



summary

Written and designed by:

Hadeel Tawalbeh

Sawsan Al-Bawadi

Contents:

- How to use me
- Basics revision
- Test Bank
- The Major concepts that were included are:

- **G+ cocci bacteria:**

- 1. **Streptococcus**

- o **β - hemolysis**

- *S. pyogenes*
 - *S. agalactiae*
 - *E. faecalis*

- o **α – hemolysis**

- *S. viridans*
 - *S. pneumonia*

- 2. **Staphylococcus**

- o **coagulase positive**

- *Staphylococcus aureus*

- o **coagulase negative**

- *Staphylococcus epidermidis*
 - *Staphylococcus saprophytic*

-

- **G+ bacilli bacteria**

- 1. **spore forming bacteria**

- o **Bacillus species**

- *Bacillus anthracis*
 - *Bacillus cereus*

- o **Clostridium species**

- *Clostridium perfringens*

- *Clostridium difficile*
- *Clostridium tetani*
- *Clostridium botulinum*

- 2. **non-spore forming bacteria**

- o **Corynebacterium**

- *Corynebacterium diphtheriae*
 - *Corynebacterium urealyticum*
 - *Corynebacterium jeikeium*

- o **Mycobacteria |**

- *Mycobacterium tuberculosis*
 - *Mycobacterium leprae*
 - *Mycobacterium avium-intracellulare*

- o **Actinomycetes**

- *Actinomyces israelii*
 - *Nocardia brasiliensis*

- **G- Bacteria**

-

- 1. **Diplococci**

- *N. meningitidis*
 - *N. gonorrhoeae*

- 2. **Enterobacteriaceae**

- o **Lactose fermenters**

- *E. coli*
 - *Klebsiella*
 - *Enterobacter*
 - *Citrobacter*
 - *Serratia*

- o **Lactose non-fermenters**

- *Salmonella*
 - *Proteus*
 - *Yersinia*
 - *Shigella*

How to study me:

- 1) Make sure you've understood all the introductory bases.
- 2) This Summary contains flow charts that it'll help you make mind maps about the bacteria, make sure to check them out first.
- 3) Try to revise from time to time.
- 4) The best summary anyone would have is his own summary, so make sure you make your own later.
- 5) If you find any mistake, please notify us as soon as possible.

And Finally, Good luck



Before we start, let's make a fast revision.

Bacteria Definition:

Microscopic, single-celled organisms that exist in their millions, in every environment, both inside and outside other organisms.

From this definition we can conclude:

>**microscopic**: cannot be seen with unaided eyes it's small 0.2-2 microns in size.

>**Single-celled**: only one cell can be an entire organism.

>**in every**: everywhere.

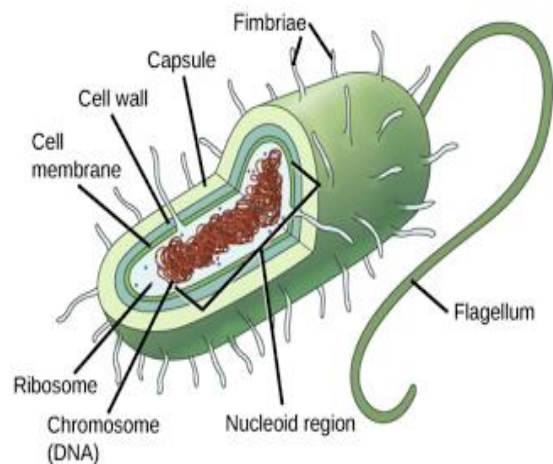
Bacteria structure:

1. Essential structures:

1. Cell wall
2. Cytoplasmic Membrane
3. Cytoplasm
4. Nucleoid region

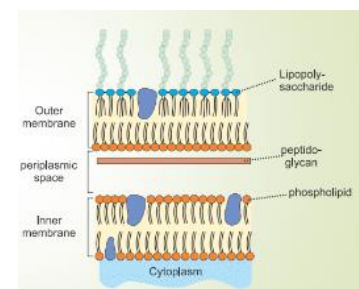
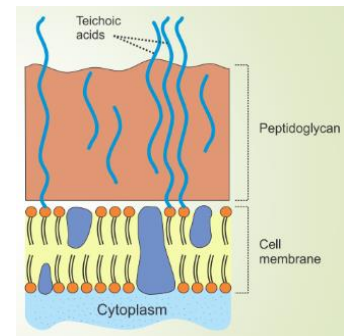
2. Non Essential structures:

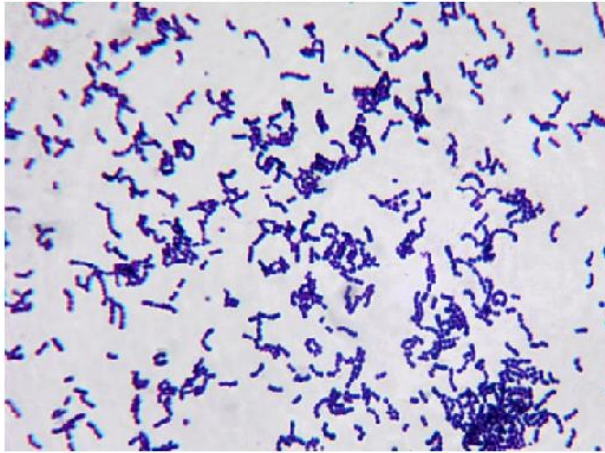
1. Capsule.
2. Flagella
3. Pili
4. Plasmid
5. Spores
6. Inclusion granules



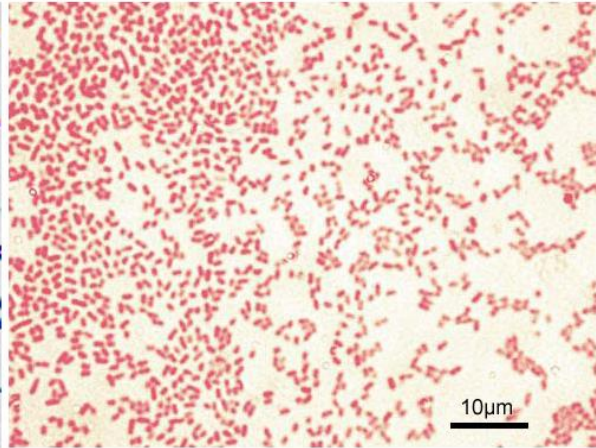
- **Cell wall:** It is a rigid material made that surrounds the bacterial cell for protection and also to give its shape, it's classified according to the Gram stain into:

- **Gram Positive:** the peptidoglycan forms a thick layer (60%) external to the cell membrane. Cell wall of gram positive bacteria also contain Teichoic acid molecules.
- **Gram-negative:** the peptidoglycan layer (10-20%) is thin and is overlaid by an outer membrane. The space between the plasma membrane and the outer membrane, is called the periplasmic space. The outer membrane contains Lipopolysaccharide (LPS), LPS is toxic (endotoxin).



