Host Parasite Relationship and Sources of infections

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Objectives

- Definitions
- Different host-parasite relationships
- Pathogenesis
  - Source of infection
  - Mode of transmission
  - Route of entry
  - Virulent factors
  - Body’s defence

Definition of host and parasite

- Host - macroorganism, usually multicellular
  phylogenetically higher level
  usually an eukaryote (animal, plant)
  able to exist independently

- Parasite- Living on/in the host → damages → may cause disease
  Microorganisms
  obtaining necessities of life from the host
  prokaryote/ eukaryote

CLASSIFICATION OF MICROORGANISMS

Protista

Vira

DNA-viruses and RNA-viruses

Eukaryotes

Fungi

Algae

Protozoa

Slime moulds

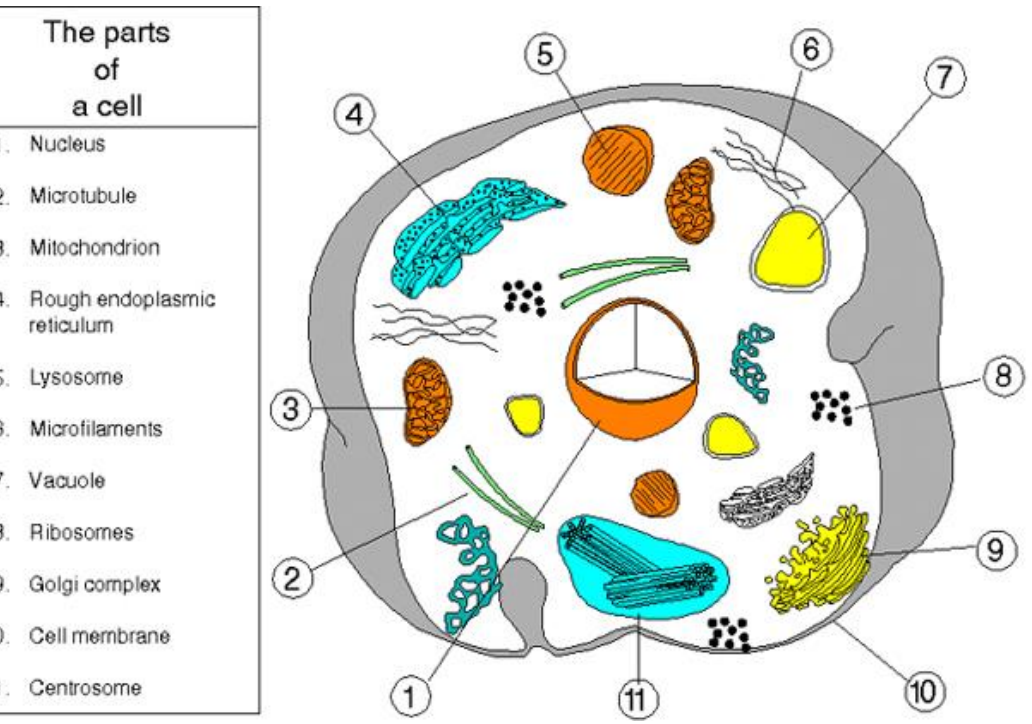
Prokaryotes

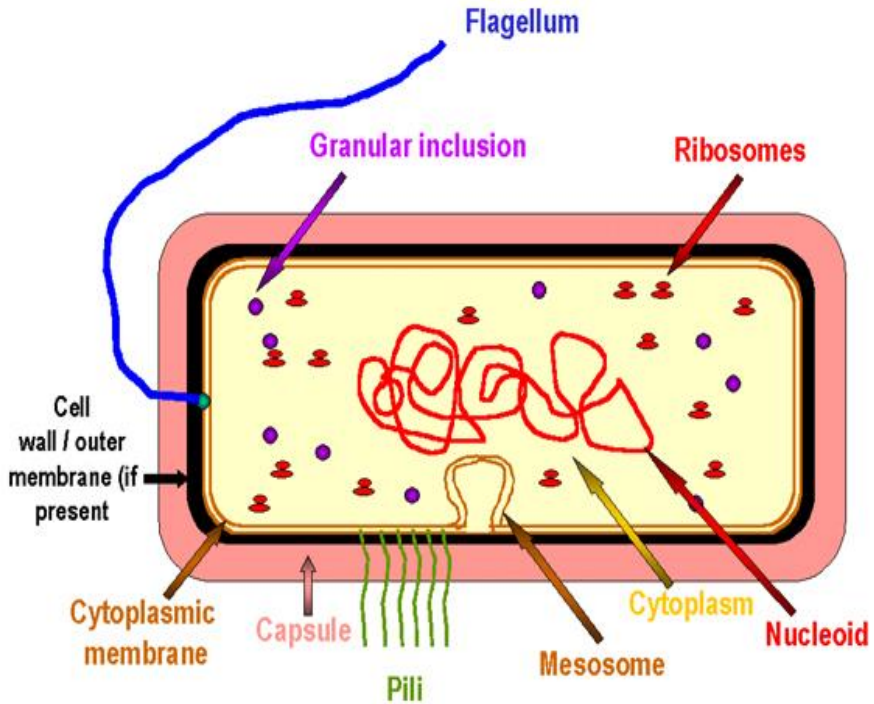
Blue-green algae

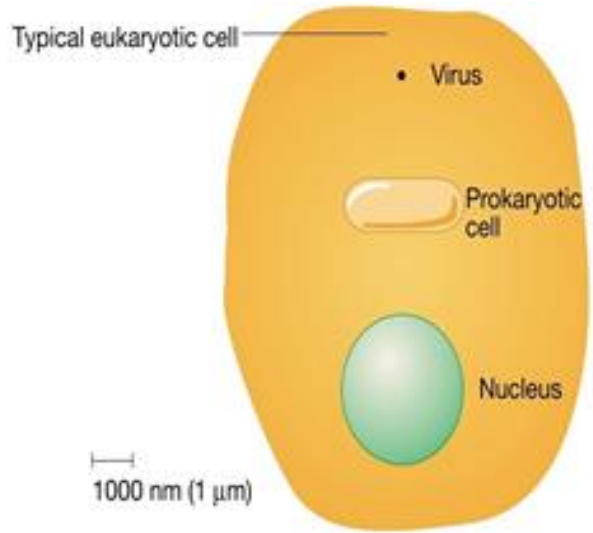
Bacteria

Saprophytes (free living in environment)
or Parasites

Eukaryotes Vs *Prokaryotes*







Different Relationships

