Some important Questions with model answers

MCBG Part-III Paper 4 GroupB

1. *Give one example of neurotoxin and cytotoxin*?

Ans:

- neurotoxin – Botulinum toxin (BoNT:Botulism Neurotoxin)/
  Tetanus neurotoxin (TeNT)
- Cytotoxin - Shiga toxin (STX)/
  The Salmonella cytolethal distending toxin (S-CDT), first described as the "typhoid toxin"

2. *Name one normal flora inhabiting the skin and tooth and mention the disease caused by them?*

Ans:.

- teeth – Streptococcous mutans : Dental caries (disease)/
  Streptococcus salivarius(dental plaque)
- Skin – Propionebacterium acnes: Acne vulgaris (disease)/
  Staphylococcus aureus (atopic dermatitis)

3. *What do you meant by commensalistic behavior of human normal microflora?*

Ans: Normal microflora that colonize humans are commensal; - meaning they co-exist without harming humans. Human provides the bacteria with nutrients and a stable environment but the microflora on normal condition, could not cause disease and grow as nonpathogic flora. Example- Staphylococcus epidermis on skin.

However, some commensal bacteria provide the host with essential nutrients and vitamins. They metabolize indigestible compounds, defend against colonization of opportunistic pathogens and contribute to the development of the intestinal architecture as well as stimulation of the immune system among others.

4. *Name two virulence factors other than toxins which microbes use in causing disease?*

Ans:

- capsule (immunoevation)
- Hyaluronidase (tissue invading enzyme)/
- adhesins including lipoteichoic acid, trimeric autotransporter adhesins, PaP(Pathogenic pili/ pyelonephritis-associated pili)/
- immunoglobulin (Ig) proteases (Immunosuppression)

5. *What do you mean by Pathogenesity island?*

Ans: Pathogenicity islands (PAIs) are a series of contiguous genes on the chromosomes of a large number of bacterial pathogens which encode various virulence factors including, adhesins, secretion systems (like type III secretion system), toxins, invasins, antigens, serum resistance, capsule synthesis etc.

Example: SPI- 1, SPI-2 of *Salmonella enterica*

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6. *Differentiate between Resident microorganism and Transient microorganism found on the human body.*

Ans:

Resident micoorganism	Transient micoorganism
The microorganisms that usually occupy a particular body site permanently are called the resident flora. These species are life-long members of the body's normal microbial community and if disrupted, reestablished itself promptly. These microbes do not typically harm the host, while they benefit from feeding on the cellular waste and dead cells of the host's body. An example of these is E.coli in gut microbiota.	Microorganisms that colonize people for hours to weeks but do not establish themselves permanently are called transient flora. Transient flora are unable to remain in the body for extended periods of time and are easier to remove. Transient flora may cause disease if not been eliminated by immune system or competition with resident flora An example of this is the Norovirus, which can cause the stomach flu.

7. *What benefits might a human derive from the normal flora*?

Ans: The overall beneficial effects of microbes are summarized below.

1. The normal flora synthesize and excrete vitamins in excess of their own needs, which can be absorbed as nutrients by their host. For example, in humans, enteric bacteria secrete Vitamin K and Vitamin B12, and lactic acid bacteria produce certain B-vitamins.
2. The normal flora prevent colonization by pathogens by competing for attachment sites or for essential nutrients. This is thought to be their most important beneficial effect, which has been demonstrated in the oral cavity, the intestine, the skin, and the vaginal epithelium.
3. The normal flora may antagonize other bacteria through the production of substances (certain fatty acid ,peroxides specific bacteriocins),which inhibit or kill nonindigenous species.
4. The normal flora stimulate the development of certain tissues, i.e., the caecum and certain lymphatic tissues (Peyer's patches) in the GI tract.
5. The normal flora stimulate the production of natural antibodies. Low levels of antibodies produced against components of the normal flora are known to cross react with certain related pathogens, and thereby prevent infection or invasion.