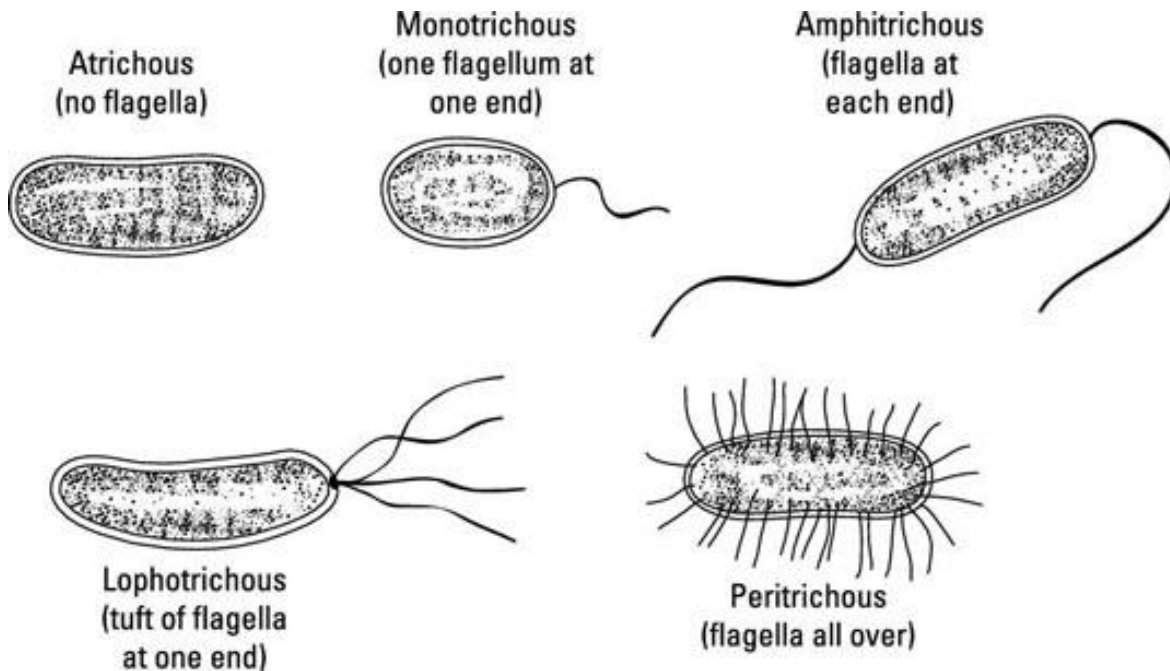


Gram Positive Bacteria

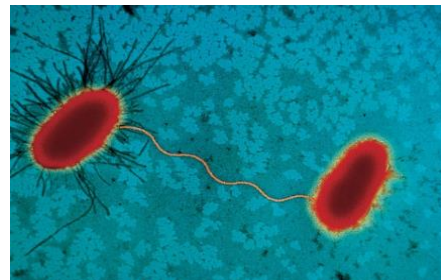
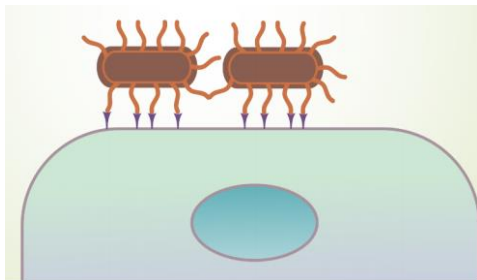


Gram Negative Bacteria

- **Cytoplasmic membrane:**
Surrounds the cytoplasm, it is a bilayer of phospholipids, its Functions are:
 1. Selective permeability
 2. Respiration
 3. Contains many essential enzymes
 4. Excretion
- **Cytoplasm:** A homogeneous soft gel mass inside the cell, It stores nutrients, a medium for the biochemical reactions and contains:
 1. **Nuclear body:** Consists of single circular DNA molecule coiled to form a mass. It carries all essential genetic information of the cell.
 2. **Plasmids:** Plasmids: are small extrachromosomal pieces of circular DNA. Plasmids carry non-essential genes such as antibiotic resistance genes. Some Plasmids can be transmitted from one bacterium to another.
 3. **Ribosomes:**
 4. **Enzymes.**
 5. **Storage granules**
- **Outer covers of bacteria:** Protection of bacteria against phagocytosis, drying, help bacteria in adherence to surfaces:
 1. **Capsule:** is a well-defined gelatinous protective outer covering surrounding and firmly attached to the bacterial cell wall.
 2. **Slime layer:** A slime layer is a zone of diffuse, unorganized material, loosely associated with the cell wall and can be easily removed.
- **Flagella (single Flagellum):**
Flagella are long helical appendages composed of repeating protein subunits (flagellin). It's used for bacterial motility. Its divided into:
 1. **Monotrichous:** only one flagellum
 2. **Lophotrichous:** many flagella protruding from only one pole
 3. **Amphitrichous:** many flagella protruding from both poles
 4. **Peritrichous:** many flagella that surrounds all the bacterial surface



- **Pili:** are short hair-like surface appendages. Pili exist in two classes:
1. Ordinary pili: are involved in bacterial adherence.
 2. Sex pili: involved in transfer of genetic material (conjugation).

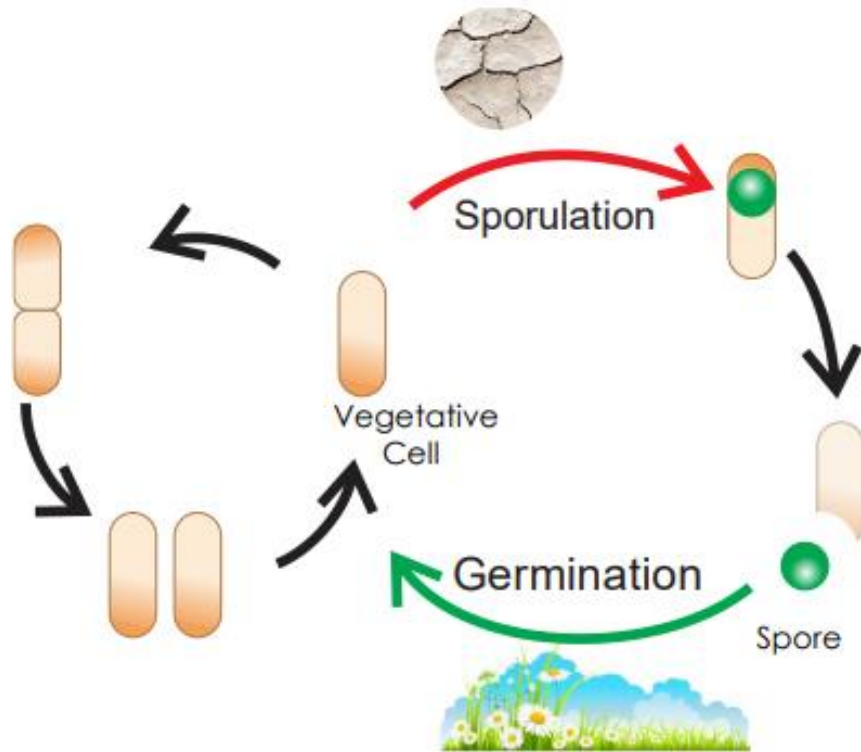


- **Spores:** are highly resistant resting forms of some bacteria. Spores are formed on exposure to unfavorable conditions e.g. dryness, heat and depletion of nutrients and so their extraordinary resistance to killing by heat, chemicals and ordinary sterilization methods. Steam heating under pressure is a useful way to get rid of them.



Useful terms:

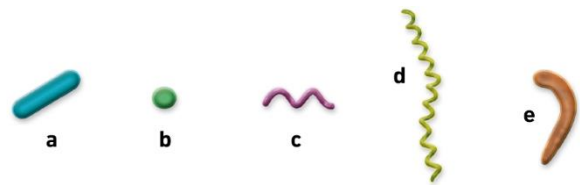
1. **Sporulation (sporogenesis):** the process of formation of spores from vegetative cells.
2. **Germination:** opposite to sporulation i.e. formation of vegetative cells from spores in favorable conditions.



