Microbiology

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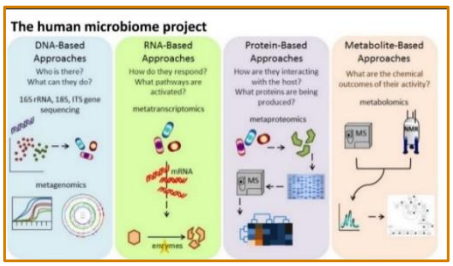
Microbiota

- **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

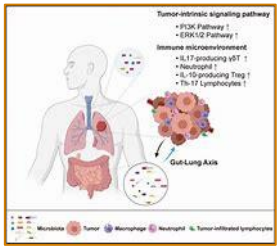
- **Human Microbiome Project**
  - *Objective*: Investigate the role of microbial ecosystems in human health and disease.
  - *Initiation*: Launched by the NIH in 2007.
  - *Focus Areas*:
    - ✓ Diversity of the human microbiome.
    - ✓ Factors affecting microbial distribution and evolution.
  - *Research 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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