8. *Why the colon is considered as a large fermenter vessel?*

Ans: Fermentation is the enzymatic decomposition and utilization of foodstuffs, particularly carbohydrates, by microbes in absence of oxygen. Inside the colon is anaerobic and Large intestinal epithelial cells do not produce digestive enzymes, but contain huge numbers of bacteria which have the enzymes to digest and utilize many substrates by fermentation. Thus, the large intestine is quantitatively the most important site of fermentation. Hence, colon (large intestine) is considered as large fermenter vessel.

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9. Why is there no normal flora at Lower respiratory tract?

Ans: Lower respiratory tracts are usually sterile because –

1.The epithelial lining is interspersed with goblet cells that secrete a protective mucus.
2. The epithelium lining the respiratory tract is covered in small hairs called cilia. These beat rhythmically out from the lungs, moving foreign particles toward the laryngopharynx upwards and outwards, and prevent mucus accumulation in the lungs.
3.Macrophages in the alveoli are part of the immune system which engulf and digest any inhaled harmful agents.

10. Name one communicable bacterial disease with causative agent.

Ans : Example of communicable disease is Cholera; causative agent: Vibrio cholerae /
Bacillary dysentery, also known as shigellosis; causative agent: Shigella dysenteriae type 1

11. *What is sepsis?*

Ans: Sepsis is a life-threatening condition resulting from the presence of harmful microorganisms in the blood or other tissues and the body's overwhelming response by a dysregulated host response to infection, potentially leading to the malfunctioning of various organs, shock, and death.

12. Mention three stages of Manifestation of sepsis.

Ans: Manifestation of sepsis have three stages. The first stage is the least severe and usually has symptoms of fever and an increased heart rate. The second stage is more severe and is characterized by symptoms of difficulty breathing (Fast respiratory rate (> 22 breaths/minute) and possible organ malfunctions, while the third is the most severe stage (septic shock or severe sepsis) with life-threatening low blood pressure (≤ 100 mm Hg systolic)

13. What is the mode of action of chlolera toxin?

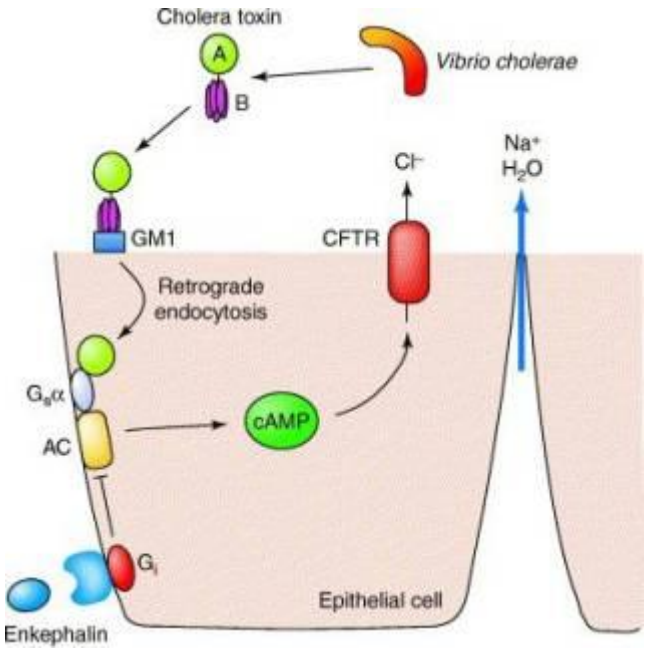
Ans: Mode of action of cholera toxin:

When cholera toxin is released from the bacteria in the infected intestine, it binds to the intestinal cells known as enterocytes through the interaction of the pentameric B subunit of the toxin with the GM1 ganglioside receptor on the intestinal cell, triggering endocytosis of the toxin.

Next, the A/B cholera toxin must undergo cleavage of the A1 domain from the A2 domain in order for A1 to become an active enzyme.

Once inside the enterocyte, the enzymatic A1 fragment of the toxin A subunit enters the cytosol, where it activates the G protein Gsa through an ADP-ribosylation reaction that acts to lock the G protein in its GTP-bound form, thereby continually stimulating adenylate cyclase to produce cAMP.

The high cAMP levels activate the cystic fibrosis transmembrane conductance regulator (CFTR), causing a dramatic efflux of ions and water from infected enterocytes, leading to watery diarrhoea.