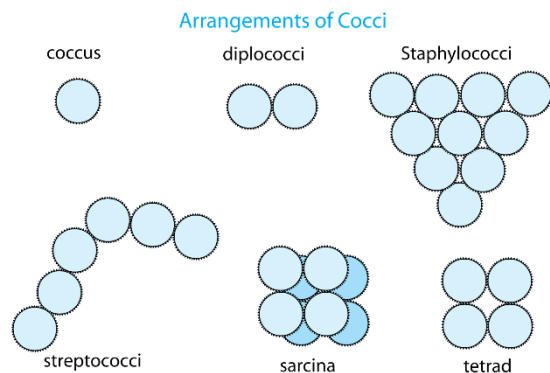
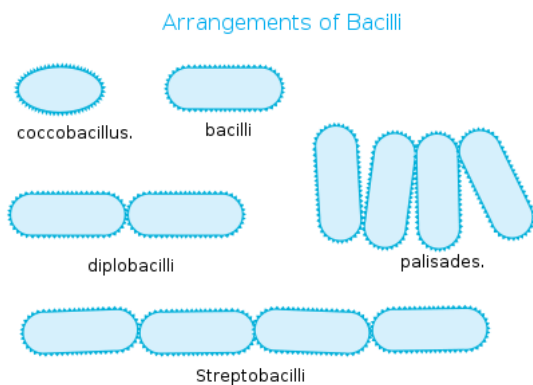
- **inclusion bodies:** Storage of energy or structural building blocks.
- **Ribosomes:** they're responsible for making proteins.

According to their shape, its classified into:

1. Cocci
2. Bacilli
3. Spirochetes/ spiral
4. Vibrio



****Cocci and bacilli are further classified as these two photos show:**



Bacterial Taxonomy

| MORPHOLOGY | GRAM-POSITIVE | GRAM-NEGATIVE |
|---|--|--|
| Circular (Coccus) | <i>Streptococcus</i> <i>Enterococcus</i> <i>Staphylococcus</i> | <i>Neisseria</i> <i>Moraxella</i> |
| Rod (Bacillus) | <i>Corynebacterium</i> <i>Listeria</i> <i>Bacillus</i> <i>Clostridium</i> <i>Mycobacterium</i> (acid-fast) | ENTERICS (live in the GI tract): <ul style="list-style-type: none"> • <i>Escherichia coli</i> • <i>Shigella</i> • <i>Salmonella</i> • <i>Yersinia</i> • <i>Klebsiella</i> • <i>Proteus</i> • <i>Enterobacter</i> • <i>Serratia</i> • <i>Vibrio</i> • <i>Campylobacter</i> • <i>Helicobacter</i> • <i>Pseudomonas</i> • <i>Bacteroides</i> (anaerobic) <i>Haemophilus</i> <i>Bordetella</i> <i>Legionella</i> <i>Yersinia</i> <i>Francisella</i> <i>Brucella</i> <i>Pasteurella</i> <i>Gardnerella</i> |
| Spiral | | <i>Spirochetes</i> : <ul style="list-style-type: none"> • <i>Treponema</i> • <i>Borrelia</i> • <i>Leptospira</i> |
| Branching filamentous growth (like fungi) | <i>Actinomyces</i> (anaerobic) <i>Nocardia</i> (partially acid-fast) | |
| Pleomorphic | | <i>Chlamydia</i> <i>Rickettsiae</i> |
| No cell wall | <i>Mycoplasma</i> | |

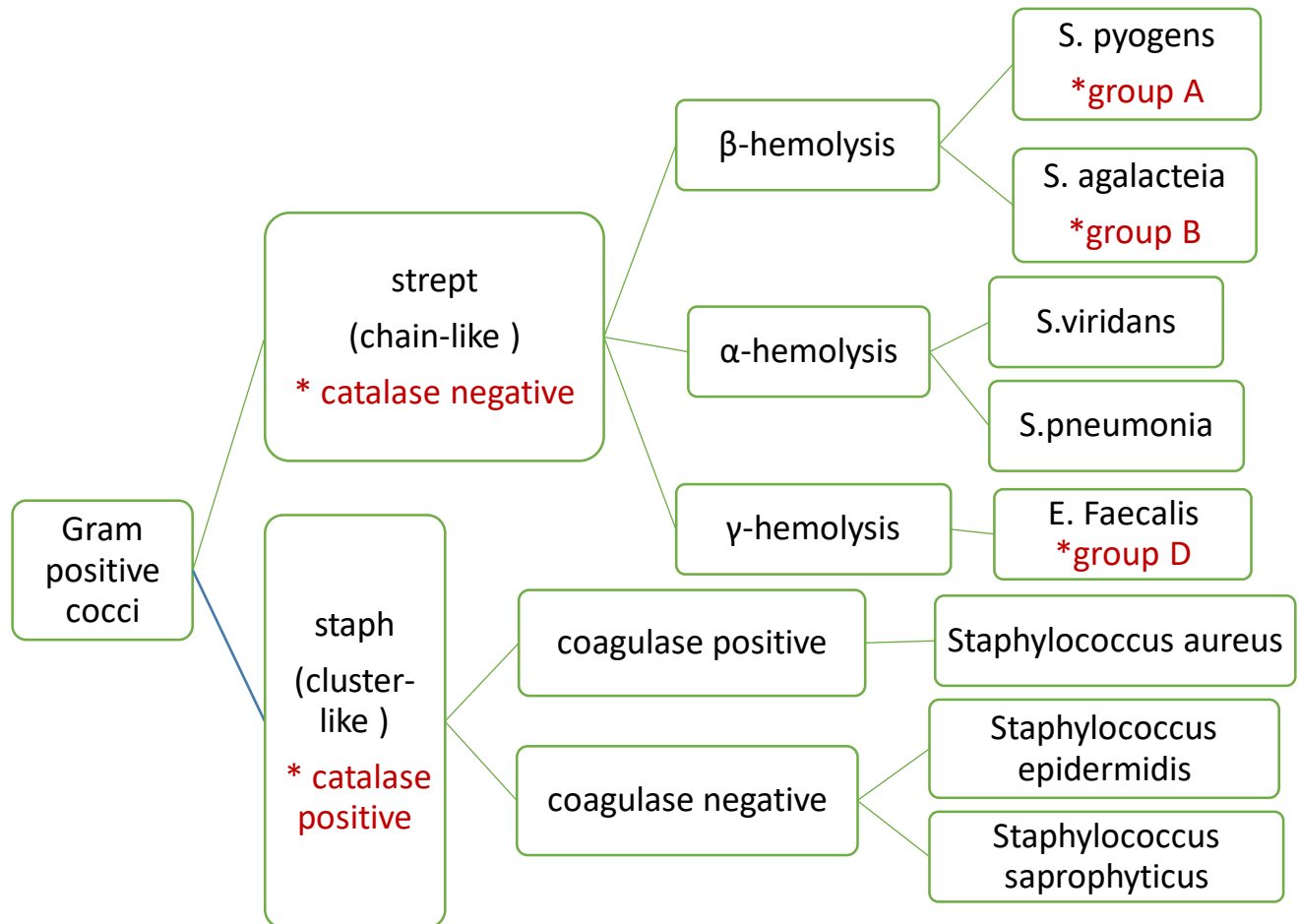
Gram-Positive

There are 7 classic gram-positive bugs that cause disease in humans, and basically every other organism is gram-negative. Of the gram-positives, 3 are cocci, and the other 4 are rod-shaped (bacilli).

The 3 gram-positive cocci both have the word coccus in their names:

1) *Streptococcus* 2) *Enterococcus* form strips of COCCI. 3) *Staphylococcus* forms clusters of cocci.

