RAMA UNIVERSITY

www.ramauniversity.ac.in

FACULTY OF NURSING

Chapter-01

INFECTION

Mr. SHAHANWAZ KHAN
LECTURER (MSN)

What is Infection

- An **infection** is the colonization of a host by Microbial species. Infecting **Microbes** seek to use the host's resources to reproduce, often resulting in disease. Colloquially, infections are usually considered to be caused by microscopic organisms like viruses, prions, bacteria, and viroids, though larger organisms like macro **parasites** and fungi can also infect.

Basis of Classification of Infections

- Infections are classified in multiple ways. They are classified by the causative agent as well as by the constellation of symptoms and medical signs that are produced.
- An infection that produces symptoms is an *apparent* infection. An infection that is active, but does not produce noticeable symptoms, may be called *in apparent*, *silent*, or *subclinical*. An infection that is inactive or dormant is called a *latent infection*

Understanding ……
Infection and Disease

A. Definitions

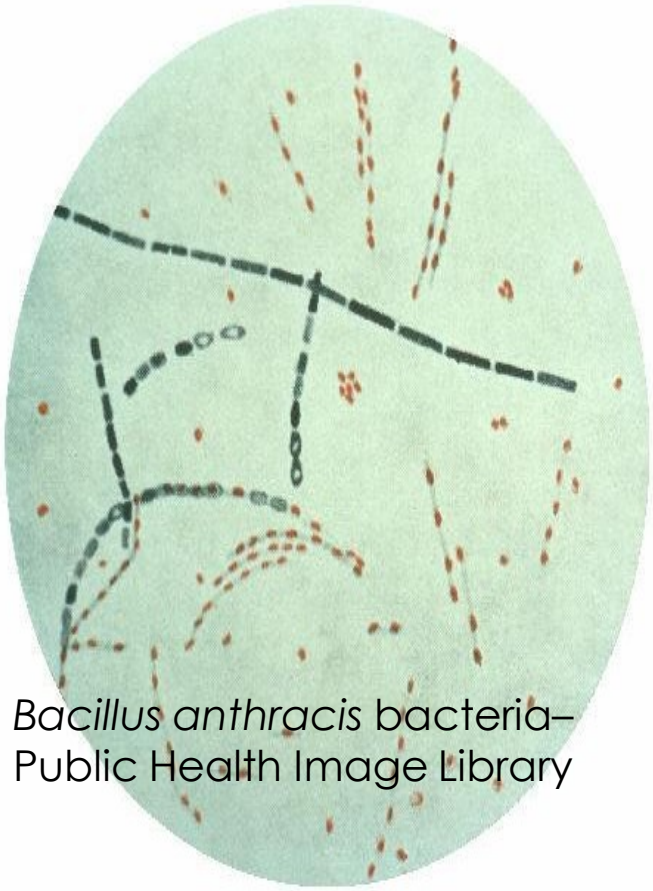
B. The Normal Flora of Humans

C. Generalized Stages of Infection

D. Virulence Factors and Toxins

What Causes an Infectious Disease?

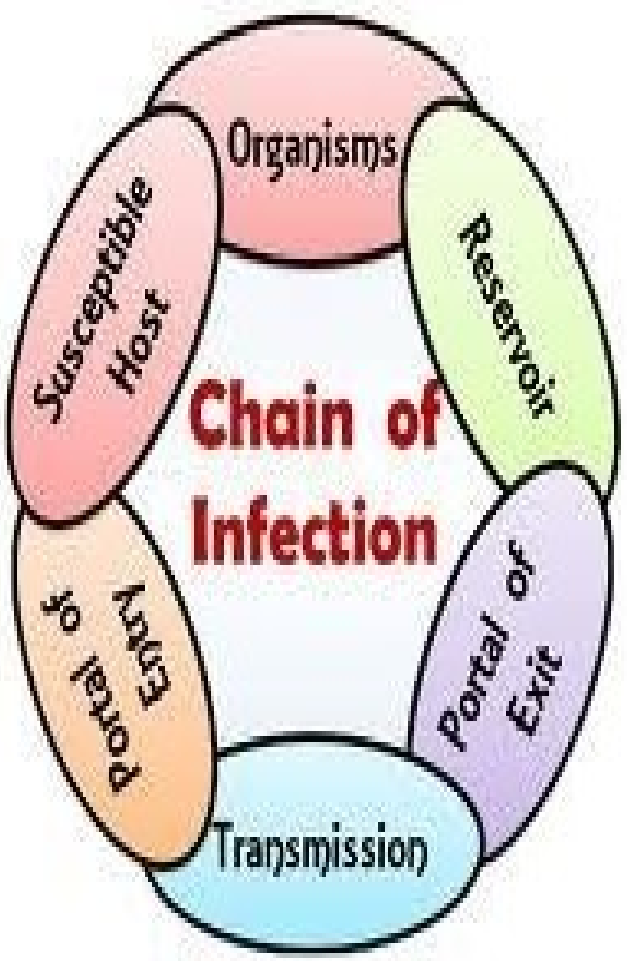
- **Infection is caused by microorganism**
- **The microorganism may be a bacteria, a virus, a parasite or a fungus**



Bacillus anthracis bacteria–
Public Health Image Library

Overview

- **Types of Microorganisms**
- **Principles of Infection**
  - Transmission
  - Host resistance
  - Virulence and pathogenicity
  - Control of transmission and infection
- **Development of Infection**
  - Onset and course
  - Clinical signs and symptoms
  - Diagnostic tests
- Antimicrobial Drugs
- Example of Infection: Influenza



Conditions required for infection to spread from one person to another

- 1. One person must be infected with a microorganism
- 2. The other person must be susceptible to infection with that microorganism
- 3. The microorganism must be able to leave the body of the infected person and enter the body of the susceptible person.

Types of infection

- **Colonization** – infection present on surface of body –
  - Organism propagating at a rate sufficient to maintain its numbers without producing identifiable evidence of any reaction in host
- Inapparent or subclinical infection
  - organism not only multiplying but also causes a measurable reaction that is however not clinically detectable
- **Symptomatic infection**
  - Organism causes clinically detectable reaction

Time parameters of interaction

- **Latency Period** = the time between infection agent and onset of infectiousness
- **Incubation Period** = the time between infection and onset of symptoms
- **Latency period** may not be the same as the incubation period

Definitions

- **Disease and Infectious Disease**
  - Disease
    - Any deviation from a condition of good health and well-being
  - **Infectious Disease**
    - A disease condition caused by the presence or growth of infectious microorganisms or parasites

Definitions

- Pathogenicity and Virulence
  - Pathogenicity
    - The ability of a microbe to cause disease
    - This term is often used to describe or compare species
  - Virulence
    - The degree of pathogenicity in a microorganism
    - This term is often used to describe or compare strains within a species

Definitions

- **Acute infection vs. chronic infection**
  - **Acute Infection**
    - An infection characterized by sudden onset, rapid progression, and often with severe symptoms
  - **Chronic Infection**
    - An infection characterized by delayed onset and slow progression

Definitions

- **Primary infection vs. secondary infection**
  - **Primary Infection**
    - An infection that develops in an otherwise healthy individual
  - **Secondary Infection**
    - An infection that develops in an individual who is already infected with a different pathogen

Definitions

- **Localized infection vs. systemic infection**
  - **Localized Infection**
    - An infection that is restricted to a specific location or region within the body of the host
  - **Systemic Infection**
    - An infection that has spread to several regions or areas in the body of the host