- **Symbiosis:** living together in more or less intimate association or close union of two dissimilar organisms

  (macro- and microorganism live together)

  1. **Mutualism:** advantageous for both (reciprocal benefit)

  2. **Commensalism:** one benefits and the other is not significantly harmed or helped

  3. **Parasitism:** one member benefits while the other is harmed

     damages to macro-organisms by the microorganism (pathogens) → disease of the host

     - endoparasites - live within the host's body
     - ectoparasites - live on host's surfaces

Commensalism and mutualism in human as host

- **Normal microbial flora** on skin and mucous membranes, in gut and vagina → colonisation
  - **host cell : microbe cell number = 1:10**
  - no entry, no penetration, no colonization inside cells, tissues, organs

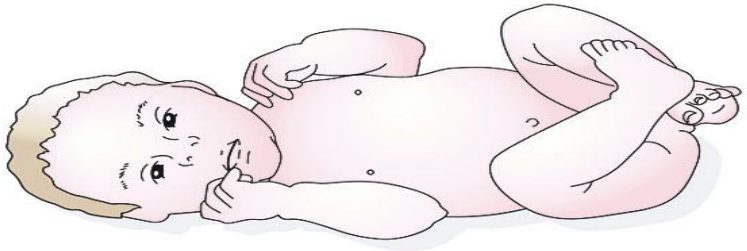
  Ex : bacteria, microscopic fungi - are found as normal flora

  protozoa and helminths - are not found as normal flora

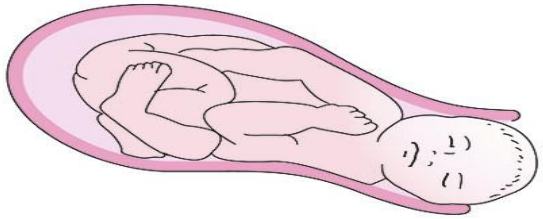
  viruses – not found as normal flora, but latent viruses can be shed without symptoms