G+ Cocci Bacteria Flow chart



Streptococci Table

| G+ Cocci | METABOLISM | VIRULE.NCE | TOXINS | PATHOLOGY | MISCELLANEOUS |
|--|--|---|---|--|--|
| group A: Streptococcus pyogenes | 1. Catalase-negative 2. Microaerophilic 3. Beta-hemolytic, due to enzymes that destroy red and white blood cells A. Streptolysin O: a. Oxygen labile b. Antigenic B. | 1. M-protein (70 types) a. Adherence factor b. Anti-phagocytic c. Antigenic: Induces antibodies which can lead to phagocytosis | Erythrogenic or Pyrogenic Toxin (produced only by lysogenized Group A Streptococci): responsible for scarlet fever 2. Toxic shock syndrome toxin | *By invasion: puerperal fever, cellulites, erysipelas, bacteremia or sepsis, and necrotizing fasciitis (streptococcal) | * identified by inhibition of growth by bacitracin |

| | | | | | |
|---|--|--|---|---|--|
| | Streptolysin-S a. Oxygen stable b. Non-antigenic | 2. Lipoteichoic acid: adherence factor 3. Streptokinase 4. Hyaluronidase 5. DNAase 6. Anti-C5a peptidase | (similar to, but different from the staph exotoxin TSST-1) | gangrene, flesh eating bacteria). *local infection: Streptococcal sore throat (tonsillitis), Streptococcal infection of superficial layers of skin (impetigo) *Toxin: Streptococcal toxic shock syndrome, and scarlet fever (pyrogenic toxins) *Post streptococcal diseases (Rheumatic fever due to cross reactivity, and Glomerulonephritis due to immune-complex formation. e.g. Antibodies- Spa | |
| group B: Streptococcus agalactiae | 1. Catalase-negative 2. Facultative anaerobe 3. Beta-hemolytic | - | - | *In Neonatal: meningitis/ pneumonia/ sepsis. *Sepsis in pregnant women (with secondary infection of fetus) *Increasing incidence of infections in elderly >65 years of age and patients with diabetes or neurological disease: causes sepsis and pneumonia. | *normal flora in vagina and lower GIT *Needs candle jar + 10% CO2 |
| group D/ Enterococci: Streptococcus faecalis | 1. Catalase-negative 2. Facultative anaerobe | Extracellular dextran helps them bind to heart valves | - | 1. Subacute bacterial endocarditis. 2. Biliary tract Infections | - |

| | | | | | |
|---|---|---|---|---|---|
| | 3. Usually gamma-hemolytic, but may be alpha-hemolytic | | | 3. U urinary tract infections (especially the enterococci) | |
| Streptococcus viridans | 1. Catalase-negative 2. Facultative anaerobe 3. Alpha-hemolytic | Extracellular dextran helps them bind to heart valves | - | Causes endocarditis + dental crisis | Normal flora in upper respiratory tract |
| Streptococcus pneumoniae (pneumococci) | 1. Catalase-negative 2. Facultative anaerobe 3. Alpha-hemolytic | Capsule (83 serotypes) | • Pneumolysin: binds to cholesterol in host-cell membranes (but its actual effect is unknown) | 1. Pneumonia 2. Meningitis 3. Sepsis 4. Otitis media (in children) | - |

Terms to understand:

- **Beta-hemolytic streptococci:** completely lyse the RBCs, leaving a clear zone of hemolysis around the colony.
- **Alpha-hemolytic streptococci:** only partially lyse the RBCs, leaving a greenish discoloration of the culture medium surrounding the colony. This discolored area contains unlysed RBCs and a green-colored metabolite of hemoglobin.
- **Gamma-hemolytic:** streptococci are unable to hemolyze the RBCs.

G+ Cocci Bacteria/ Staphylococci Table:

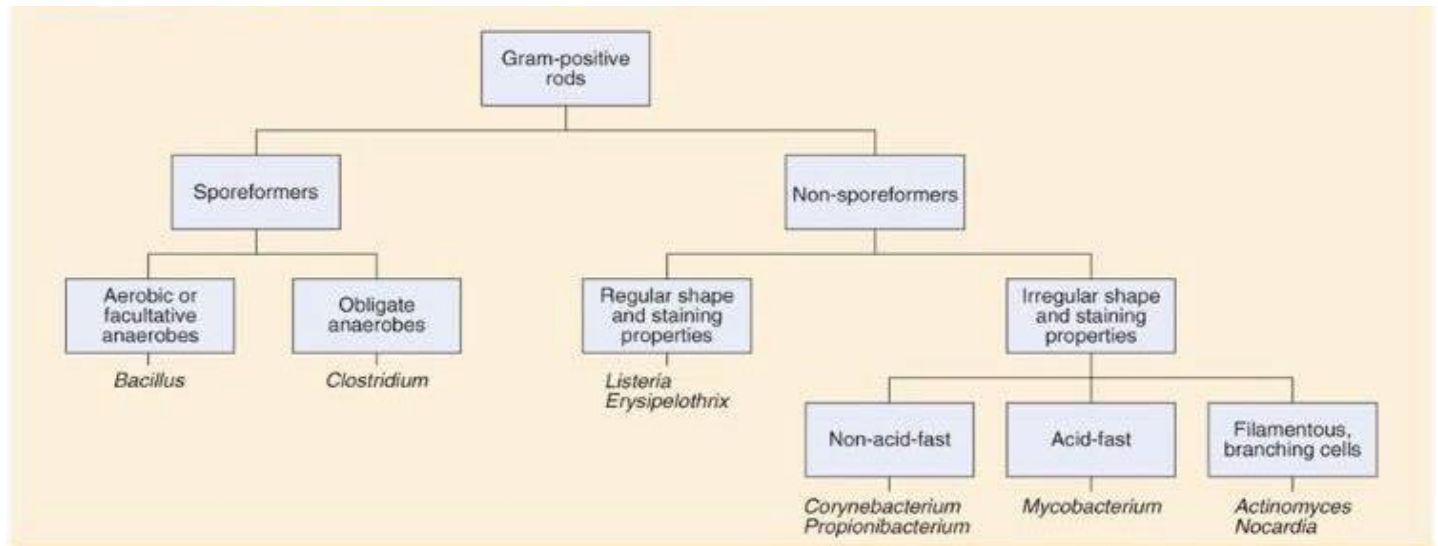
* non-motile, usually arranged in grapelike irregular clusters.

* some are members of the normal microbiota of the skin and mucous membranes of humans.

| G+ cocci | METABOLISM | VIRULENCE | TOXINS | Pathology |
|------------------------------|--|--|--|---|
| Staphylococcus aureus | 1. Catalase positive 2. Coagulase positive 3. Facultative anaerobe | *Protective Proteins: 1. Protein A: binds IgG, preventing opsonization and phagocytosis 2. Coagulase: allows fibrin formation around organism 3. Hemolysins 4. Leukocidins 5. Penicillinase | Assault Weaponry 1. Exfoliatin: scalded skin syndrome 2. Enterotoxin: food poisoning 3. Toxic shock syndrome toxin (TSST-1) | 1. Staphylococcal lesion includes: furuncle or other localized abscess 2. Osteomyelitis (necrosis of bone and chronic suppuration) 3. pneumonia, meningitis, empyema, endocarditis, or sepsis with suppuration in any organ |