14. State two preventive measures against Giardiasis.

Ans: Two Preventive measures against giardiasis:

1,Practice good hygiene: Hands should be thoroughly washed with soap and clean running water for 20 seconds, especially before and after eating, after using the toilet.

2,Avoid eating uncooked or unprocessed food or water: Fruits and vegetables should be washed thoroughly under hot water. Raw or undercooked meats should not be eaten. Untreated water from pools, lakes, rivers, ponds should not be consumed. At least water should be boiled for 10min.

15. What are the differences between endotoxin and exotoxin?

Ans:

	Exotoxin	Endotoxin
Species	Some species of both Gram-positive and Gram-negative bacteria	Most Gram-negative bacteria and *Listeria*
Protein Location	Proteins secreted from cell	Part of cell (lipopolysaccharide) that fragments off
Gene Location	Genes for exotoxin are in plasmid or bacteriophage	Genes for endotoxin are on bacterial chromosome
Toxicity	High toxicity	Low toxicity
Antigenicity	Highly antigenic (host forms antibodies called antitoxins)	Poorly antigenic
Vaccine	Vaccine available (formed from toxoids)	No vaccine available
Heat Stability	Heat labile	Heat stable
Example	Think cholera, tetanus, botulism	Think meningococcemia, sepsis

BASIS FOR COMPARISON	ENDOTOXINS	EXOTOXINS
Meaning	Endotoxins are the lipopolysaccharide-protein complexes, responsible for the making an integral part of the cell wall of Gram-Negative Bacteria.	Exotoxins are the proteins which are secreted by a few species of bacteria.
Location	Endotoxins are part of the cells.	Exotoxins are released from the cell.
Source	After the lysis of the gram-negative bacteria.	In the living gram-positive and gram-negative bacteria.
Molecular Weight	50-1000 KDa.	10 KDa.
Made up of	Lipopolysaccharide.	Protein.
Heat Sensitivity	Endotoxins are heat stable and active at 250° C or even at 1000° C	Exotoxins are heat liable and destroyed beyond 60-80° C.
Denaturation on boiling	Endotoxin does not get denatured.	Exotoxin gets denatured.
Immune Reactions	Weak.	Strong.
Toxoids Conversion	Not possible.	Possible.
Fever	Yes.	No.
Disease	Sepsis, meningococcemia.	Diphtheria, botulism, tetanus.
Detected by	Limulus lysate assay.	Various test like neutraliation, precipitation, etc.
Enzymatic Activity	High enzymatic activity.	No enzymatic activity.
Specificity	They are non-specific.	They are specific to particular bacterial strain.
Antigenicity	Poor.	High.
Examples	Salmonella typhi, E.coli, Vibrio cholera, Shigella.	Bacillus cereus, Bacillus anthrcis,Staphylococcus aureus, Streptococcus pyogenes.

16. What is toxoid?

Ans: A toxoid is an inactivated toxin (usually an exotoxin) whose toxicity has been suppressed either by chemical or heat treatment, while other properties, typically immunogenicity, are maintained. Eg. Tetanus toxoid

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17. What is Virulence?

Ans: Virulence is the degree of pathogenicity of a microorganism, as indicated by the severity of the disease produced and its ability to invade the tissues of a host.

Some examples of virulence factors are:

- Attachment factors/ Adhesins,
- Anti-phagocytic factors (capsule),
- Spreading factors and enzymes.
- Toxins; exotoxin and endotoxin.

18. *Mention the name of two microbes found in normal human* skin.

Ans:. Bacteria

- *Staphylococcus epidermidis.*
- *Corynebacterium spp.*
- *Streptococcus mitis*

Fungi

- C*andida albicans,*
- *Rhodotorula rubra,*
- *Microsporum gypseum, and*
- *Trichophyton rubrum*

18. *What is neurotoxin? Give an example*.