  Human endogenous retroviruses - SDL

Introduction of a flora

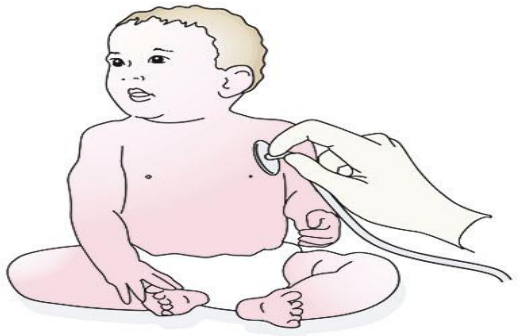


During passage through the birth canal

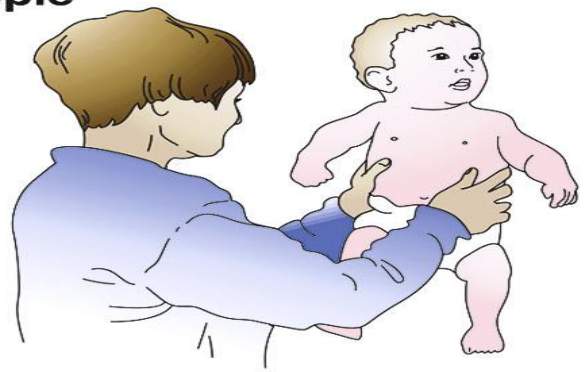


By contact with feeding materials

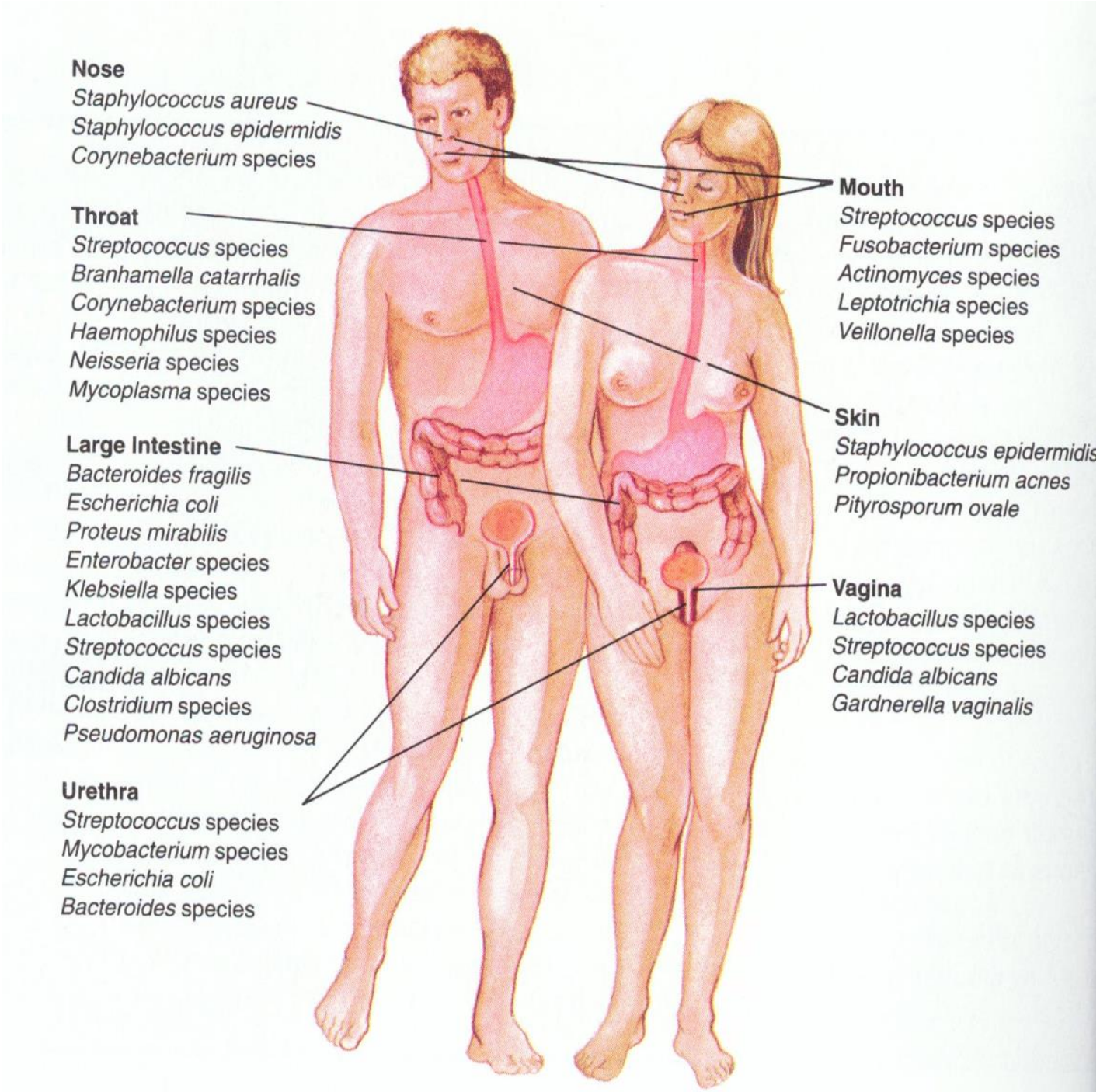
By contact with instruments



By contact with other people



During nursing


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
Enterobacter species
Klebsiella species
Lactobacillus species
Streptococcus species
Candida albicans
Clostridium species
Pseudomonas aeruginosa
Urethra
Streptococcus species
Mycobacterium species
Escherichia coli
Bacteroides 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

Advantages of commensalism/mutualism

- For microorganisms
  - shelter and food
  - colonization, but no entry (penetration) into tissues

- For the host (human)
  - to prevent colonization of harmful microbes (parasites)
    - Occupying surface and cell receptors
    - Producing antimicrobial compounds
  - Processing/degrading food components
    - Producing useful metabolites (vitamin K or B12)

Parasite microorganisms in human host

- By pathogenic mechanisms → damage host cells/ tissues → disease in host

- Entry → attachment → multiplication → invasion → dissemination

  (pathogenesis)

Types of parasitism

- **Obligate parasites:** in defined host (range of hosts)
  - always pathogenic, never found in the normal flora

- **Facultative parasites:**
  - depending on the condition of both host and microbe and presence of predisposing/ risk factors in host
  - Members of the normal flora

- **Opportunistic parasites:**
  - not pathogenic in normal healthy people
  - take advantage in case of host disorders (usually immunosuppression)
  - Normal flora/ saprophytes

Predisposing/risk factors for pathogens

- **For facultative parasites**
  - Physical/mental stress
  - acute diseases, wounds, burns
  - chronic debilitating conditions (diabetes, alcoholism)
  - urinary tract obstruction (Ex. calculi)
  - Medical interventions
  - Nosocomial infections