| | | | | |
|-------------------------------------|---|--|---|--|
| | | <p>*Tissue-Destroying Proteins:</p> <p>1. Hyaluronidase: breaks down connective tissue</p> <p>2. Staphylokinase: lyses formed clots</p> <p>3. Lipase</p> | | <p>4. Scalded skin syndrome, is caused by the production of exfoliative toxins (Exfoliative toxin A and exfoliative toxin B > dissolving the mucopolysaccharide matrix of the epidermis</p> <p>5. Toxic shock syndrome is associated with TSST-1 > abrupt onset of high fever, vomiting, diarrhea, myalgias, rash, and hypotension with cardiac and renal failure in the most severe cases. (it occurs in women that use tampon)</p> <p>6. Food poisoning: some have enterotoxin B which is heat stable > emetic effect</p> |
| Staphylococcus epidermidis | <p>1. Catalase positive</p> <p>2. Coagulase negative</p> <p>3. Facultative anaerobe</p> | <p>1. Polysaccharide capsule: adheres to a variety of prosthetic devices. Forms a biofilm.</p> <p>2. Highly resistant to antibiotics!</p> | - | <p>A. Nosocomial infections:</p> <p>1. Prosthetic joints</p> <p>2. Prosthetic heart valves</p> <p>3. Sepsis from intravenous lines</p> <p>4. Urinary tract infections</p> <p>B. Frequent skin contaminant in blood cultures!</p> |
| Staphylococcus saprophyticus | <p>1. Catalase positive</p> <p>2. Coagulase negative</p> <p>3. Facultative anaerobe</p> | - | - | Urinary tract infections in sexually active women |

G+ bacilli bacteria flow chart:



G+ bacilli Bacteria Table:

| ORGANISM | RESERVOIR/ Morphology | TRANSMISSION | METABOLISM | VIRULENCE | TOXINS | CLINICAL |
|---------------------------|--|---|--|--|--|---|
| Bacillus anthracis | Herbivores (zoonotic) A. Sheep B. Goats C. Cattle | Endospores 1. Cutaneous 2. Inhalation 3. Ingestion | Aerobic (but since it can grow without oxygen, it is classified as a facultative anaerobe) | 1. Unique protein capsule (polymer of gamma-D-glutamic acid): antiphagocytic 2. Non-motile 3. Virulence depends on acquiring 2 plasmids. One carries the gene for the protein capsule; the other carries the gene for its exotoxin | Exotoxins: 1. Protective antigen (PA) 2. Edema factor (EF) 3. Lethal factor (LF) * PA form channel to facilitate entry of EF + LF | 3 types of anthrax: 1. Cutaneous > spores enter through skin 2. Pulmonary > (Woolsorters' disease) > inhalation of spores > phagocytosed in the lungs > transported to lymph node > |

| | | | | | | |
|------------------------------|--|-----------------------------|-----------|--|--|--|
| | | | | | | germination > toxin production > hemorrhagic and sepsis 3. Gastrointestinal ingested spores |
| Bacillus cereus | - | Endospores | Aerobic | 1. No Capsule 2. Motile | Enterotoxins A. Heat labile: similar to enterotoxin of cholera and E. coli. B. Heat stable: produces syndrome similar to that of Staphylococcus aureus food poisoning, but with limited diarrhea | causes food intoxication: * Grows in foods, spores survive cooking and reheating * it Causes nausea, vomiting, abdominal cramps and diarrhea (24-hour duration) |
| Clostridium botulinum | 1. soil 2. Stored vegetables: • Home-canned • Zip-lock storage bags 3. Smoked fish 4. Fresh honey: associated with infant botulism | Endospores (heat resistant) | Anaerobic | Motile: flagella (so H-antigen positive) | 1. Neurotoxin: inhibits release of acetylcholine from peripheral nerve 2. Toxin is not secreted rather it is upon the death of Bacterium. | Wound botulism: 1. Similar to Food-borne except absence of GI prodromal symptoms Infant botulism: 1. Constipation 2. Flaccid paralysis Food-borne botulism: 1. Cranial nerve palsies |

| | | | | | | |
|--------------------------------|---|--|-----------|--|---|--|
| | | | | | | 2. Muscle weakness 3. Respiratory paralysis |
| Clostridium tetani | Soil | Endospore: introduced through wound * common in geriatric patients and IV drug abusers, neonates in developing countries | Anaerobic | Motile: flagella (so H-antigen positive) | Tetanospasmin: inhibits release of GABA and glycine (both inhibitory neurotransmitters) from nerve cells, resulting in sustained muscle contraction | Tetanus 1. Muscle spasms 2. Lockjaw (trismus) 3. Risus sardonicus 4. Respiratory muscle paralysis |
| Clostridium perfringens | Ubiquitous: 1. Soil 2. GI tract of humans & mammals | Endospores | Anaerobic | NON-motile | 1. Alpha toxin: lecithinase (spl its lecithin into phosphocholine and diglyceride) 2. 11 other tissue destructive enzymes | Gaseous Gangrene: A. Cellulitis/wound infection B. Clostridial myonecrosis: fatal if untreated C. Watery diarrhea: associated with food-borne ingestion |
| Clostridium difficile | 1. Intestinal tract 2. Endospores found in hospitals and nursing homes | Fecal-oral : ingestion of endospores * Associated with or following antibiotic use > the normal GI flora is suppressed > C difficile proliferates, | Anaerobic | Motile: flagella (so H-antigen positive) | 1. Toxin A: diarrhea 2. Toxin B: cytotoxic to colonic epithelial cells | Pseudomembranous enterocolitis: antibiotic-associated diarrhea |

| | | | | | | |
|--------------------------------|--|---|--|---|--|--|
| | | producing cytopathic toxin and enterotoxin | | | | |
| Corynebacterium diphtheriae | 1. Gram- positive rods (very pleomorphic and club- shaped) 2. Non- spore- forming 3. Non- motile | Respiratory droplets from a carrier | 1. Facultative anaerobe 2. Catalase- positive | Pseudomembrane forms in the pharynx, which serves as a base from where it secretes its toxin | Exotoxin (coded by a bacteriophage): 1. A subunit: blocks protein synthesis by inactivating EF2. 2. B subunit: provides entry into cardiac and neural tissue | 1) respiratory diphtheria (pseudomembrane on pharynx) > 2 stages of disease: 1. Local infection – upper respiratory tract inflammation – sore throat, nausea, vomiting, swollen lymph nodes; pseudomembrane formation can cause asphyxiation 2. Diphtherotoxin production and toxemia – target organs primarily heart and nerves} 2) cutaneous diphtheria |

Remember:

* **Food poisoning** have two forms:

1. **Emetic type**, which is associated with fried rice

2. **Diarrheal type**, which is associated with meat dishes and sauces.

* *B. cereus* produces toxins that cause disease that is more an **Intoxication** than a Foodborne **infection** (intoxication: ingestion of toxin, infection: ingestion of bacteria)

* Tetanus vaccine is included in routine childhood **DTaP** (diphtheria, tetanus, acellular pertussis) immunizations

Mycobacteria:

* aerobic bacteria, they **resist** decolonization by acid and are therefore called “acid-fast” bacilli”.

* **Ziehl-Neelsen technique** of staining is employed

* rich in lipids (waxes, phospholipids, mycolic acid)

*grow slowly

*3 types:

1. Mycobacterium tuberculosis:

*Causes tuberculosis in debilitated patient, lung damaged person, and genetically exposed patient

*transmitted by airborne respiratory droplets

*mechanism of disease: organism deposited in alveoli> inside the alveoli, the host's immune system responds by release of cytokines and lymphocytes that stimulate monocytes and macrophages> Mycobacteria begin to multiply within macrophages}

Clinical tuberculosis divided into:

1—primary tuberculosis

infectious dose: 10 cells

(After 3-4 weeks' immune system attacks, forming **tubercles** (granulomas consisting of a central core containing bacilli surrounded by WBCs that undergoes **caseation necrosis**)

2—secondary tuberculosis (reactivation or reinfection)

If patient doesn't recover from primary tuberculosis, reactivation of bacilli can occur. the patient experiences more severe symptoms. (bloody sputum, fever, anorexia)

3—disseminated tuberculosis, aka Extra pulmonary TB

bacilli disseminate to regional lymph nodes, kidneys, long bones, genital tract, brain, And meninges

-symptoms: Fatigue, weakness, weight loss, fever, and night sweats may be signs of tuberculous disease

treatment of TB: for 6-24 months with at least 2 drugs from a list of 11 + vaccine for prevention (attenuated strain of *M. bovis*)

2. ***Mycobacterium leprae*:**

*causes **leprosy**.