Ans: A neurotoxin is a toxic agent (especially exotoxin) or substance that inhibits, damages or destroys the tissues of the nervous system, especially neurons, the conducting cells of your body's central nervous system.
Example:

- botulinum toxin (BoNT:Botulism Neurotoxin)/
- tetanus neurotoxin (TeNT)

19. Describe the role of normal microflora of human body in inhibiting the harmful microbes?

Ans: beneficial role of normal flora inhibiting pathogens

1. The normal flora prevent colonization by pathogens by competing for attachment sites or for essential nutrients. This is thought to be their most important beneficial effect, which has been demonstrated in the oral cavity, the intestine, the skin, and the vaginal epithelium.
2. The normal flora may antagonize other bacteria through the production of substances (certain fatty acid ,peroxides specific bacteriocins),which inhibit or kill nonindigenous species.
3. The normal flora stimulate the production of natural antibodies. Low levels of antibodies produced against components of the normal flora are known to cross react with certain related pathogens, and thereby prevent infection or invasion.

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20. Give example of endotoxin and exotoxin producing from bacteria.

Ans:

- **endotoxin** : lipopolysaccharide (LPS) of many gram negative bacteria {*Salmonella typhi, Shigella flexneri, Staphylococcus aureus* etc) ,
  Bacillus thuringiensis delta **endotoxin**

- **exotoxin** : cholera toxin (*Vibrio cholerae*), tetanus toxin (*Clostridium tetani),* Botulinum toxin (*Clostridium botulinum*)

21. With proper examples, explain the localized and systemic infection in man.

Ans: An infection where the pathogen or symptoms are localized in one area. Such infections are sometimes known as local infections. It affects only one body part or organ.

Example:

- Pneumonia is generally confined to one or both lungs, *S. pneumoniae, H. influenzae*
- ear infection , Alpha hemolytic *streptococci, Pseudomonas aeruginosa*
- dental caries, Streptococcus mutans
- Candidiasis (thrush) candida albicans : thrush mouth
- Cholera: *V. cholerae* remains localized to the intestine

A systemic illness is one that affects the entire body, rather than a single organ or body part;- Many organs and tissues might be involved in the complex disease process. Systemic infection leads to generation of inflammatory mediators that result in metabolic and behavioural changes.

Example:

- Sepsis, is a life-threatening complication that can happen when bacteria from another infection enter the blood and spread throughout the body. Sepsis causes inflammation throughout the body. This inflammation can cause blood clots and block oxygen from reaching vital organs, resulting in organ failure.
- AIDS, the final stage of HIV infection, is defined by low CD4+ T cell counts (fewer than 200 per microliter), and may include symptoms such as fever, swollen lymph nodes, inflammation of the throat, rash, muscle pain, malaise, and mouth and esophageal sores. Most of these conditions are opportunistic infections caused by bacteria, viruses, fungi and parasites that are normally controlled by the elements of the immune system that HIV damages. These infections affect nearly every organ system.

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22. What are adhesins?

Ans: Adhesins are cell-surface components or appendages of bacteria that facilitate adhesion or adherence to other cells or to surfaces, usually the host they are infecting or living in. Adhesins are a type of virulence factor.
Example=

- the type 1 fimbrial FimH adhesin.
- Multivalent Adhesion Molecules (MAMs), Dr family of adhesins

23. Are bioflim formation associated with virulence? Explain with example.

Ans: A biofilm comprises any syntrophic consortium of microorganisms in which cells stick to each other and often also to a surface. These adherent cells become embedded within a slimy extracellular matrix that is composed of extracellular polymeric substances (EPS like polysaccharides, proteins,etc). It was recognized that biofilm formation plays a pathogenic role during the infection process.

As the adherence of microorganisms to tissue is part of the process of acute infection, the impact of biofilm formation in infection has huge consequences. Mature biofilms are highly to the action of the innate and adaptive immune defence systems. In addition, biofilms contribute to the emergence and spread of antimicrobial resistance. From a wider perspective, biofilm formation favours the colonization of the human host by potential pathogens, as well as the transmission and persistence of these pathogens in the environment.

Bacteria frequently involved in biofilm-associated infections include the

- Gram-positive pathogens *Staphylococcus epidermidis, Staphylococcus aureus and Streptococcus species* and
- Gram-negative *Pseudomonas aeruginosa* and Enterobacteriaceae such as *Escherichia coli*.

Thus, biofilm formation of microbes leads to persistent infections resistant to conventional antimicrobial treatment and is today a major cause of treatment failure.