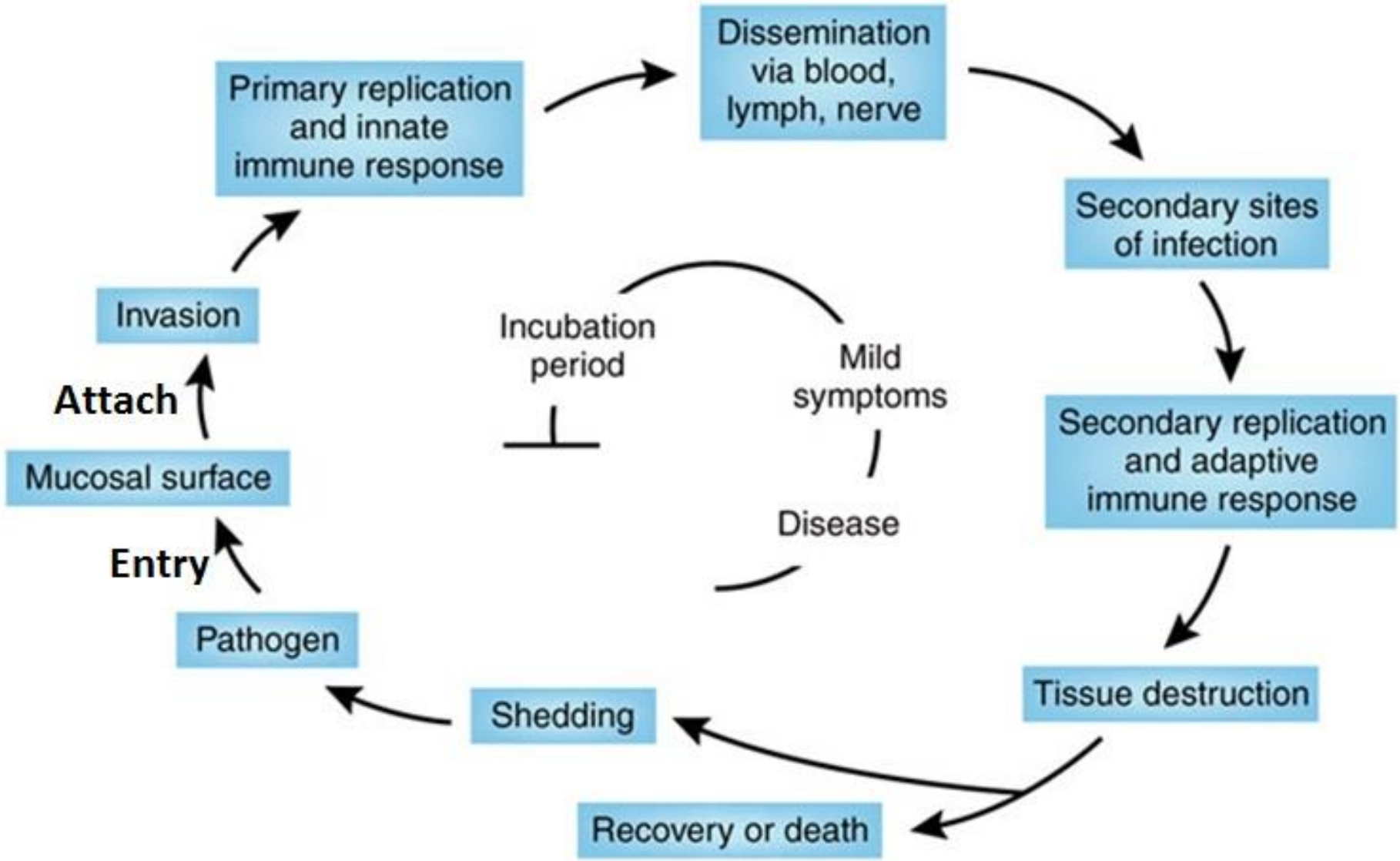
- **For opportunistic parasites**
  - Physiological immune deficiencies (newborn, elderly)
  - Primary immune deficiencies (congenital)
  - Acquired immune deficiencies (infections, medications, tumors)

Characteristics of Parasitism

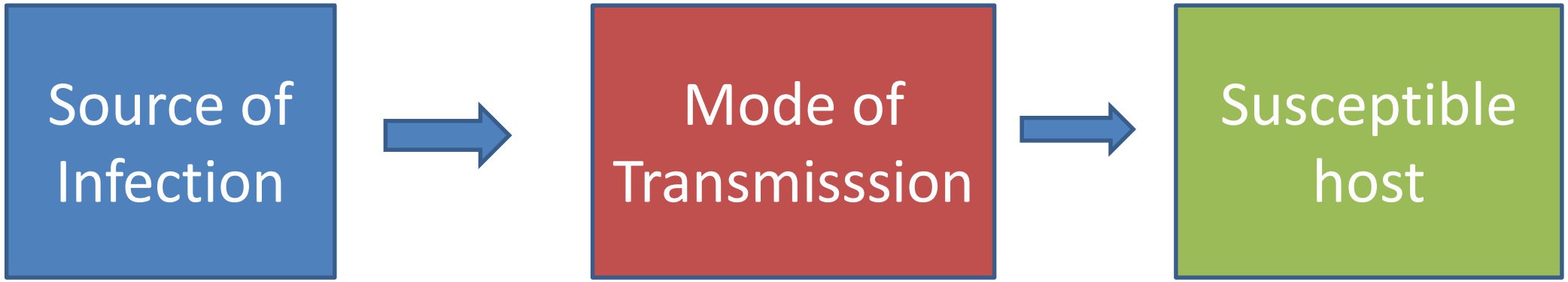
- Encounter: agent meets host
- Entry: agent enters host
- Spread: agent spreads
- Multiplication: agent multiplies
- Damage: agent, host response, or both
- Outcome: agent or host wins, or coexist