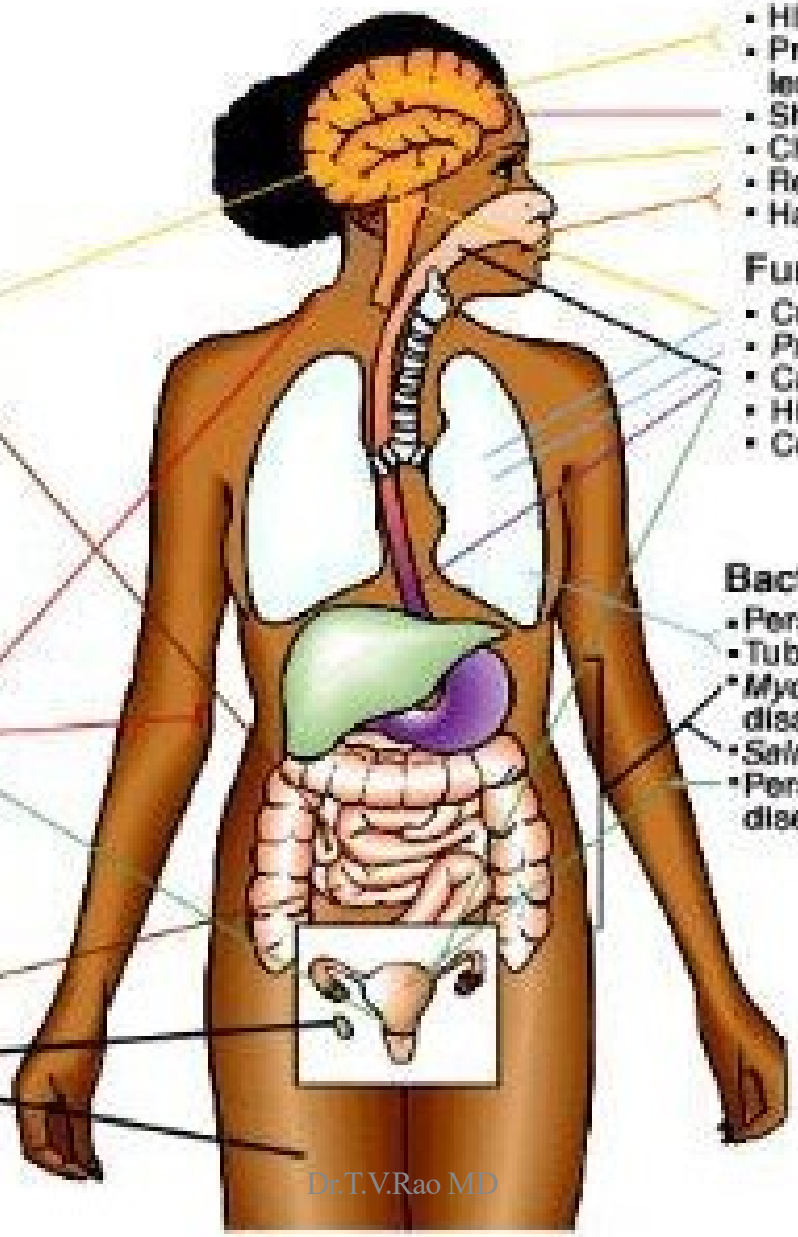
.Definitions

- **Clinical infection vs. subclinical infection**
  - –Clinical Infection
    - An infection with obvious observable or detectable symptoms
  - **–Subclinical Infection**
    - An infection with few or no obvious symptoms

Definitions

- **Opportunistic infection**
  - An infection caused by microorganisms that are commonly found in the host's environment This term is often used to refer to infections caused by organisms in the normal flora

Diseases associated with AIDS



Viral diseases
- HIV encephalopathy
- Progressive multifocal leukoencephalopathy
- Shingles, recurrent (herpes zoster)
- Chtomegalovirus retinitis
- Recurrent herpes simplex lesions
- Hairy leukoplakia (Epstein-Barr virus)

Protozoan diseases
- Toxoplasmosis
- Chronic *Cryptosporidium* diarrhea
- Chronic *Isospora* diarrhea

Fungal diseases
- Cryptococcosis
- *Pneumocystis* pneumonia
- Candidiasis
- Histoplasmosis, disseminated
- Coccidioidomycosis, disseminated

Cancers
- Lymphomas of brain, glands, lymphatic tissue
- Kaposi's sarcoma
- Invasive cervical cancer

Bacterial diseases
- Persistent pneumonia
- Tuberculosis
- *Mycobacterium avium* complex, disseminated
- *Salmonella* septicemia
- Persistent pelvic inflammatory disease (PID)

Miscellaneous conditions
- Persistent diarrhea
- Persistent generalized lymphadenopathy
- Wasting syndrome
- Night sweats
- Persistent fever

Defining

- **The suffix "-emia"**
  - A suffix meaning "presence of an infectious agent"
    - **Bacteremia** = Presence of infectious bacteria
    - **Viremia** = Presence of infectious virus
    - **Fungemia** = Presence of infectious fungus
    - Septicemia = Presence of an infectious agent in the bloodstream

Definitions

- **The suffix "-itis"**
  - A suffix meaning "inflammation of"
    - Examples:
      - Pharyngitis = Inflammation of the pharynx
      - Endocarditis = Inflammation of the heart chambers
      - Gastroenteritis = Inflammation of the gastrointestinal tract

Definitions

- **Epidemiology**
  - The study of the transmission of disease
- **Communicable Disease**
  - A disease that can be transmitted from one individual to another
- **Contagious Disease**
  - A communicable disease that is easily spread from one individual to another
- **Non communicable Disease**
  - A disease that is not transmitted from one individual to another

Definitions

- **Endemic Disease**
  - A disease condition that is normally found in a certain percentage of a population
- **Epidemic Disease**
  - A disease condition present in a greater than usual percentage of a specific population
- **Pandemic Disease**
  - An epidemic affecting a large geographical area; often on a global scale

Definitions

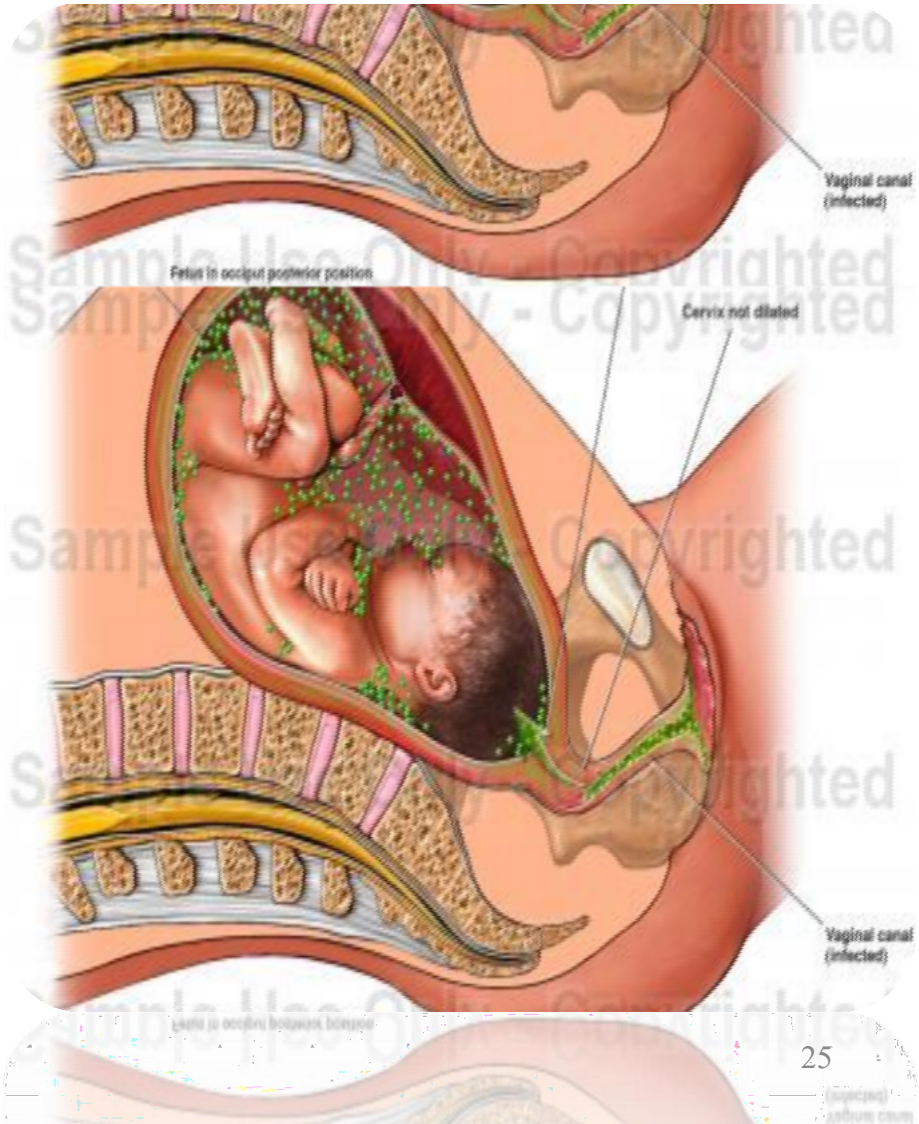
- **Reservoir of Infection**
  - The source of an infectious agent
- **Carrier**
  - An individual who carries an infectious agent without manifesting symptoms, yet who can transmit the agent to another individual
- **Fomites**
  - Any inanimate object capable of being an intermediate in the indirect transmission of an infectious agent

