

### Topic 1

#### *The Importance of Microbiology*

#### **MicroBiome Vs Microbiota**

- Microbiomes - functional collection of multiple microbes in a particular environmental system. (Microbiota + "theater of activity")
- Microbiota - All types of microorganisms present in a microhabitat

#### **BENEFITS**

- Biomarkers - predicting diseases
- Designing targeted therapies
- Personalized drug therapies and probiotics

Metagenomics - Study of genetic material from environmental/clinical samples

Using metagenomic sequencing or metasequencing techniques

#### **major microbial populations in human body**

- GI track (Gastrointestinal track) - Stomach, Small intestine, Large Intestine

phylotypes - group of organism by phenetic relationship

Human gut phylotypes :

- Gastric fluid : Firmicutes, Bacteroidetes and Actinobacteria
- Mucus Layer - Firmicutes and Proteobacteria

Stomach - *Helicobacter pylori* - in gastric mucosa

Large Intestine - Small Intestine goes to the ileum empties into the cecum.

- E. coli

#### **microbial communities in the gastrointestinal track**

*enterotypes* - stable clusters of communities co-existing

- 3 types - Bacteroides, Prevotella, Ruminococcus

Products of Metabolites

- Vitamin production
- Modification of steroids
- Amino acid biosynthesis
- Shotgun Metagenomic Sequencing
- 16S rRNA

#### *Development*

- Colonization begins - Birth - Source of vitamins and education for immune system

#### *Disorders*

- Inflammatory Bowel Disease (IBD) - Dysbiosis - disruption of homeostasis

Antibiotics - decrease microbes in the gut

*C. difficile* - spore-former, antibiotic-resistant opportunistic pathogen

Probiotics

Prebiotics - carbohydrates, provide nutrition for fermentative gut bacteria

### Topic 1 (cont)

Synbiotics - combines both pro and pre-biotics

#### **Human Virome**

- RNA virus Genomes - Typically smaller than DNA viruses, Single/double stranded
  - Viroids - Naked infectious RNAs that cause plant diseases
- The Baltimore Scheme
- 7 classes in relation to its mRNA
  - = 3 classes of DNA genome
  - = 4 classes of RNA genome
  - Class 1 - double stranded (+/-) - RNA replicase makes (+) strand to be used as mRNA and template
  - Class 2 - DNA (+) - produces replicative form
  - Class 3 - RNA (+/-) - must carry RNA replicase
  - Class 4 - RNA (-) - genome mRNA
  - Class 5 - RNA (-) - RNA replicase makes (+) strand to be used as mRNA and template
  - Class 6 - RNA (+)
  - Class 7 - DNA (+/-) - Uses reverse transcriptase Hepatitis B (HBV)

#### **Genetic Transfer Processes** - Transduction and Lysogeny

Lysogeny - Viral genes replicated not transcribed

- Prophage - Lysogenic form of Viral DNA

**Transduction:** the transfer of host genes from one cell to another by a virus, 2 modes - generalized and specialized

- Generalized - donor genes not part of viral genome and cannot replicate independently, Transducing particle - Particles containing bacterial host DNA

Bacteriophages - protective role in human health, first line of defense against pathogens

Phage - symbiotic relationship

#### **Microbiology of Water**

Sources

- Potable Water - Used for drinking and cooking
- = Filtration and Chlorination

- Recreational Water - Public ponds, lakes, Swimming pool

Testing

- Indicator organism - signals potential for diseases

#### **Microbiology of Food**



### Topic 2

#### **Microbial Structure and Function**

##### **Microbial Morphology**

- Morphology - Cell Shape
- Coccus - Spherical or ovoid
- Rod/bacillus - Cylindrical
- Spirillum - Curved or spiral
- Spirochetes - Tightly coiled

##### **cell membrane and cell wall**

###### **Bacterial Membrane**

- Hopanoids - Strengthen the membrane (Sterol-like molecules)

###### **Archaeal Membrane**

- ether linkages in phospholipids
- Has isoprenes

###### **Bacteria and Eukarya Membrane**

- Ester linkages in phospholipids

###### **Bacterial Cell Wall**

Gram-negative cell wall - two layers : lipopolysaccharide + peptidoglycan

- glycan tetrapeptide

Over view - Outer membrane, periplasm, cytoplasmic membrane

Outer - composed of lipopolysaccharide, endotoxin- lipid A - Barrier against antibiotics

Porins - transmembrane protein channels for the entrance and exit of solutes

Periplasm - Located between cytoplasmic and outer membrane

Gram-positive cell wall - One layer of peptidoglycan - interbridges of Gly

can be destroyed by lysozyme

- teichoic acids covalently bound to peptidoglycan - lipoteichoic acids
- covalently bound

###### **Archaeal Cell Wall**

no peptidoglycan

Pseudomurein - polysaccharide, similar to peptidoglycan

cannot be destroyed by lysozyme or penicillin

##### **cell surface structures and inclusions**

- not part of the cell wall
- Slime Layer - Loosely attached easily deformed
- Capsule - Tightly attached matrix, visible with India ink

##### **cell locomotion**

###### **eukaryotic microbial**