3. ***Mycobacterium avium-intracellulare*:**

*frequently infect patients with AIDS.

Filaments G+ Bacteria:

| Both forms branching filaments gram positive bacteria | |
|--|---|
| <i>Actinomyces</i> | <i>Nocardia</i> |
| Anaerobe | Aerobe |
| Not Acid Fast | Acid Fast (weak) |
| Normal oral flora | Found in soil |
| Causes oral/facial abscesses that drain through sinus tracts, forms yellow "sulfur granules" | Causes pulmonary infections in immunocompromised and cutaneous infections after trauma in immunocompetent |
| Treat with penicillin | Treat with sulfonamides |

G- bacteria flow chart

| Diplococci | "Coccoid" Rods | Oxidase ve+ (comma shaped) | Enterobacteriaceae |
|--|---|--|--|
| <p>*Maltose Fermenters/ encapsulated: <u>N.meningitidis</u></p> <p>*Maltose non-Fermenters/ non-encapsulated: <u>N.gonorrhoeae</u></p> | <p>H.influenza</p> <p>Pasteurella</p> <p>Brucella</p> <p>Bordetella pertussis</p> | <p>*Grow in 42 celsius degree: Campylobacter jejuni</p> <p>*Alkaline media: Vibrio Cholerae</p> <p>*Produce urease: Helicobacter pylori</p> | <p>1-Lactose fermenters:</p> <p>*Fast: <u>E.coli</u> <u>Klebsiella</u> <u>Enterobacter</u></p> <p>*Slow: <u>Citrobacter</u> <u>Serratia</u> <u>Others</u></p> <p>2-Lactose non-fermenters:</p> <p>*Oxidase ve+: Pseudomonas</p> <p>*Oxidase ve-:</p> <p>**produce H2S: <u>Salmonella</u> <u>Proteus</u> <u>Yersinia</u></p> <p>**Do not produce H2S: <u>Shigella</u></p> |

Diplococcus Table:

| N.Gonorrhoeae | N.meningitidis |
|---|--|
| <p>*More Characteristics: Fastidious to cool temp/ drying/ Fatty acids.</p> <p>*transmission: Sexually</p> <p>*Virulence Factors: Antigenic diversity: IgA protease/ beta lactamase/ Pillin/ Fimbriae/ Transferrin/ Lactoferrin/ Hemoglobin-binding/LOS proteins/<u>por</u>>porin protein: prevent phagocytosis (intracellular survival)/ <u>Opa</u>>opacity protein> Firm adhesion/ <u>Rmp</u> protein> protect other surface antigens Opa and por.</p> <p>*Diseases:</p> <p>**Female: 50% symptomatic/asymptomatic reservoir 1-Genital infection: (cervix/ Vagina..etc). 2-Complications: Salpingitis/ pelvic inflammation/ DGI 3-if pregnant may cause: neonatal conjunctivitis</p> <p>**Male: 20% symptomatic 1-Geital infection: restricted in urethra> dysuria & purulent discharge 2-Complication: epididymitis/ prostatitis/ DGI</p> <p>More about DGI> disseminated Gonococcal infection: Skin lesions/ Joints inflammation/ complication> (Hepatitis/ endocarditis/ meningitis)</p> | <p>*Transmission: Oral and RS secretions/ contact with patients.</p> <p>*Virulence Factors: IgA protease/ Capsule/ Pill/ fimbriae/ endotoxins:(protein A/ LOS). *serogroups: A,B,C,Y,W135 (90% of infections)</p> <p>*Pathogenesis: Fimbriae binds to GD1 gangliosides on epithelial cells in Nasopharynx> internalised by phagocytic Vacuoles> avoid intracellular killing> replicate intracellularly> Migrate to the subepithelial space> produce endotoxins.</p> <p>*Disease: 1-Meningitis/ meningoencephalitis (2nd most common after S.pneumoniae). 2-Pneumonia 3-Septicemia 4-arthritis</p> <p>*People at risk: <u>Childrens</u> less than 1-5 years</p> |

Enterobacteriaceae:

1-E. coli: Normal Flora of GI

*Virulence Factors:

Fimbriae/ K-Capsule/ LPS endotoxin/ Enterotoxins (LT/ ST).

***Disease:** Most E. coli are harmless and causes brief diarrhea whereas O157:H7 is not.

1. Septicemia
2. Urinary tract infection: From colon to contaminate urethra and maybe to bladder and the kidneys.
3. Neonatal meningitis
4. Gastroenteritis: 5 different pathogenic groups:

a. **Enterotoxigenic (ETEC):** not invasive
Mechanism>

1. by enterotoxins
 - >Heat stable (ST)> Guanylate cyclase
 - >Heat Labial (HT)> Adenylyl cyclase
- 2) Stimulate Hypersecretion of fluids and electrolytes.

Disease> Traveler's and infant diarrhea.

b. **Enteropathogenic (EPEC):** moderately invasive

Mechanism> Attachment> Disrupt Microvilli

Disease> Infant Diarrhea

c. **Enteraggregative (EAEC):**

Mechanism>

plasmid mediated aggregative adherence of rods.

Diseases: infant and traveler's diarrhea.