Definitions

- **Animal Vectors**
  - An animal (nonhuman) that can transmit an infectious agent to humans
  - **Two types: mechanical and biological**
    - Biological animal vectors: The infectious agent must incubate in the animal host as part of the agent's developmental cycle; eg, the transmission of malaria by infected mosquitoes
    - Mechanical animal vectors: The infectious agent is physically transmitted by the animal vector, but the agent does not incubate or grow in the animal; eg, the transmission of bacteria sticking to the feet of flies

Definitions

- **Direct Mechanisms of Disease Transmission**
  - Directly From Person to Person
  - Examples:
    Direct Skin Contact
    Airborne (Aerosols)
  - From Mother to fetus

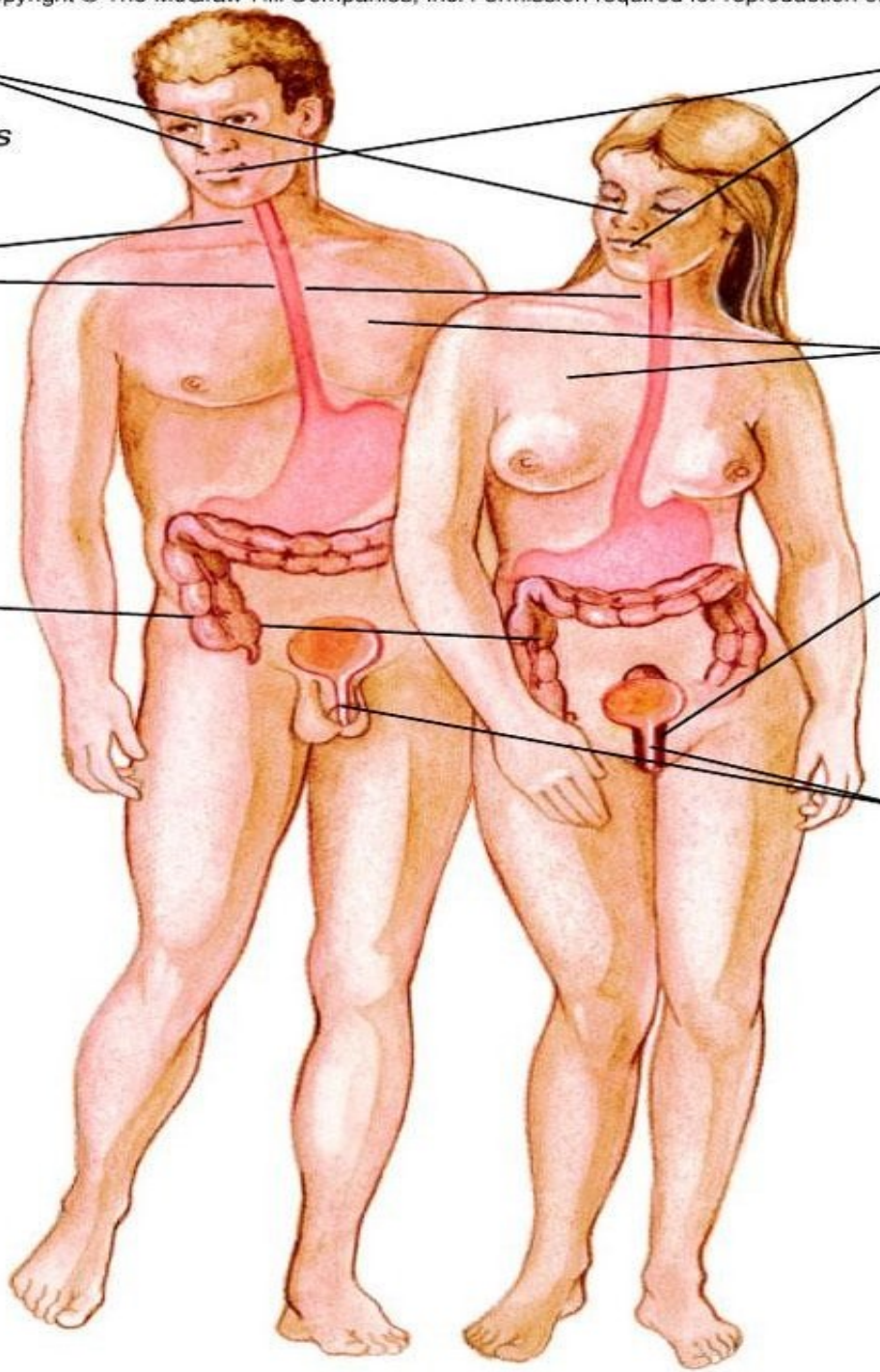


Indirect Transmission

- Indirect Mechanisms of Disease Transmission
  - Examples:
    Food &
    Waterborne
    Transmission
    Fomites
    Animal Vectors

The Normal Flora of Humans

- **Types of Symbiosis**
  - **Mutualism**
    - A symbiotic relationship in which both species benefit
  - **Commensalism**
    - A symbiotic relationship in which one species benefits, and the other species is neither helped nor harmed



Nose
Staphylococcus aureus
Staphylococcus epidermidis
Corynebacterium species

Throat
Streptococcus species
Branhamella catarrhalis
Corynebacterium species
Haemophilus species
Neisseria species
Mycoplasma species

Large intestine
Bacteroides fragilis
Escherichia coli
Proteus mirabilis
Klebsiella species
Lactobacillus species
Streptococcus species
Candida albicans
Clostridium species
Pseudomonas species
Enterococcus species

Mouth
Streptococcus species
Fusobacterium species
Actinomyces species
Leptotrichia species
Veillonella species

Skin
Staphylococcus epidermidis
Propionibacterium acnes
Pityrosporum ovale

Vagina
Lactobacillus species
Streptococcus species
Candida albicans
Gardnerella vaginalis