  - ❖ Pathogenesis

Pathogenesis



Pathogenesis



Source of Infection

- It is defined as the person, animal, object or substance from which an infectious agent passes or is disseminated to the host

Source of Infection

- **origin** from which a **host** acquires the infection
  - Exogenous – from outside
    - Humans
    - Animals/ vectors
    - Objects
      - Food, water, Contaminated medical equipment, contaminated surfaces, soil
  - Endogenous – from own flora

SOURCES OF INFECTION

- Human Beings
  - Patients
  - Carriers
    - Healthy
    - Convalescent
    - Temporary
    - Chronic
    - Contact
- Animals
  - Zoonosis
  - Reservoir
- Insects
  - Mechanical
  - Biological
- Objects
  - Soil & Water
  - Food
  - Contaminated equipment/ surfaces

Humans as a source

- Case/ patient (having a overt disease)
  - Clinical case (with symptoms)
  - Subclinical case (without symptoms)
  - Carriers (continue to harbor and shed the pathogens)
    - Incubatory carriers
      - Shed during incubation period (Ex. Measles)
    - Convalescent carriers
      - Shed during convalescent period (Ex typhoid)
    - Healthy carriers
      - Carrier state without suffering from overt disease, but shed (Ex. Meningococcal meningitis)
    - Temporary/ chronic carriers

Features of a Carrier

1. Presence of specific microbes in the body
2. Absence of apparent symptoms and signs
3. Shedding of micro-organisms in the discharges or excretions
4. As a source of infection to others

Animals/ Insects as a source

- ***Zoonosis***
  - Infectious diseases transmitted from animals to man
  - Bacterial , rickettsial, viral, fungal, protozoal, helminths

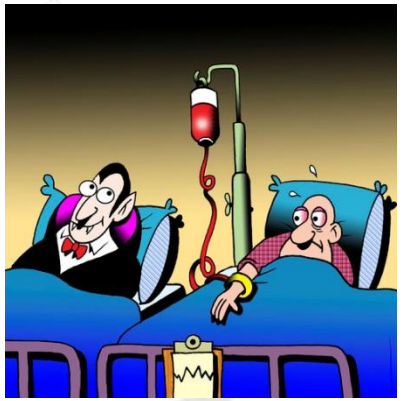
- Mechanical vectors
- Biological vectors
- Reservoir
  - Some animals and insects can harbor organisms and act as reservoir of infection
  - Lives,multiplies and transmitted to a susceptible host

Objects as a source

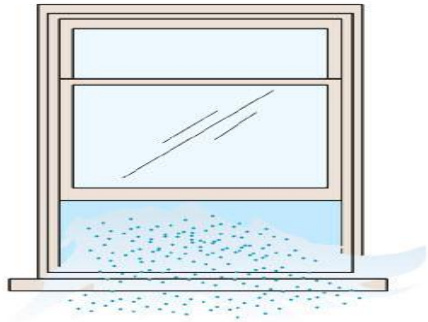
- Soil
- Water
- Food
- Medical devices
  - HAI
- Surfaces
  - HAI

Mode of Transmission of Infectious Diseases

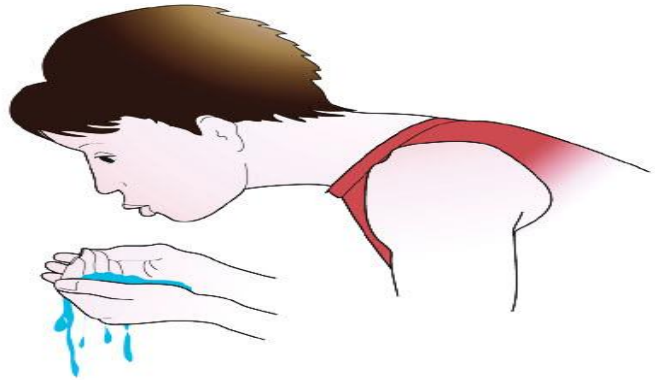
- Inhalation – ex: RTI (pneumonia)
- Ingestion (faeco-oral)– ex: gastroenteritis
  - – Food borne – food poisonong
  - – Water borne – Hepatitis A
- Contact – ex: chickenpox
- Blood transfusion/ body fluids – ex: Hep B, HIV
- Sexual contact – ex: gonorrhoea, Hep B
- Transplacental (mother to foetus) - rubella, CMV
- Vectors – ex: Dengue
- Iatrogenic/ lab acquired



