

Orientation to Gram Positive Bacteria of Medical Importance

Date: 22/10/2024

Dr. Sulaiman Mahmoud Bani Abdel-Rahman

Bachelor degree in Medicine and Surgery - Mutah university

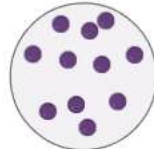
MSC Medical Microbiology – University of Manchester

PhD Medical Virology - University of Manchester

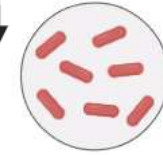


Gram-positive

Cocci



Rods



Clostridium
Corynebacterium
Listeria
Bacillus
Mycobacterium

Catalase test



Streptococci



Staphylococci

Growth on sheep's blood agar



None

γ -hemolytic

Enterococcus



β -hemolytic

Group A

S. pyogenes

Group B

S. agalactiae



α -hemolytic

Capsule

S. pneumoniae

No Capsule

Viridans streptococci

Coagulase test



S. saprophyticus
S. epidermidis



S. aureus



Shapes of Bacteria



Coccus



Coccobacillus



Bacillus



Vibrio



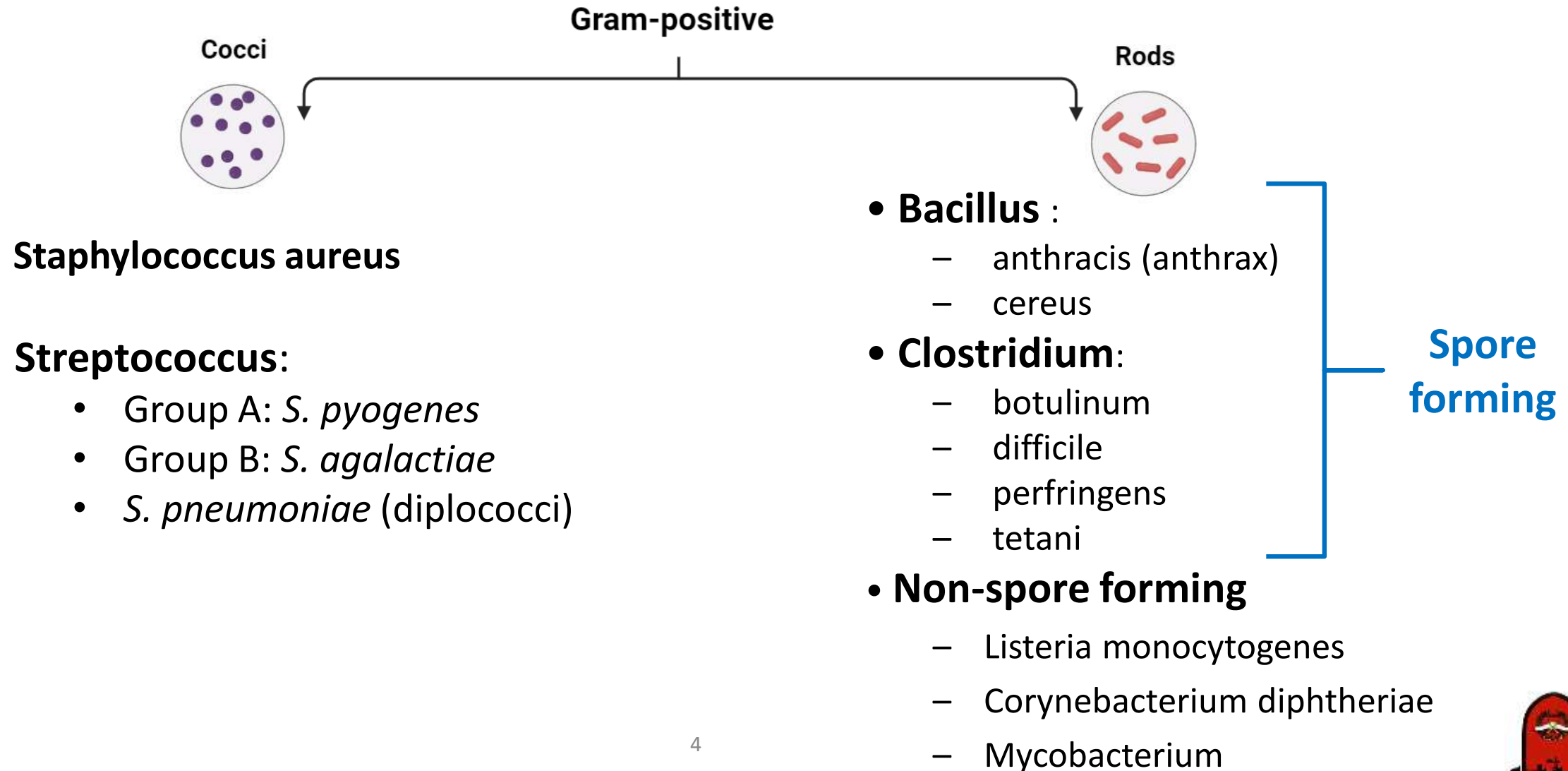
Spirillum



Spirochete



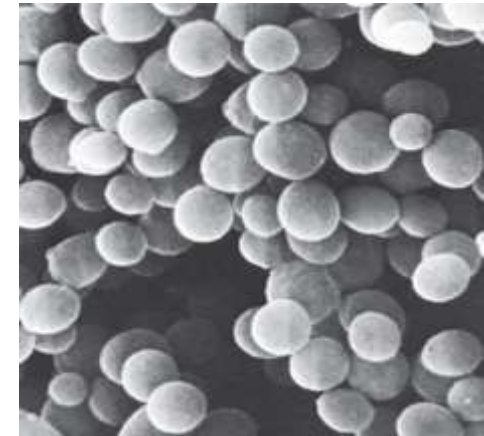
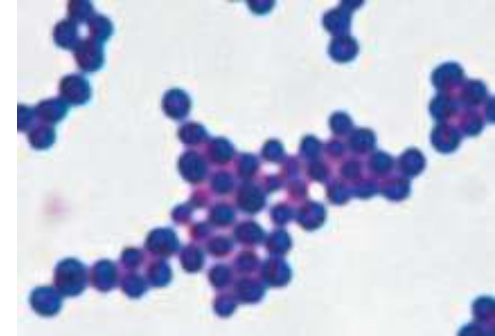
Medically Important Gram-Positive Cocci



Medically Important Gram-Positive Cocci

Staphylococci General Characteristics

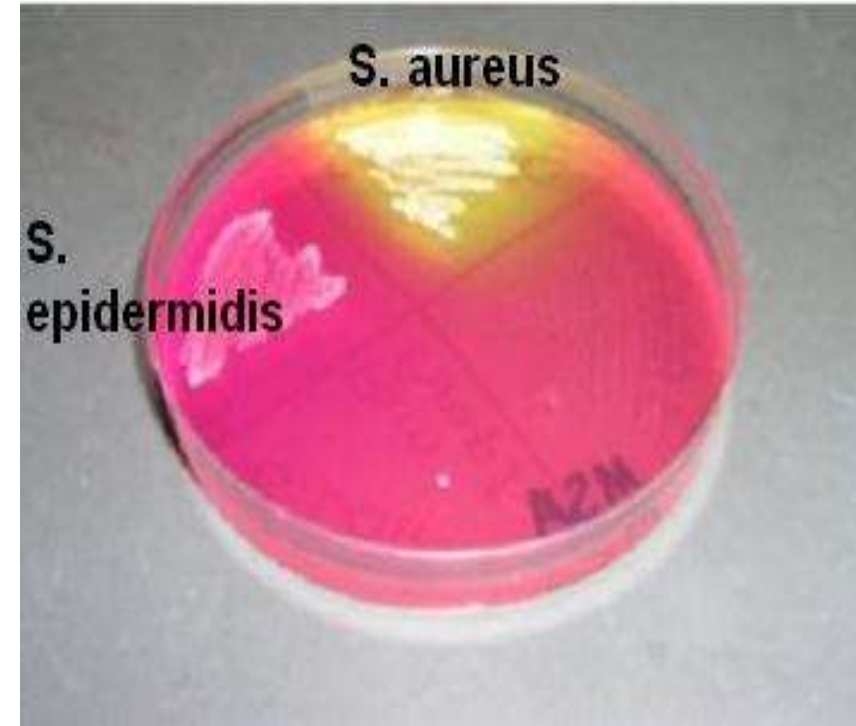
- Common inhabitant of the skin and mucous membranes.
- Spherical cells arranged in irregular clusters.
- Produces many virulence factors



Medically Important Gram-Positive Cocci

Staphylococcus aureus

- Diseases:
 - Food poisoning.
 - Localized infections (Abscess formation).
 - Spreading infections.
 - Necrotizing infections.
 - Systemic infections (ex. Osteomyelitis).



