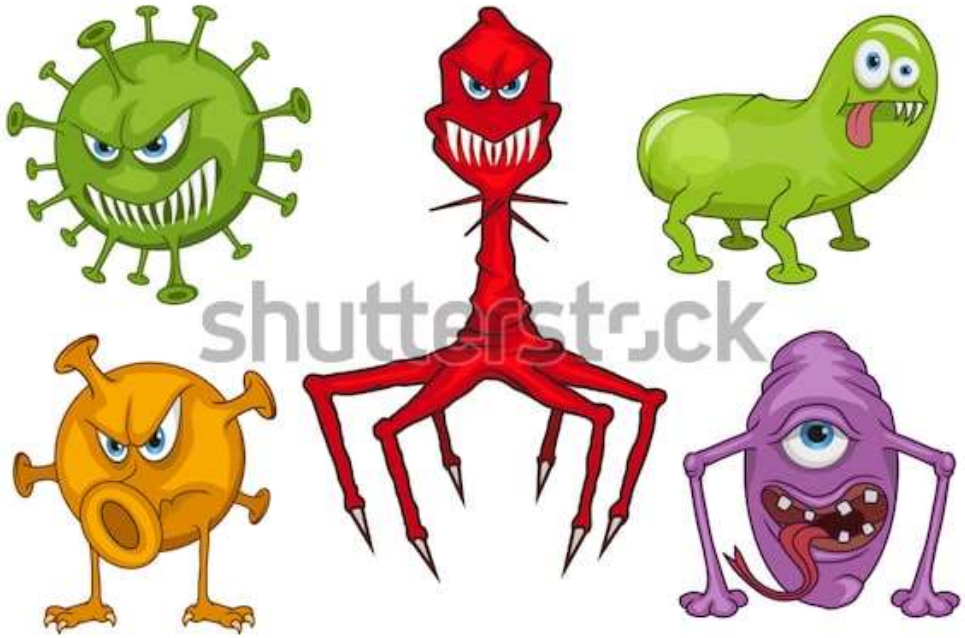
Disease Agent



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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 o**f 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, >>>>>>>>>>>>

1. 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**
2. **pathogenicity**
3. **virulence**

(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.
Antigenic power of micro-organism
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Dose of infection (inoculums)
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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=**

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

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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 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.

iii. Period and ease of communicability

Can be measured by **the Secondary attack rate** =

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

Pathogenicity and virulence of micro-organism.
Antigenic power of micro-organism
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Dose of infection (inoculums)
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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. 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.

Pathogenicity and virulence of micro-organism.
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VI 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.

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

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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

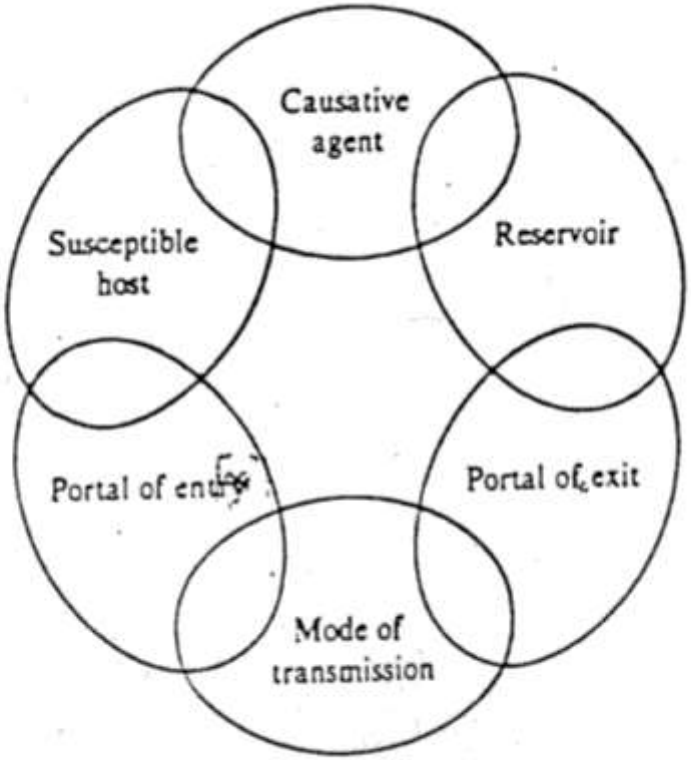
(***e.g. tetanus and anthrax)***

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.

Sources and reservoir



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(2) RESERVOIR OF INFECTION