



Microbiology 1

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Microbiota

• Microbiota:

- Is an "ecological community of commensal, symbiotic and pathogenic microorganisms" found in and on all multicellular organisms studied to date from plants to animals.
- **Microbiome:** describe either the collective genomes of the microorganisms that reside in an environmental or the microorganisms themselves.

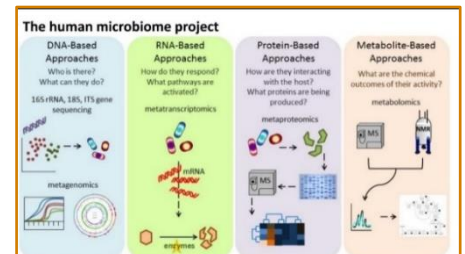
• The clinical importance of study microbiota:

- Describe the composition and *diversity* of human microbiota
- Explain the *role* of microbiota in health
- Identify the impact of *dysbiosis* on disease
- Explore *factors* influencing microbiota composition



• Human Microbiome Project

- **Objective:** Investigate the role of microbial ecosystems in human health and disease.
- **Initiation:** Launched by the NIH in 2007.
- **Focus Areas:**
 - ✓ Diversity of the human microbiome.
 - ✓ Factors affecting microbial distribution and evolution.
- **Research Techniques:**
 - ✓ 16S rRNA Gene Sequencing: Primary method for studying microbial communities.
 - ✓ Mass Spectrometry: Additional analytical tool.
 - ✓ Culturing Challenges: Difficulties in culturing microbes may lead to incomplete data.
- **Research Questions:**
 - ✓ Stability and resilience of an individual's microbiota over time.
 - ✓ Similarity of microbiomes within families and communities.
 - ✓ Presence of a "core" microbiome among all humans and its modes of acquisition.
 - ✓ Impact of genetic diversity on microbial adaptation and host health.



• Skin Microbiota

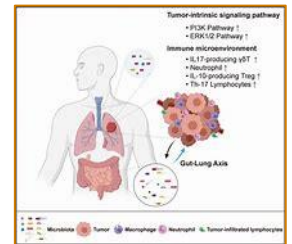
- **Harsh Environment:** The skin presents a **challenging habitat** for microorganisms, characterized by dryness, low nutrient availability, acidity, fatty acids from sebaceous secretions, and the presence of antimicrobial substances like lysozyme and peptides.
- **Diversity:** Despite these conditions, the skin is home to a diverse microbiota, including both transient and resident microorganisms.
- **Resident Flora:** The skin features a stable resident microbiota that varies across different anatomical areas, influenced by factors such as secretions, clothing, and proximity to mucous membranes (e.g., mouth, nose, perineal regions).
- **Predominant Microorganisms:**
 - ✓ Diphtheroid Bacilli: Includes genera like *Corynebacterium* and *Propionibacterium*.
 - ✓ Staphylococci: Nonhemolytic aerobic and anaerobic species, such as *Staphylococcus epidermidis* and other coagulase-negative staphylococci.
- **Role in Immunity:** The skin microbiota plays a crucial role in protecting against pathogenic bacteria. Disruption of the skin barrier can lead to infections that may involve these resident microorganisms.

- **Gut Microbiota**

- **Complexity:** The human gut hosts the most complex microbiota among non-sterile body cavities, significantly influencing host homeostasis and immune balance, which are vital for health.
- **Diversity:** The gut microbiota is highly diverse and varies greatly between individuals.
- **Influencing Factors:**
 - ✓ Host Genetics
 - ✓ Gender and Age
 - ✓ Immune System
 - ✓ Health/Disease Status
 - ✓ Geographic and Socio-Economic Factors
 - ✓ Diet and Treatments

- **The respiratory tract microbiota**

- **Gatekeeper Role:** Respiratory microbiota acts as a defense, preventing harmful pathogens from settling in the respiratory tract.
- **Supports Health:** It aids in the development and maintenance of respiratory functions and immune balance.
- **Changing Conditions:**
 - ✓ pH increases from the nose to the lungs.
 - ✓ Temperature and humidity are highest in the nasal cavity.
 - ✓ Oxygen and carbon dioxide levels vary along the tract.
- **Inhaled Particles:**
 - ✓ Large particles (>10 μm) stay in the upper respiratory tract (URT).
 - ✓ Small particles (<1 μm) can reach the lungs.
 - ✓ These particles can carry bacteria and viruses.
- **Lung Microbiota:**
 - ✓ Healthy lungs have a distinct but transient microbial community.
 - ✓ Similar bacteria to the URT are present:
 - e.g., *Moraxella*, *Haemophilus*, *Staphylococcus*, *Streptococcus*
 - ✓ Unlike in chronic diseases, these microbes don't form a stable community in healthy lungs



- **Urogenital Tract Microbiota**

- **Urine Composition:** Evidence suggests that urine may not be completely sterile, with some bacteria potentially present from the urethra.
- **Vaginal Microbiota Development:**
 - ✓ **At Birth:** Aerobic lactobacilli appear in the vagina shortly after birth and persist as long as the pH remains acidic.
 - ✓ **Neutral pH:** When the vaginal pH becomes neutral (up until puberty), a mixed flora of cocci and bacilli is present.
 - ✓ **Puberty:** At puberty, both aerobic and anaerobic lactobacilli reemerge, helping to maintain an acidic pH by producing lactic acid from carbohydrates.
 - ✓ **Bacterial Vaginosis:** This condition is characterized by significant shifts in the vaginal microbiota from a healthy state dominated by Lactobacilli to a diseased state with increased Actinobacteria and Bacteroidetes.
- **Microbiota Transmission:**
 - ✓ **Vaginal Birth:** Infants born vaginally acquire microbiota derived from their mother's vaginal microbiota.
 - ✓ **Cesarean Section:** Babies delivered by C-section tend to have a microbiota similar to their mother's skin, predominantly featuring *Propionibacterium* and *Staphylococcus* species.
 - ✓

Question

Q1. Where the human microbiota is primarily found in the body?

- a) Only on the skin surface
- b) Exclusively in the gastrointestinal tract
- c) Distributed across various body sites such as the skin, oral cavity, gastrointestinal tract, and more
- d) Mainly in the respiratory system

Q2. The most commonly used way to investigate the diversity of bacterial microbiota species in a sample from the human gut is:

- a) Use of selective culture media
- b) Use of differential culture media
- c) Biochemical testing
- d) DNA-based approaches (e.g. metagenomics)

Q3. The skin microbiota contributes to the body's immune system by:

- a) Triggering allergies
- b) Producing vitamin D
- c) Competing with potential pathogens
- d) Controlling blood sugar levels

Q4. The disruption of the normal balance of the microbiota is known as:

- a) Dysbiosis
- b) Homeostasis
- c) Symbiosis
- d) Eubiosis



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