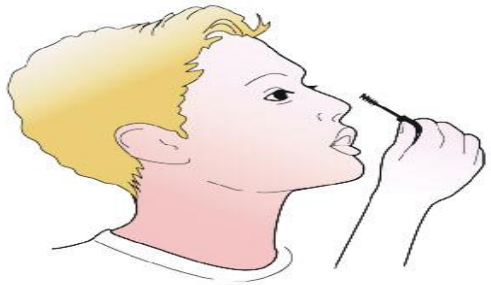
By respiratory droplets



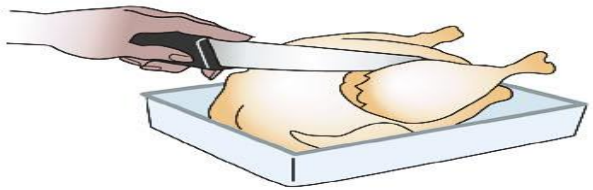
By dust



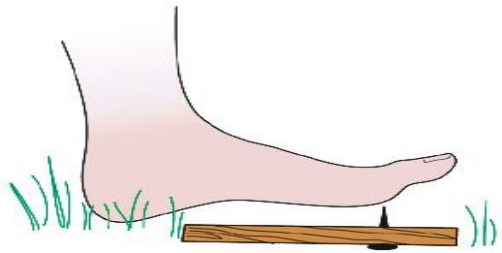
By contaminated water



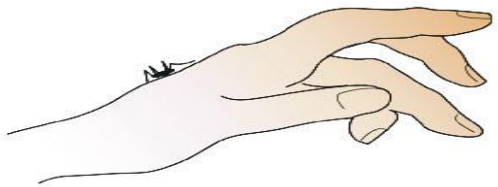
By contact with contaminated objects



By contaminated food



By injection of contaminated soil



By arthropod bites

By contact with animals

Portal of entry

- Respiratory Tract - most common portal
- Gastrointestinal - via food, water contaminated fingers
- Penetration through skin
- Parenteral Route
- Genitourinary tract
- Multiple portals of entry
  - Tuberculosis - respiratory droplets, food & milk, wounds

Pathogenicity/ virulence factors

- Attachment
- Invasion
- Toxin production
- Multiplication and spread

Body's response

- By immune system
  - Barriers, Cells, Tissues, Secretions
  - Prevent entry of microorganisms
  - failing that, to seek out and destroy them
- Microorganisms have various mechanisms to evade the immune response

Characters of pathogens

- Bacteria should be able **to enter** the body.
- Organism should be able **to multiply** in the tissue.
- They should be able **to damage** the tissue.
- They must be capable **to resist** the host defense.

Stages of infectious disease

- ***Incubation period*** – no symptoms.
- ***Prodromal period*** – mild and generalized symptoms (fever, weakness, headache).
- ***Invasive stage*** – symptoms specific to the disease.
- ***Decline stage*** – symptoms subside.
- ***Convalescence*** – no symptoms, health returns to normal.

Other terms/ types of infections

- Bacteraemia/ Viraemia/ fungaemia
- Septicaemia
- Localized/superficial/ generalized/ deep seated/ disseminated
- Primary/ reinfection/ superinfection/ secondary/ atypical
- Community acquired/ hospital acquired
- Endemic/ Epidemic/Pandemic/ Outbreak

Summary

- Definitions
- Different host-parasite relationships
- Pathogenesis
  - Source of infection
  - Mode of transmission
  - Route of entry
  - Virulent factors
  - Body’s defence

References

- **Demystified . . . Human endogenous retroviruses;**P N Nelson, P R Carnegie,J Martin
- **Infectious diseases epidemiology**;Mauricio L Barreto, Maria Glória Teixeira, and Eduardo Hage Carmo; J Epidemiol Community Health 2006 Mar; 60(3): 192–195