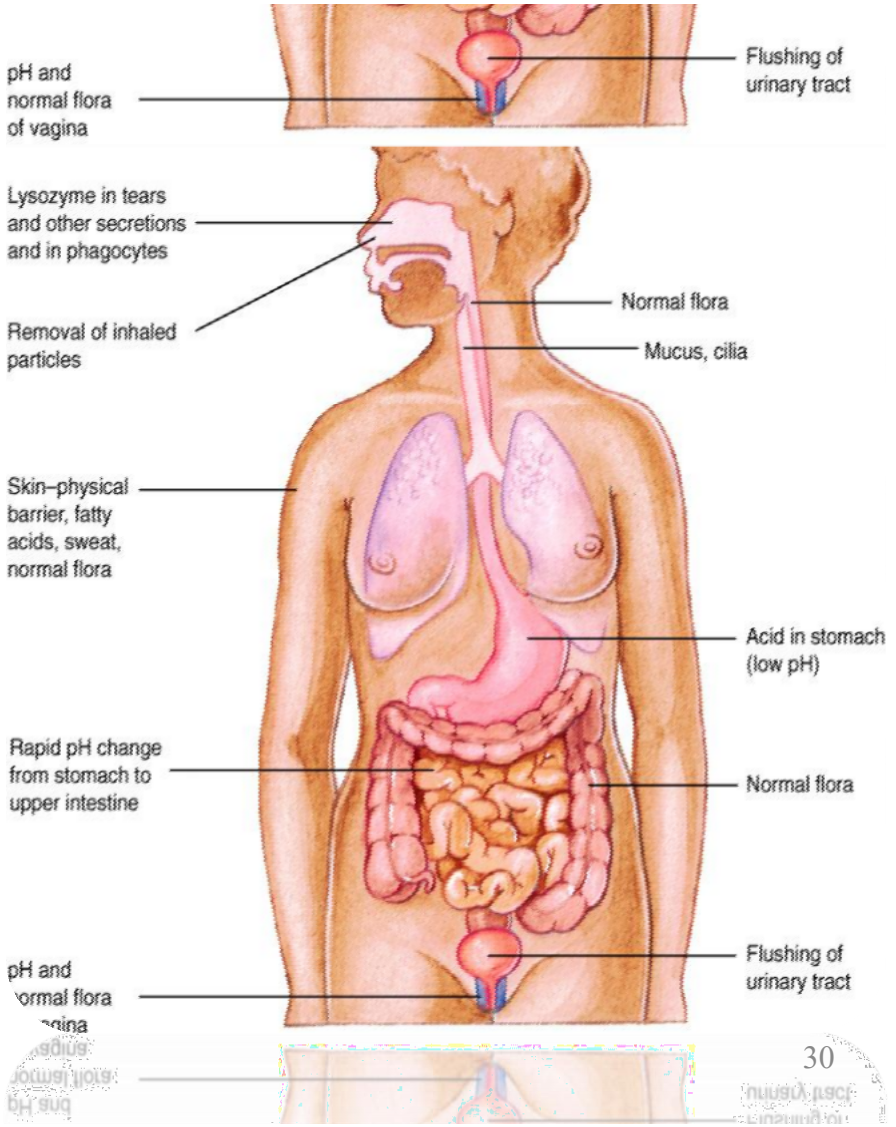
Urethra
Streptococcus species
Mycobacterium species
Escherichia coli
Bacteroides species

The Normal Flora of Humans

- **Types of Symbiosis (cont.)**
  - **Parasitism**
    - A symbiotic relationship in which one species benefits, and the other species is harmed
    - Generally, the species that benefits (the parasite) is much smaller than the species that is harmed (the host)

. The Normal Flora of Humans

- Normal flora is present in
  - skin
  - upper respiratory tract
  - oral cavity
  - intestine, especially large intestine
  - vaginal tract
- Very little normal flora in eyes & stomach



The Normal Flora is absent

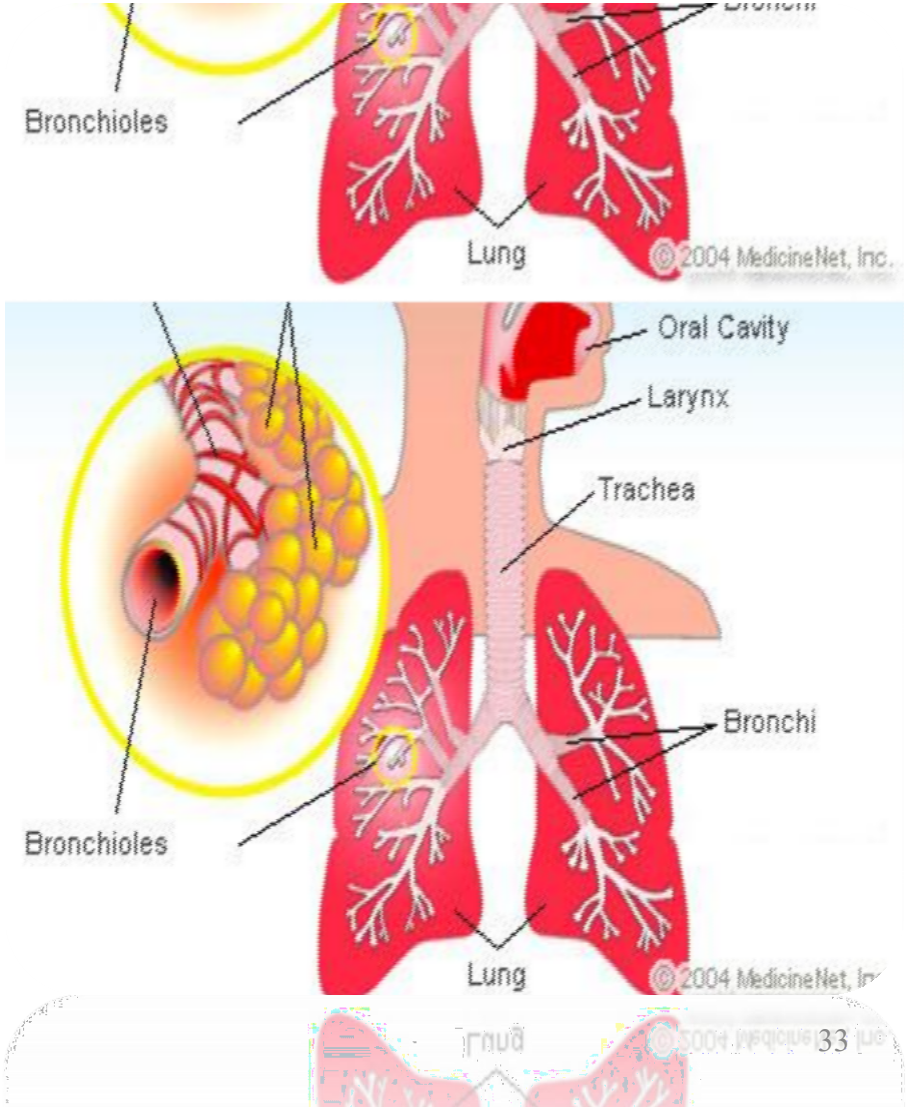
- **Notably absent in most all internal organs**
  - Absent in:
    - lower respiratory tract
    - muscle tissue
    - blood & tissue fluid
    - cerebrospinal fluid
    - peritoneum
    - pericardium
    - meninges

The Normal Flora of Humans

- Benefits of the normal flora
  - Nutrient production/processing eg Vitamin K production by *E. coli*
  - Competition with pathogenic microbes
  - Normal development of the immune system
- Normal flora and opportunistic infections

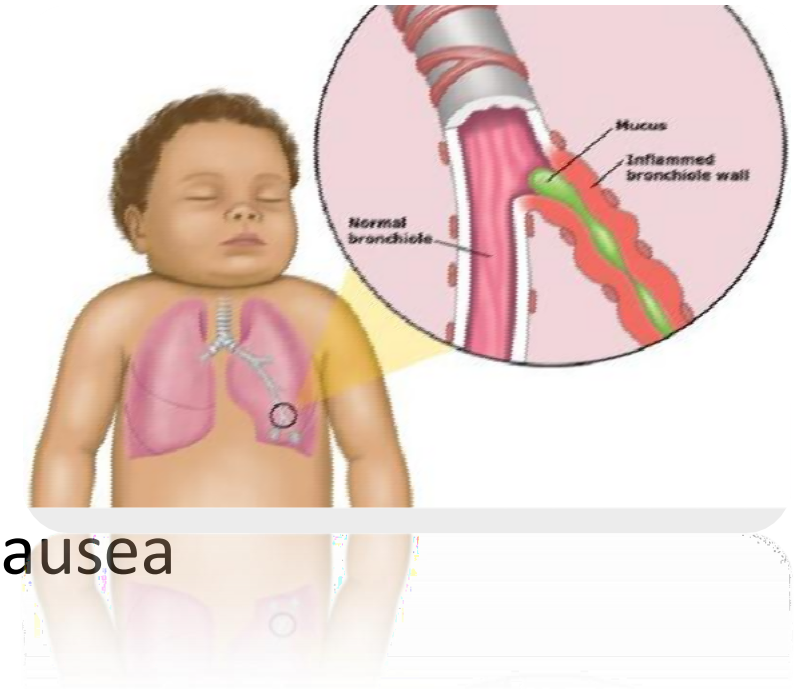
Development of Infection: Onset and Course