d. **Enterohemorrhagic (EHEC):**

Mechanism>

1. Cytotoxic Shigella Toxin: disrupt protein synthesis
2. Destruction of intestinal microvilli

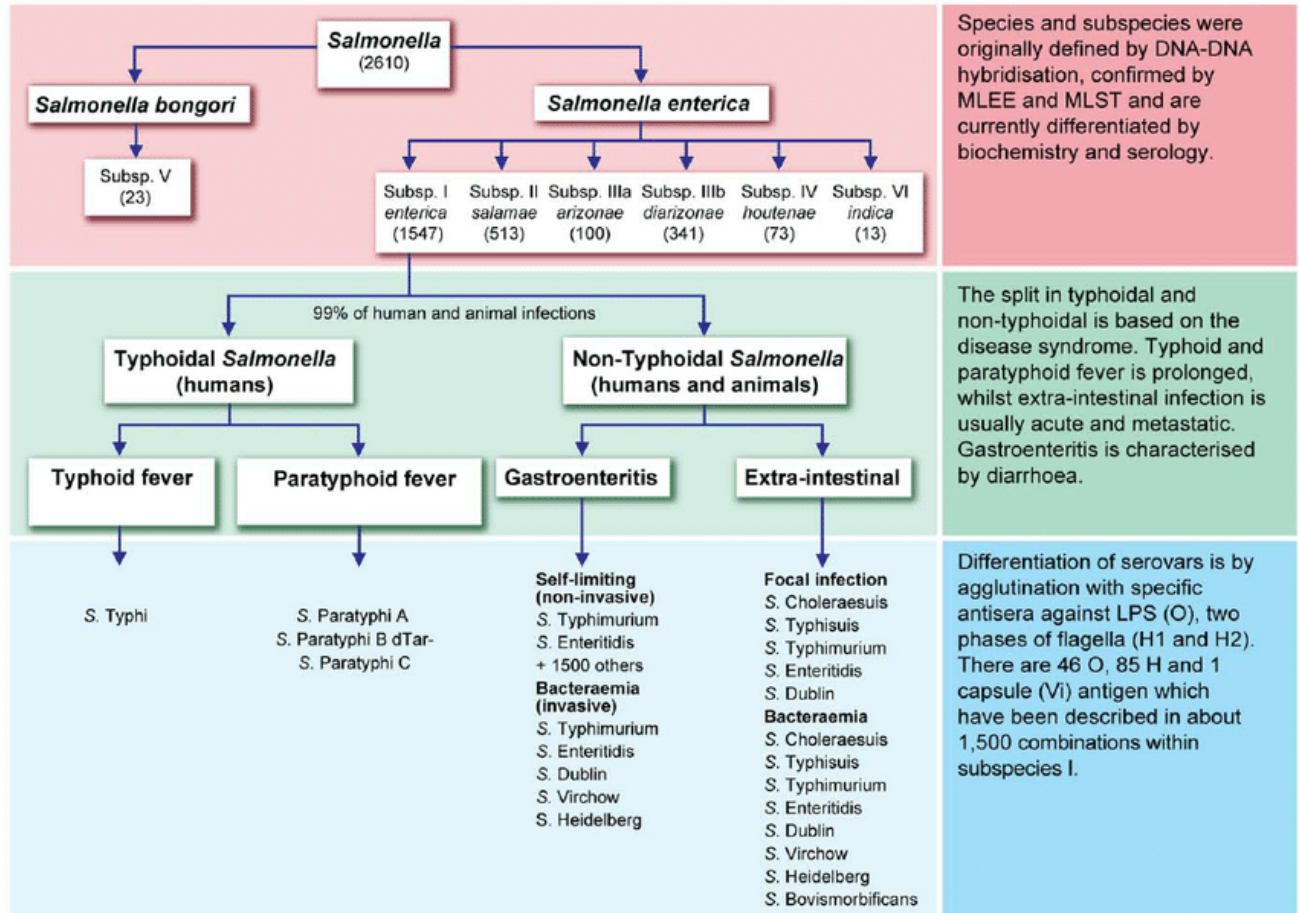
Disease> Hemorrhagic Colitis/ Hemolytic Uremic Syndrome (HUS)

e. EIEC.

| Name/ Category: | 2-Klebsiella | 3-Enterobacter | 4-Serratia |
|-----------------|---|---|--|
| Characteristics | Facultative anaerobes/ encapsulated/ normal flora of RS and GI | Highly Resistance | Usually non-pigmented/ prodigiosin characterise S.macrohaemolytic |
| Disease | 1-pneumoniae 2-Nosocomial UTI infection and Bacteremia | Board-range of hospital acquired infection, such as: pneumonia/ UT/ wound + device infection | 1-pneumonia 2-bacteremia 3-endocarditis Especially: Nicotine addicts/ Hospitalized patients |

5-Salmonella:

Classification: the pic



Morphology:

1. Peritrichous flagella.
2. LPS: O antigen (immune stimulant)/ Lipid A.
3. Capsule: K/ Vi antigen.
4. Common polysaccharide antigen.

Transmission:

1. Direct contaminated food
2. Fecal-oral spread in children

Diseases:

1. Enteric fever (Typhoid):

Pathogenesis: M.O> mouth> Small intestine> invasion of lymphatic + Bloodstream> infection of Liver/Spleen/ marrow> multiply and again pass to blood (Bacteremia)> Onset of illness (10-14 days)> **Fever, Headache, constipation, Bradycardia, Myalgia, rose stomach** > colonize in gallbladder> invasion of intestines again.

2. Gastroenteritis.

3. Paratyphoid fever.

4. Bacteremia + Focal lesions (Extraintestinal):

Pathogenesis: Oral infection> bloodstream> lung/ bones/ meningitis ****No intestinal manifestation.**

Diagnosis:**Culture:** S-S agar/ DCA/ XLD/ MacConkey agar.**Specimen:** Stool/ Urine/ Blood**Tests:** Widal test, antigen used: typhi O/H / Paratyphi A O/H / Paratyphi B O/H

>It takes one week> Blood Culture positive.

>It Takes 3 weeks or more> Stool culture.

Treatment: Replacement of fluids/ antibiotic/ Oral attenuate + IV vaccine.**6-Yersinia:****Virulence Factors:**

1. V and W antigen> antiphagocytic
2. yersiniabactin> siderophore (Fe+3 binding agent)
3. Exotoxin
4. F1-antigen-capsule like antigen.

Species:

| Y.Pestis | Y. enterocolitica | Y.pseudotuberculosis |
|--|---|---|
| *Virulence Factor: 1-F1-Capsule like antigen. 2-Coagulase-temp dependent activities (20-28 celsius>flea temp). 3-Fibrinolytic activities (35-37 celsius> Host temp). *Transmission: Natural sources are: (Cats, Rabbits, Domestic animals), so it's transmitted by: 1-flea Bits 2-Direct contact with infected tissue 3-person to person by inhalation. *Disease: 1-Bubonic plague/ Black death> hemorrhage and lesions all over the body. 1-Bubonic plague> hemorrhage and lesions all Organs. 2-Pneumonic plague. | *Characteristics: Can grow in cold temp/ pleomorphic / Ball's eyes with red center appearance. *Disease: 1-Gastroenteritis (acute watery diarrhea or chronic diarrhea). 2-Enteric disease in children> enlarged mesenteric lymph nodes. | *Diseases: TB like diseases in animals. |

7-Proteus:**People at risk:**

1. Debilitated patients
2. Contaminated IV infusions

Species:

1. **P.Mirabilis**> characterised by Rapid motility (Swarming) and causes urinary tract infection.
2. **P.Vulgaris along with morganella morganii**> nosocomial pathogens.

8-Shigella:**Virulence Factors:** Endotoxin/ Exotoxin (Shigella Toxin)/ Endotoxin/ Neurotoxin

Species:

1. S.dysenteriae:

Transmission:

fecal-oral route

Incubation period:

1-2 days

Diseases:

1. Hemolytic Colitis (HC)
2. Hemolytic uremic Syndrome
3. bloody Diarrhea
4. CNS rxn> Coma + meningitis

2. S.flexneri:

shigellosis> Bacillary dysentery in developing countries.

3. S.boydii

4. S.Sonnei:

Shigellosis> Bacillary dysentery in industrial world.

****Note: it's a Lactose fermenter**

The infectious dose for each pathogen:

| Shigella | Compylobacter jejuni | Salmonella | E.coli | V.cholera |
|----------|----------------------|------------|--------|--|
| 10^3 | 10^2 - 10^6 | 10^3 | 10^8 | In water: 10^{10} In Food: 10^4 |

Test yourself:

1. Scalded skin syndrome is caused by exotoxin (exfoliatins) produced by

- a. Streptococcus pyogenes
- b. Pseudomonas aeruginosa
- c. Staphylococcus aureus
- d. Propionibacterium acne
- e. Demodex folliculorum

2. Which of the following microorganisms causes scarlet fever?

- a. Streptococcus pyogenes
- b. Pseudomonas aeruginosa
- c. Staphylococcus aureus
- d. Propionibacterium acne
- e. Demodex folliculorum

3. Which of the following is not the characteristics of impetigo?

- a. Common in children
- b. Can be caused by Staphylococcus aureus
- c. Can be caused by Streptococcus pyogenes
- d. Is highly contagious
- e. Can be caused by pseudomonads

