

# Classification of Bacteria & Normal Flora

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# Classification of Bacteria

Bacteria can be classified on the basis of :

1. Nature of cell wall
2. Staining characteristics
3. Ability to grow in presence or absence of oxygen
4. Spore formation

# Classification of Bacteria

- Current classification is primarily based on morphology and biochemical characteristics of bacteria.
- Initial criteria used is the structure of cell wall i.e. it is rigid, flexible or not.
  - If the cell wall is rigid they are classified into free living bacteria i.e. they can grow on lab medium.

- Non free living bacteria – which are obligate intracellular parasites and only live in human or animal cells.
- Free living are further subdivided for shape and staining reactions into gram positive cocci, gram negative cocci and rods, with different oxygen needs & spore forming ability.

# Flexible Bacteria

- Flexible bacteria – can be with thin wall (e.g Spirocahetes) and without cell wall (Mycoplasma).
- On the basis of bio-chemical reactions bacteria can be classified into separate genus and species.
- Current criterion is the base sequence of DNA genome.
- Several bacteria have been re-classified on this basis.

- DNA sequencing has revealed different classification of bacteria, previously classified into other genus.
- *Pseudomonas cepacia* has now been re-classified as *Burkholderia cepacia* because the base sequence of DNA was found to be significantly different from the DNA of the members of genus of *pseudomonas*.

# Normal Flora

## Introduction

- Normal flora is the term used to describe various bacteria or fungi, which are permanent residents of certain body sites like skin, mouth, colon.
- Viruses and parasites are usually not included in this category.
- Normal flora are also referred to as commensals i.e. they derive benefit from the host but do not damage it.

- Members of the normal flora are low virulence organisms.
  - They are nonpathogenic in their normal anatomical sites and if they leave that site they can cause the disease in immuno-compromised persons.
  - Normal flora vary both in number and kind from each other. Internal body organisms e.g. CNS, blood, bronchi, liver, spleen, kidney, heart and bladder are usually sterile while other body areas show the presence of normal flora.
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# Important Terminologies

## **Carrier State:**

- This term implies when a person harbors a potential pathogen and can be a source of infection to others. (Typhoid Marry)

## **Colonization:**

- Is the acquisition of new organisms. It can cause the disease or can get eliminated by host defense. The colonizer can transmit the organisms to others i.e. reservoir of infection.
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# Normal Flora

- Members of normal flora can play role in health maintenance or cause disease in three ways:
  - Basically the organisms are non pathogenic in their usual anatomical locations but can be pathogenic in other parts of the body like Immuno-compromised and debilitated persons.

- Protective host defense mechanism is constituted by normal flora by colonization resistance which limits the growth of pathogens.

When normal flora is suppressed, pathogens grow and produce the disease e.g. antibiotics reduce the normal colonic flora and allow clostridium difficile to overgrow which is resistant to antibiotics.

- Intestinal bacteria produces vitamin B & K. Normal flora serves a nutritional function. The patients who are poorly nourished and treated with oral antibiotics can have deficiency of these vitamins.

# Skin Normal Flora

- Staph. epiderimidis is the most predominant bacteria on skin which can involve artificial heart valves and joint prosthesis.
- Population of organisms is  $10^3$ - $10^4$  per cm square
- It is located on stratum corneum layer of skin which is superficial and in hair follicles.
- Anaerobic skin organisms are peptococcus. Proprini bacterium (acne) are located in deeper follicles in the dermis.

- Yeast (*Candida albicans*) is also present on skin which can enter the blood stream and cause disease in IV catheters and drug users.
- It is important cause of systemic infections in decreased cell immunity patients.

# Respiratory tract Normal Flora

- Mouth, nose, throat is the site of colonization of many organisms.
- Nose is colonized by staphylococcus aureus and streptococcus which result in occasional outbreaks in newborn nursery.
- Throat contains mixture of viridans streptococcus, Neisseria species and staph. epidermidis.

- These non pathogenic organisms occupy the attachment sites on pharyngial mucosa and limit growth of pathogenic organisms.
- Mouth has big population of viridans streptococcus.
- Strept. mutans causes dental plaque leading to caries teeth. This produces large amounts of acid which demineralizes the enamel and initiate caries.
- Viridans strept is the leading cause of subacute bacterial endocarditis after dental surgery.



- *Eikenella corrodens* causes skin and soft tissue infections with human bite and clenched fist injuries.
- Anaerobic bacteria like bacteroides, prevotella, fusobacterium, clostridium, peptostreptococcus are found in cervices of gums. These organism can cause lung abscess in poor dental hygiene and debilitated patients.
- *Actinomyces israelii* can cause abscess of jaw, lungs, abdomen.

# Intestinal tract Normal Flora

- Stomach contains very few organisms due to acidity. Small intestine has small number of streptococcus, lactobacilli and yeast.
- Large amount of these organisms are found in terminal ileum
- Colon is the major location for bacteria in GIT.
- About 20% feces consist of bacteria, 90% beings the anaerobes especially bacteroides fragilis. Most abundant facultative bacteria is E.coli.

- Normal gut flora plays significant role in extra intestinal diseases e.g. E.coli causing UTI and B.fragilis causing peritonitis.
- Other anaerobic bacteria are fusobacterium, peptostreptococcus, enterococcus faecalis (UTI and endocarditis) and pseudomonas aeruginosa (hospital acquired infections).

- Antibiotics like clindamycin can suppress the normal flora and allow rare toxin producing organism to grow and cause the disease.
- Neomycin used to sterilize gut can also reduce the normal flora population.

# Genito urinary tract normal flora

- Adult women have lactobacillus species responsible for acid production and low pH.
- pH increases in menopause and before puberty due to rare presence of lactobacillus which prevents the growth of potential pathogens.
- Use of antibiotics results in growth of candida species leading to candida vaginitis.

- Colonization of vagina can occur due to close approximate of anus by faecal flora e.g. E.coli and enterococci.
- 15% -20% women carry group B streptococcus in vagina during the child bearing age.
- Vagina can also be colonized by staph.aureus in about 5% women leading to toxic shock syndrome

- Urine is sterile in healthy persons but can be contaminated by staph.epidermidis, coliform, diphtheroids and nonhemolytic streptococci.
- Mycobacterium smegmatis can contaminate area around urethra of women and uncircumcised men.
- Staph.saprophyticus can cause UTI by contamination of skin surrounding genito urinary tract.