- Incubation period
  - Organism present; no clinical signs, symptoms
- Prodromal period
  - Symptoms; don't feel like yourself
- Acute period
  - Fully developed infection



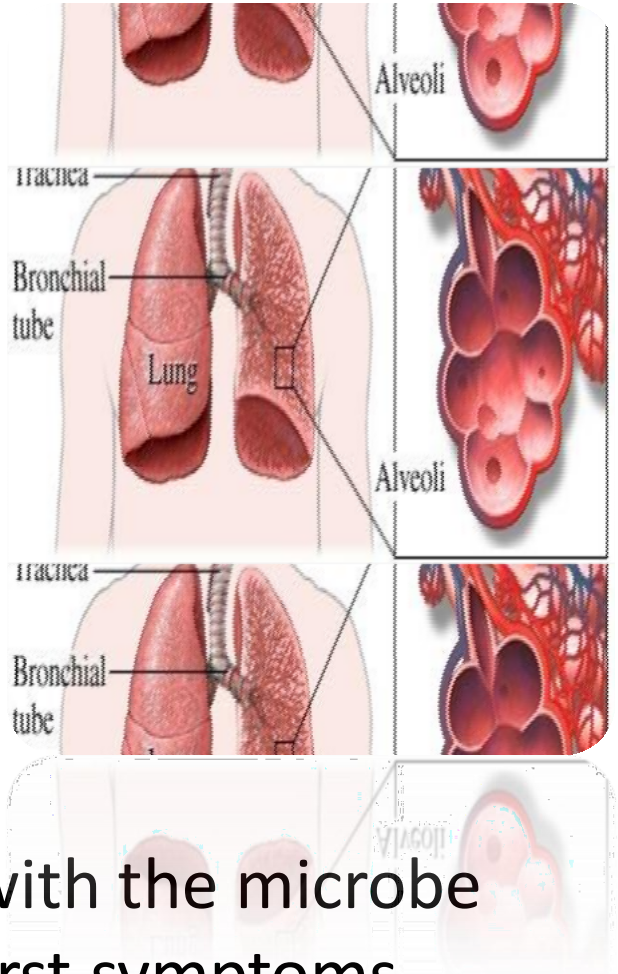
Development of Infection: Clinical Signs and Symptoms

- **Local signs**
  - Inflammation
  - Purulent exudate if bacterial infection; serous exudate if viral
  - Tissue necrosis
  - Lymphadenopathy
  - Respiratory effects
- **Systemic signs**
  - Fever, fatigue, headache, nausea



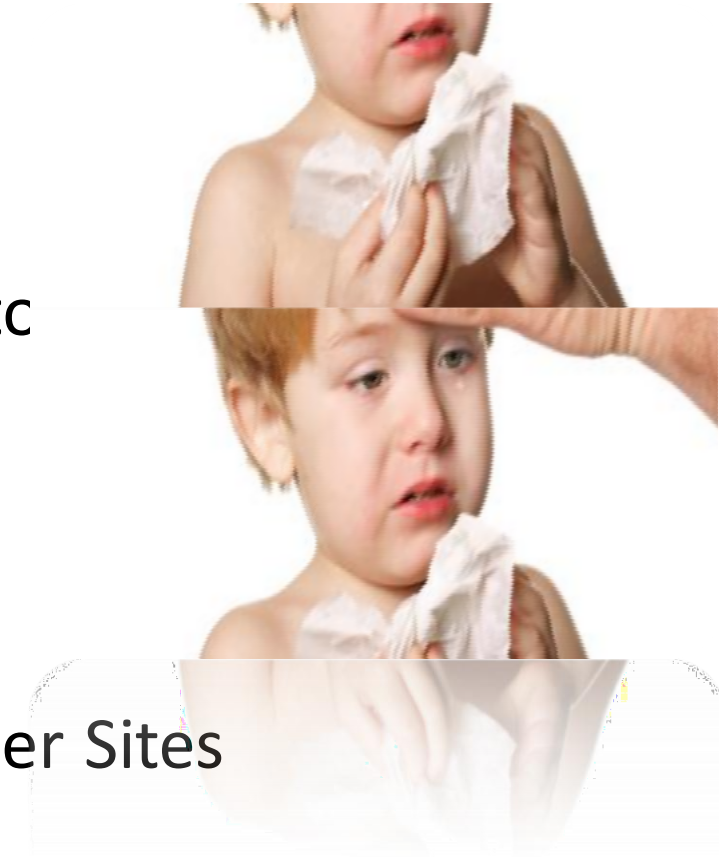
Generalized Stages of Infection

1. **Entry of Pathogen**
   - Portal of Entry
2. **Colonization**
   - Usually at the site of entry
3. **Incubation Period**
   - Asymptomatic period
   - Between the initial contact with the microbe and the appearance of the first symptoms



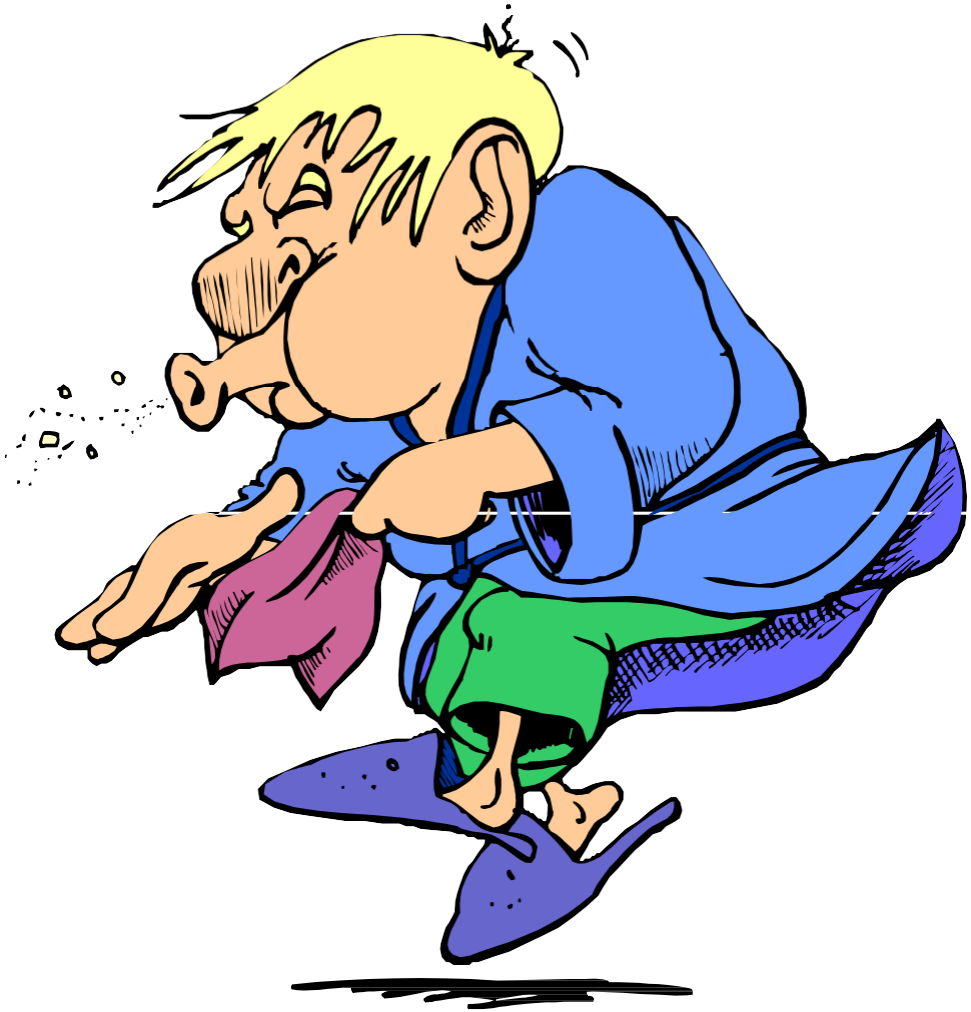
Generalized Stages of Infection

4. Prodromal Symptoms
   - Initial Symptoms
5. Invasive period
   - Increasing Severity of Symptc
   - Fever
   - Inflammation and Swelling
   - Tissue Damage
   - Infection May Spread to Other Sites
   - Acme (Fastigium)