4. Burn patients often develop nosocomial infection caused by:

- a. Streptococcus epidermis
- b. Corynebacterium spp.
- c. Staphylococcus aureus
- d. Candida albicans
- e. Pseudomonas aeruginosa

5. The bacteria that multiply in blocked skin pores, metabolize sebum, and can lead to the development of acne are:

- a. Pseudomonas aeruginosa
- b. Propionibacterium spp.
- c. Serratia marcescens
- d. Streptococcus pyogenes
- e. Acne is not caused by bacterial infection

6. Bacterial conjunctivitis (inflammation of the eye conjunctiva) can be caused by:

- a. Staphylococcus aureus
- b. Streptococcus pneumoniae
- c. Neisseria gonorrhoeae
- d. Pseudomonas aeruginosa
- e. All of the above bacteria can cause conjunctivitis

7. Gas gangrene is most likely associated with infection with:

- a. Staphylococcus aureus
- b. Clostridium perfringens
- c. Streptococcus pneumoniae
- d. Neisseria gonorrhoeae
- e. Pseudomonas aeruginosa

8. Which of the following statements is correct?

- A. Streptococci are catalase positive.
- B. Growth of Streptococcus pneumoniae is not sensitive to optochin.
- C. Streptococcus pyogenes is highly sensitive to bacitracin.
- D. Streptococci are obligate anaerobes.
- E. Enterococcus faecalis is β -hemolytic

9- A 55-year-old man was admitted to a local hospital with fever and chills. The patient was human immunodeficiency virus positive and had received multiple courses of antibiotics. Blood cultures grew gram-positive cocci, which tested positive with group D streptococcal anti - sera. The isolate was resistant to penicillin and vancomycin. Which one of the following is the most likely pathogen?

- A. *Streptococcus pneumoniae*
- B. *Enterococcus faecium*
- C. *Streptococcus pyogenes*
- D. *Streptococcus agalactiae*
- E. *Streptococcus mutans*

10- A 65-year-old male presents to his family physician with a rapid onset fever, chest pain and cough productive of rusty-yellow sputum. Chest X-ray shows focal lobar infiltrates. A Gram stain of a sputum sample contained many polymorphonuclear leukocytes and extracellular gram-positive diplococci. Capsule-specific antibodies bound to the diplococci resulted in a positive Quellung reaction. Which of the following is the most likely pathogen?

- A. *Streptococcus pneumoniae*
- B. *Enterococcus faecium*
- C. *Streptococcus pyogenes*
- D. *Streptococcus agalactiae*
- E. *Enterococcus faecalis*

11- A diagnosis of diphtheria is confirmed by:

A. microscopic appearance of organisms stained with methylene blue.

B. isolation of a typical colony on Tinsdale agar.

C. isolation of typical organisms from materials such as blood, showing invasiveness.

D. detection of β phage plaques in cultures of suspicious isolates.

E. demonstration of toxin production by a suspicious isolate.

12- A 26-year-old woman, 8 months pregnant, visits her obstetrician complaining of fever, myalgia and backache of recent onset. Three weeks earlier, the patient had been a weekend guest at a rural farmhouse, where all the food was reported to be "unprocessed" and "natural." A culture of the patient's blood shows gram-positive rods that are catalase positive and display a distinctive tumbling motility in liquid medium. What is the most likely source of the woman's infection?

- A. Well-done roast beef
- B. Fresh, raw cow's milk
- C. Home-baked bread
- D. Homemade applesauce
- E. Baked apple pie

13- A 45-year-old cattle rancher presents to his physician with a wound on his forearm that resembles a large scab. Samples collected from the wound were cultured and examined. The bacteria recovered were

Gram positive, nonmotile rods with square ends. The cultured bacteria formed irregularly shaped, nonhemolytic colonies on blood agar plates and individual cells from the plates had a centrally located spore. What is the most likely cause of this infection?

- A. *Listeria monocytogenes*
- B. *Staphylococcus aureus*
- C. *Legionella pneumophila*
- D. *Corynebacterium diphtheriae*
- E. *Bacillus anthracis*

14-Which of the following neisserial virulence factors is subject to high-frequency antigenic variation by a mechanism involving recombination between silent and expressed chromosomal loci?

- A. Lipooligosaccharide
- B. Capsule
- C. Porin
- D. Pilin
- E. Opacity proteins

15- Which of the following neisserial virulence factors is part of the tetravalent vaccine that protects against some but not all serogroups of *Neisseria meningitidis*?

- A. Lipooligosaccharide
- B. Capsule C.Porin D.Pilin
- E. Opacity proteins

16-Gram negative rods that do not ferment lactose is:

- 1. *Bacillus*
- 2. *Bacillus subtilis*
- 3. *Salmonella*
- 4. *Klebsiella*

17-'Shigellosis' is a disease found particularly in

- 1. Pigs
- 2. Rats
- 3. Human
- 4. Goats

18-E. coli can ferment

- 1. Maltose
- 2. Sucrose
- 3. Lactose
- 4. Galactose

19-Causative agent for 'neonatal meningitis' is:

- 1. *E.coli*
- 2. *Shigella*
- 3. *Klebsiella*
- 4. *Proteus*

20-Strains that are produced from 'enterotoxins' do not cause:

- 1. Inflammation
- 2. Dysentery
- 3. Plague
- 4. Rash

21-A Commensal pathogen (such as *E. Coli*) means:

- 1. An opportunistic pathogen
- 2. A primary pathogen
- 3. pathogen that lives within us
- 4. A fastidious pathogen

22-The genus *Neisseria* include bacteria which cause(s):

- 1. Syphilis and Lyme Disease.
- 2. Pneumonia and Septicemia.
- 3. Gonorrhea and Meningitis.
- 4. All zoonotic diseases (parasites in humans and animals).

23-the pathogenic group that causes Traveler's diarrhea:

- 1. ETEC
- 2. EAEC
- 3. EPEC
- 4. Both 1 and 2

24-One of the Following Bacteria can produce prodigiosin, which is:

1. Y.pestis
2. N.gonorrhoeae
3. S.marrescense
4. S.sonnei

25-Widal test is used for:

1. E.coli
2. S.typhi
3. S.dysenteriae
4. S.pneumoniae

26-Y.pestis optimal coagulase activity is:

1. 35-37 celsius
2. 24-28 celsius
3. 36-38 celsius
4. 20-28 Celsius

27-the Black death is caused by:

1. S.flexneri
2. S. paratyphi
3. Y.pestis
4. V.cholera

28-Bull's eye appearance with red center:

1. P.mirabilis
2. Y.enterocolitis
3. E.coli
4. N. meningitidis

29-All of the following bacteria are non-lactose fermenters, except:

1. S.sonni
2. Y.pseudotuberculosis
3. S.typhimurium
4. P.Vulgaris

Answers

- | | |
|------|------|
| 1- a | 16-3 |
| 2- e | 17-3 |
| 3- e | 18-3 |
| 4- e | 19-1 |
| 5- b | 20-1 |
| 6- e | 21-1 |
| 7- b | 22-3 |
| 8-c | 23-4 |
| 9-b | 24-3 |
| 10-a | 25-2 |
| 11-e | 26-4 |
| 12-b | 27-3 |
| 13-e | 28-3 |
| 14-d | 29-1 |
| 15-b | |

The end ...Good luck ☺

الطموح اللامحدود هو الوقود الذي يساعد الانسان على الوصول الى طريق النجاح الدائم. النجاح يجذب النجاح، ليس هنالك مفر من هذا القانون الكوني العظيم فاحرص على تحقيق جزءا منه سواء كنت عاملا بالاجر أو أميراً.

إنهض فإن لك نصيب من هذا النجاح !