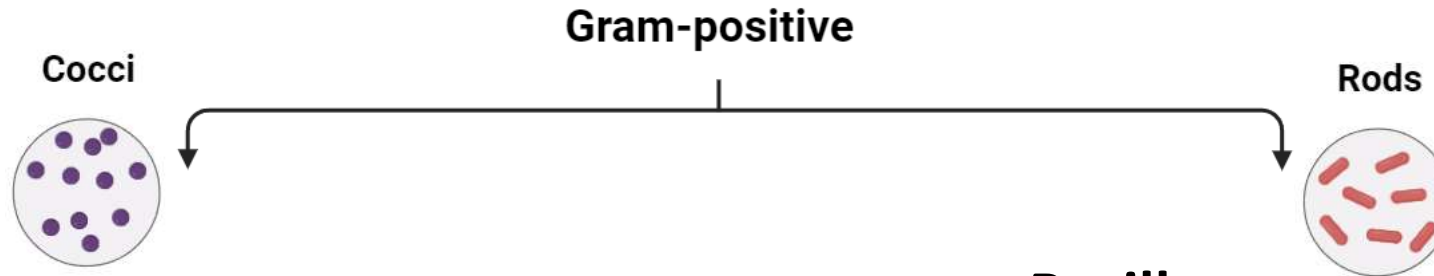
Medically Important Gram-Positive Cocci

Coagulase-negative staphylococcus

- Frequently involved in nosocomial and opportunistic infections.
- *S. epidermidis* – lives on skin and mucous membranes; endocarditis, bacteremia, UTI.
- *S. saprophyticus* – infrequently lives on skin, intestine, vagina; UTI.



Medically Important Gram-Positive Cocci



Staphylococcus aureus

Streptococcus:

- Group A: *S. pyogenes*
- Group B: *S. agalactiae*
- *S. pneumoniae* (diplococci)

• **Bacillus :**

- anthracis (anthrax)
- cereus

• **Clostridium:**

- botulinum
- difficile
- perfringens
- tetani

• **Non-spore forming**

- *Listeria monocytogenes*
- *Corynebacterium diphtheriae*
- *Mycobacterium*

Spore forming



Medically Important Gram-Positive Cocci

Streptococci

- Gram-positive cocci
- Catalase & Coagulase negative
- Sensitive to drying, heat, and disinfectants
- Classification
 - **α -hemolytic:** partial hemolysis of RBCs
 - **β -hemolytic:** complete hemolysis of RBCs
 - **γ -hemolytic:** no hemolysis of RBCs



Medically Important Gram-Positive Cocci

Streptococci - *S. pyogenes*

***S. pyogenes* (Group A strep):**

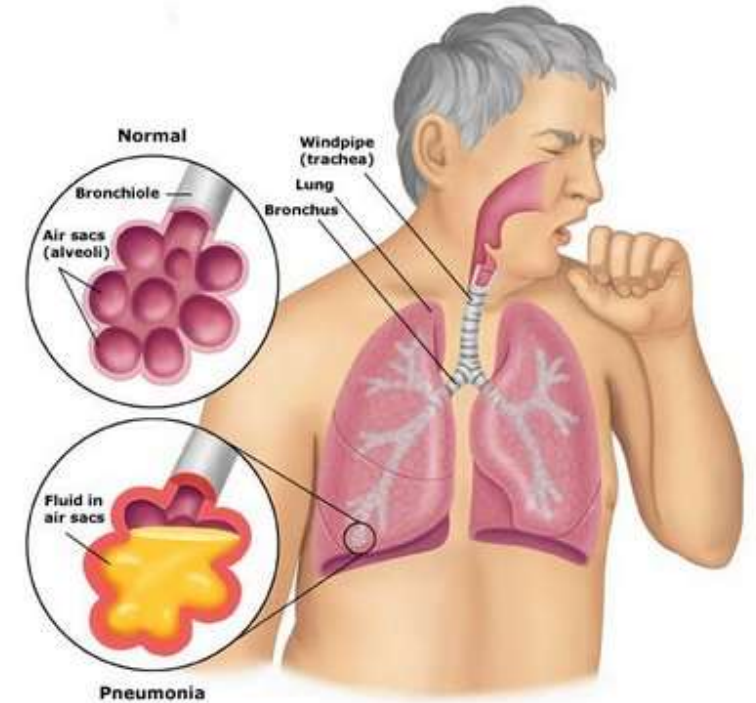
- Group-A streptococci (GAS).
- β -hemolytic.
- Most serious streptococcal pathogen.
- Inhabits throat, nasopharynx, occasionally skin.
- Diseases:
 - Pharyngitis.
 - Skin infections.
 - Necrotizing infections.
 - Systemic infections