Modes of Transmission

- Direct contact
- Indirect contact
- Droplet transmission
- Hands
- Vector-borne
- Nosocomial



Modes of Transmission

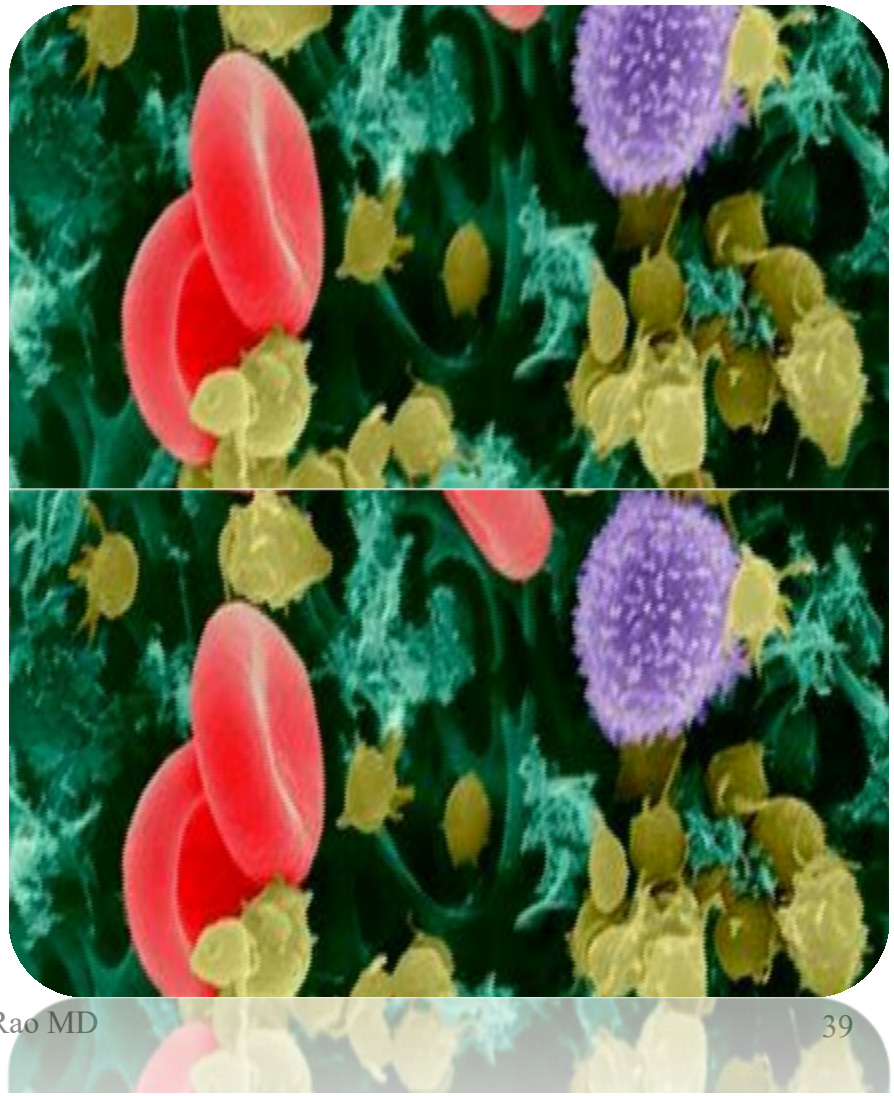
Direct transmission	Indirect transmission
Direct contact	Airborne
Droplet spread	Vehicle borne
	Vector borne

Virulence and Pathogenicity

- **Pathogenicity:** capacity of microbes to cause disease
- **Virulence:** degree of pathogenicity of specific microbe
  - **Based on:**
    - Invasive qualities
    - Toxic qualities
    - Presence of pili or fimbriae for adhesion
    - Ability to avoid host defenses (mutate)

Virulence Factors and Toxins

- State of the Host Immune System
- Number of Pathogenic Cells encountered by the Host
  - **Infectious Dose**

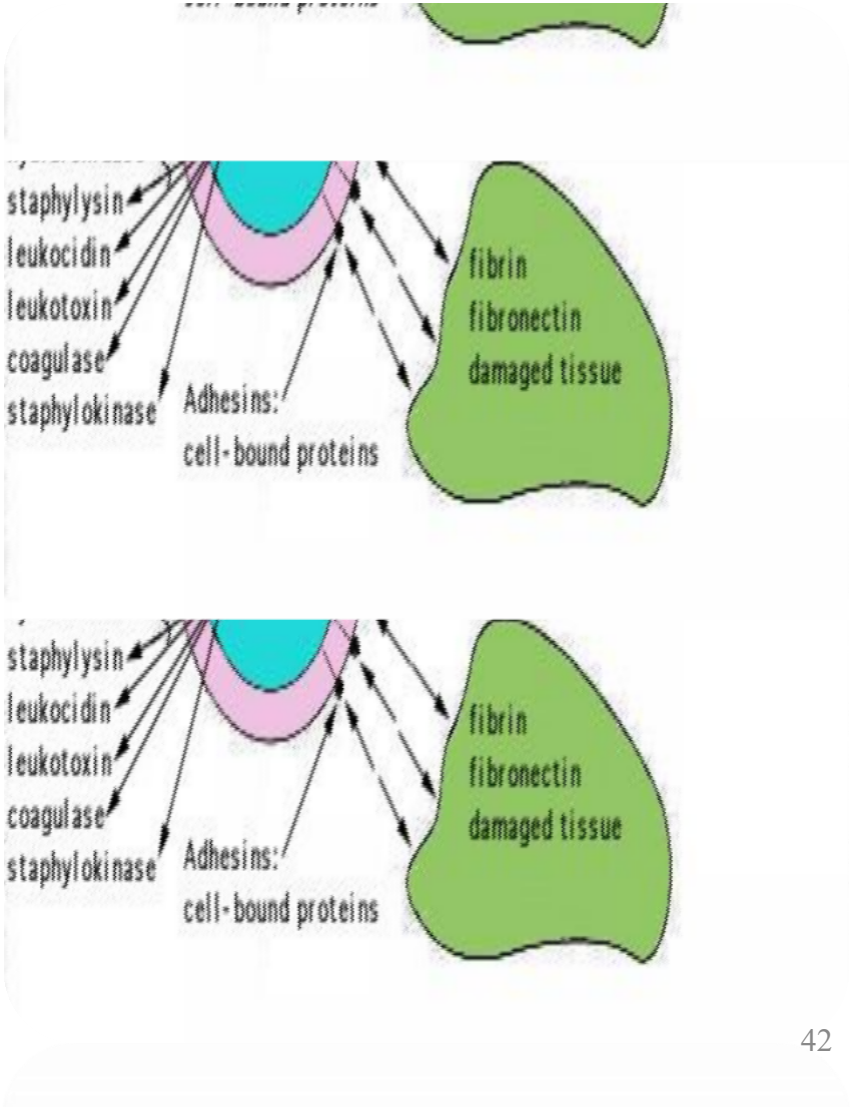


Virulence Factors and Toxins

- Enzymatic Virulence Factors
  - Examples:
    - Coagulase (*Staphylococcus aureus*)
    - Streptokinase (*Streptococcus pyogenes*)
    - Hyaluronidase (Many pathogens)
    - Collagenase (Many pathogens)
    - Leukocidin (Many pathogens)
    - Hemolysin (Many pathogens)

