

**Commensal  
and  
Pathogenic  
Microbial Flora  
in Humans**

- Medical microbiology is the study of interactions between humans and microorganisms such as bacteria, viruses, fungi and parasites.
- Although the primary interest is in diseases caused by these interactions, it must be also appreciated that microorganisms play a critical role in human survival.
- The normal microflora participates in the metabolism of food products, provides essential growth factors, protects against infections with highly virulent bacteria, and stimulates the immune system.
- In the absence of bacterial microflora, life as we know it would be impossible.

- The microbial flora is determined by a variety of factors:
  - age
  - diet
  - hormonal state
  - health
  - personal hygiene
- The human fetus lives in a protected, sterile environment, the newborn is exposed to microbes from the mother and environment.
- The infant's skin is colonized first, followed by the oropharynx, gastrointestinal tract, and other mucosal surfaces.

- Throughout the life of an individual, the microbial population continues to change.
- For example, hospitalization can lead to the replacement of normally avirulent bacteria in the oropharynx with gram-negative rods, e.g. *Pseudomonas aeruginosa* or *Klebsiella pneumoniae*, that can invade the lungs and cause pneumonia.
- The growth of *Clostridium difficile* in the gastrointestinal tract is controlled by the other bacteria present in the intestines. In the presence of antibiotics, normal (susceptible) bacteria are eliminated and *C. difficile* is able to proliferate and produce gastrointestinal disease.

## Exposure of an individual to bacteria can lead to one of three outcomes:

- The bacteria can transiently colonize the person.
- The bacteria can permanently colonize the person.
- The bacteria can produce disease.

- It is important to understand the distinction between colonization and disease.
- Some medical workers use the term infection inappropriately as a synonym for both terms.

- An understanding of medical microbiology requires knowledge not only of the different classes of bacteria but also of their propensity for causing disease.
- Strict pathogens:
  - *Mycobacterium tuberculosis*,  
*Neisseria gonorrhoeae*, *Francisella tularensis*,  
*Plasmodium* spp., rabies virus
- Opportunistic pathogens:
  - e.g. bacteria that are typically members of the human 's normal microflora (*Staphylococcus aureus*, *Escherichia coli* and other)

# Mouth, oropharynx, nasopharynx

- The upper respiratory tract is colonized with numerous bacteria, with 10 to 100 anaerobes for every aerobic bacterium.
- The most common anaerobic bacteria are *Peptostreptococcus*, *Veillonella*, *Actinomyces* and *Fusobacterium* species.
- The most common aerobic bacteria are *Streptococcus*, *Haemophilus* and *Neisseria* species.



# Ear

- The most common microorganism colonizing the outer ear is coagulase-negative *Staphylococcus* species.

# Eye

- The surface of the eye is colonized with coagulase-negative staphylococci as well as rare numbers of bacteria found in the nasopharynx (e.g. *Haemophilus* sp., *Neisseria* sp. and viridans streptococci).

# Lower respiratory tract

- The larynx, trachea, bronchioles and lower airways are generally sterile, although transient colonization with secretions of the upper respiratory tract may occur after aspiration.

# Gastrointestinal tract

- The gastrointestinal tract is colonized with microbes at birth and remains the home for a diverse population of microorganisms throughout the life of the host.
- Although the opportunity for colonization with new bacteria occurs daily with the ingestion of food and water, the population remains relatively constant.
- Some factors can lead to change of normal microflora, e.g. using of antibiotics.

# Genitourinary tract

- In general, the anterior urethra and vagina are the only anatomic areas of the genitourinary tract system permanently colonized with microbes.
- Although the urinary bladder can be transiently colonized with bacteria migrating upstream from the urethra, these should be cleared rapidly by the bactericidal activity of the uroepithelial cells and flushing action of voided urine.
- The other structures of the urinary system should be sterile except when disease or an anatomic abnormality is present.

# Skin

- Although many microorganisms come into contact with skin surface, this relatively hostile environment does not support the survival of most bacteria.
- Gram-positive bacteria (e.g. coagulase-negative staphylococci and, less commonly, *Staphylococcus aureus*, corynebacteria and propionibacteria) are the most common microorganisms found on the skin surface.
- Gram-negative bacteria do not permanently colonize the skin surface, because the skin is too dry.