Virulence Factors and Toxins

- Adhesion Factors
  - Examples:
    - Protein A (*Staphylococcus aureus*)
    - Protein M (*Streptococcus pyogenes*)



Virulence Factors and Toxins

- **Exotoxins**
  - A type of bacterial toxin with the following properties:
    - May be produced by either gram-positive or gram-negative bacteria
    - Is secreted by the bacteria
    - The action of the exotoxin does not necessarily require the presence of the bacteria in the host
    - Most exotoxins are peptide or protein
    - Most exotoxins are heat sensitive (exception: enterotoxin of *Staphylococcus aureus*)

Virulence Factors and Toxins

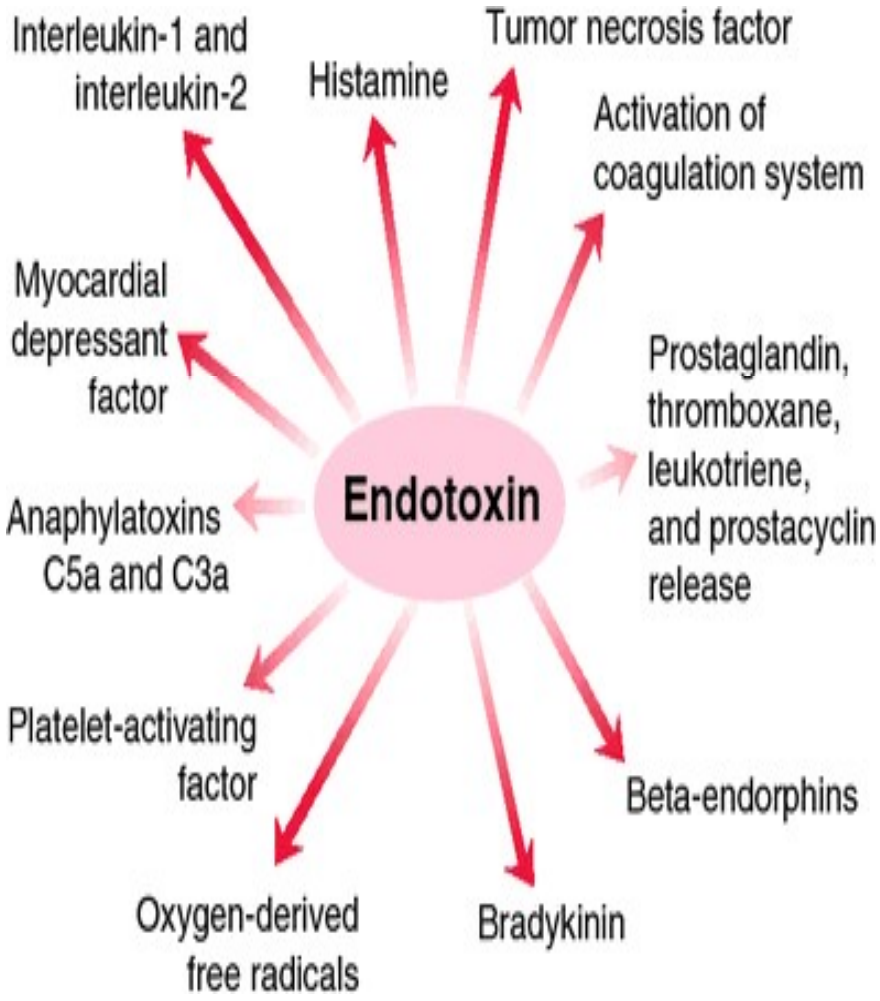
- **Exotoxins (cont.)**
  - Classes of exotoxins: Neurotoxic, cytotoxic, or enterotoxic exotoxins
    - Neurotoxins: Interfere with proper synaptic transmissions in neurons
    - Cytotoxins: Inhibit specific cellular activities, such as protein synthesis
    - Enterotoxins: Interfere with water reabsorption in the large intestine; irritate the lining of the gastrointestinal tract

Virulence Factors and Toxins

- **Endotoxins**
  - A type of bacterial toxin having the following properties:
    - Produced only by gram-negative bacteria
    - Endotoxins are a component of the gram-negative cell wall
    - The action of endotoxin requires the presence of the bacteria in the host. The endotoxin may be released from the cell wall as the cells die and disintegrate

Virulence Factors and Toxins

- **Endotoxins (cont.)**
  - Endotoxin is composed of Lipid A: Part of the lipopolysaccharide layer
  - Mode of action: Irritation/inflammation of epithelium, GI irritation, capillary/blood vessel inflammation, hemorrhaging



Development of Infection: Diagnostic Tests

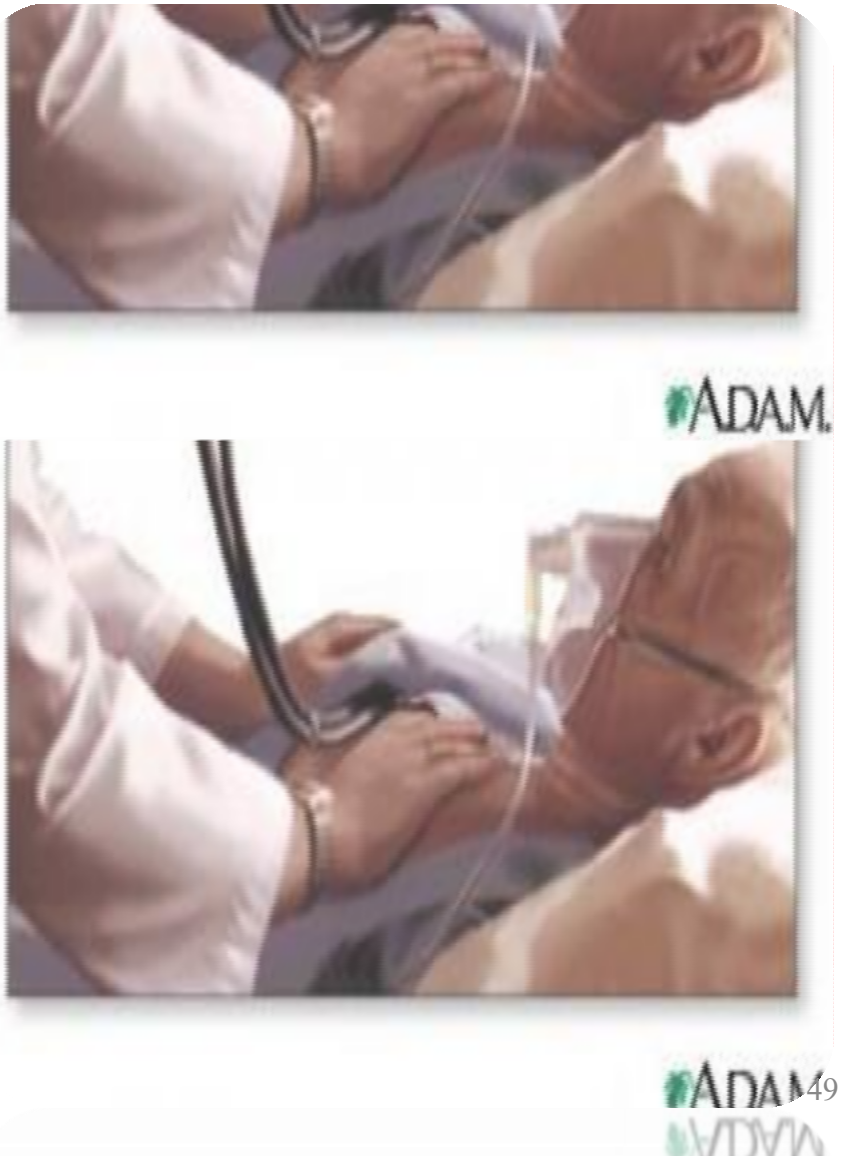
- **Cultures and stains**
  - bacteria
- Blood tests
  - Bacteria
    - Leukocytosis
  - Virus
    - Leukopenia
  - Increase in neutrophils w/ acute; increase in lymphocytes and monocytes w/ chronic
- **Radiologic exams**

Steps to Minimize Risk of Infection

- Locate, remove reservoir host
- Block portal exit of microbes from reservoir
- Know mode(s) of transmission of specific infections
- Block portals of entry
- Cleaning
- Sterilization
- Disinfectants
- Antiseptics

Hospital acquired infections

- Infection which was neither present nor incubating at the time of admission
- Includes infection which only becomes apparent after discharge from hospital but which was acquired during hospitalisation (Rcn, 1995)
- Also called nosocomial infection



HOSPITAL GENERAL STATISTICAL FORM.

This Sheet will serve for the Classification of Cases in Hospitals under the following headings:—"Remaining, 1st January"—"Admitted"—"Cured (or Relieved)"—"Dead"—"Discharged incurable, for Irregularities, or at their own Request"—"Remaining, 31st December"—"Duration of Cases in Days."

Write the Name of Hospital, the Sex, the required Heading, and Date, with the Pen.

Ages	Months. 0	3	6	1	2	3	4	5	10	15	20	25	30
CLASS I.—Order I. (Zymotic Diseases.)													
1. Small Pox													
Measles													
Whooping Cough													
Croup													
Scarlatina													
Quinsy													
Diphtheria													
Coryza, Catarrh, Influenza													
Ophthalmia (purulent)													
Erysipelas													
Metria (puerperal Fever)													
Pyæmia													
Hospital gangrene													
Carbuncle, Boil													
Dysentery													
Diarrhœa													
Cholera													
Typhoid Fever (typhia)													
Typhus													
Relapsing Fever (typhinia)													
Ague													
Remittent Fever													
Rheumatism													
Others													

The very first requirement in a hospital is that it should do the sick no harm

Order II.

Scrofula
Tuberculosis Mesenterica

the diseases in
marginal list
frequent occur-
itals; and all
ceptions, are
"Others" in
orders in the
ns. They will
d in abstract-
s by writing
persons ab-
or dead, &c.,
rticular dis-
ases below.
ons aged 15
dmitted for
indicated in
his sheet by
"Others" of
I.; and his
be written
ipe" in the
so of other
diseases not
in the mar-
written in
partments.
the facts is
uld be given
to the gene-

I.
I.

with abscess
(placed to

ER II.
(Greek elephan-

glanders
hydrophobia
malignant pustule
pecuia*
* *Infection by punc-
ture in dissection
or by handling the
parts of dead ani-
mals*

Order III.

rickets
bronchocele
cretinism
ergotism

Order IV.

Modes of spread

Two sources of infection:

- Endogenous or self-infection - organisms which are harmless in one site can be pathogenic when transferred to another site e.g., E. coli
- Exogenous or cross-infection - organisms transmitted from another source e.g., nurse, doctor, other patient, environment (Peto, 1998)

1st principle of infection prévention

at least 35-50% of all nosocomial infections are associated with patient care practices:

- Use and care of urinary catheters
- Use and care of vascular access lines
- Therapy and support of pulmonary functions
- Experience with surgical procedures
- Hand hygiene and standard precautions

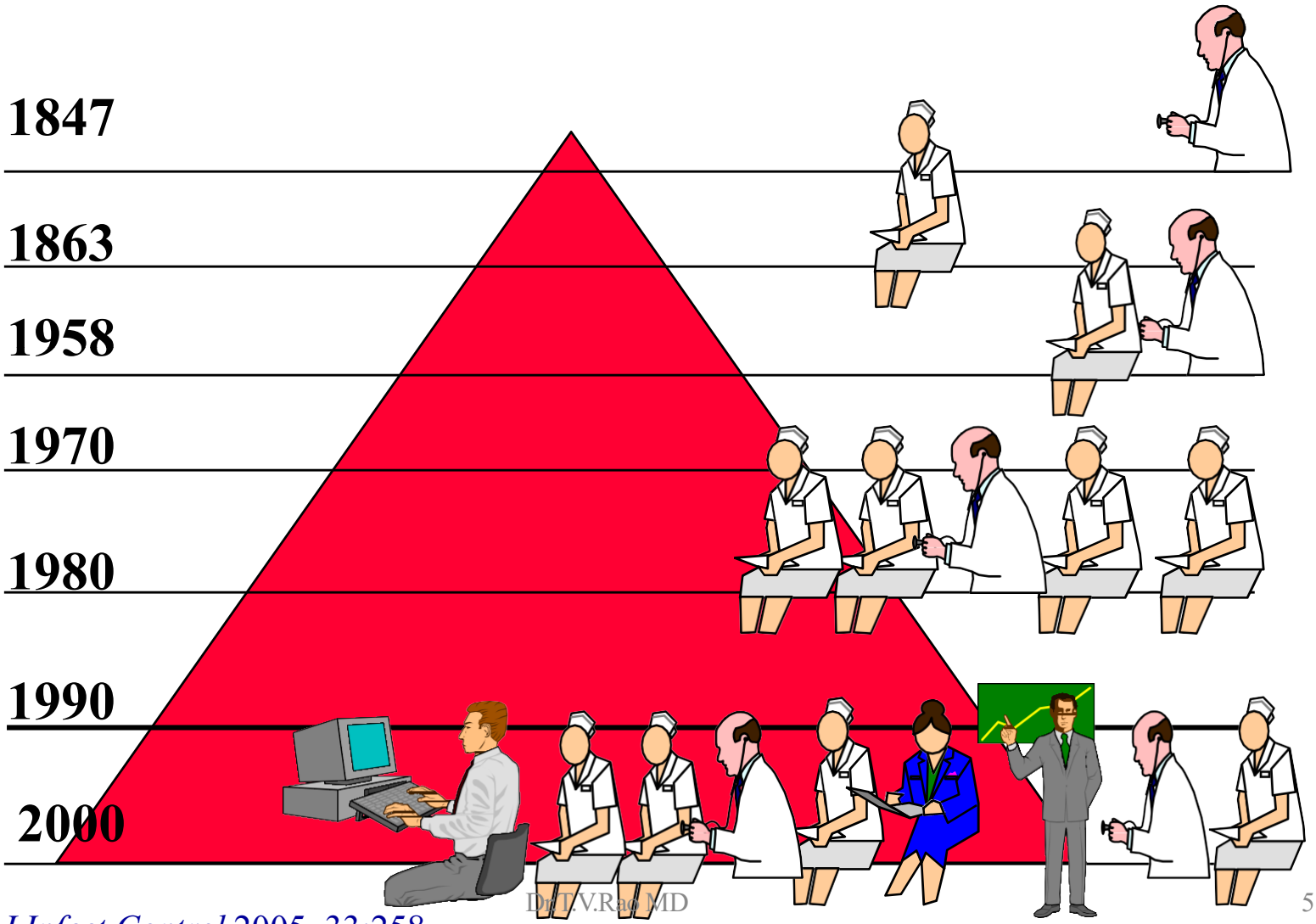
Basic steps in Prevention of Infection

- There are possible treatment and prevention to stop the infection cycle. This is through adequate hygiene, sanitary environment maintenance and health education.

Antimicrobial agents In Infection

- Anti-infective drugs such as antibiotics, antiviral, antifungal and ant tubercular drugs suppress infection. It can be administered by mouth, topically or intravenously depending on the infection extent and severity. Sometimes, if drug resistance is known, multiple drugs are used to stop drug resistance and increase drug effectiveness. Antibiotics only work for bacterial infection and have no effect on viral ones.

Multidisciplinary team approach



Pittet D, *Am J Infect Control* 2005, 33:258

THANK YOU