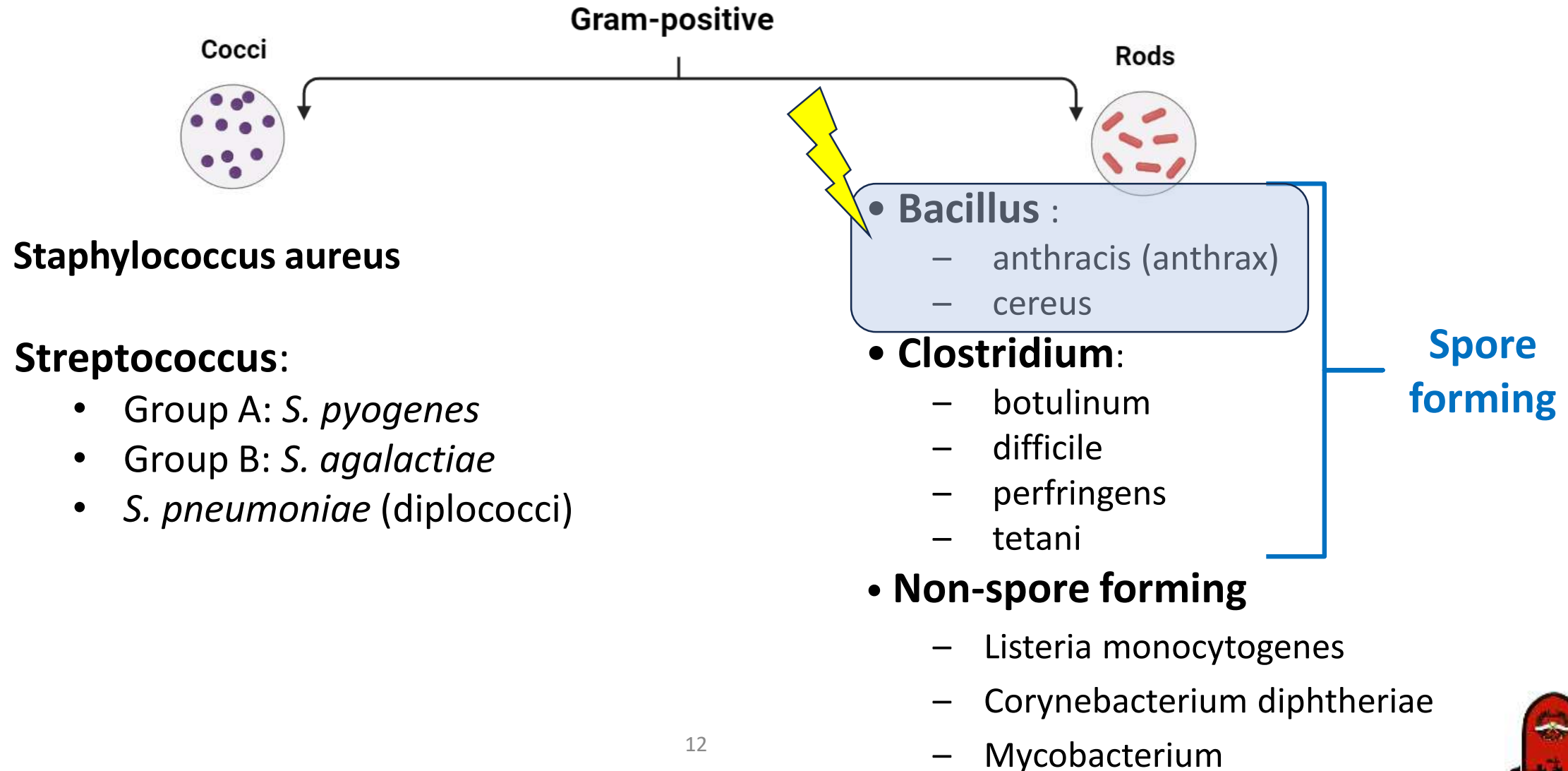
Medically Important Gram-Positive Cocci

Streptococci - *Streptococcus pneumoniae*

- Pneumonia-inflammatory condition of the lung.
- Inhabits nasopharynx of healthy people.
- May also infect brain: (pneumococcal meningitis) and blood stream (pneumococcus septicemia).



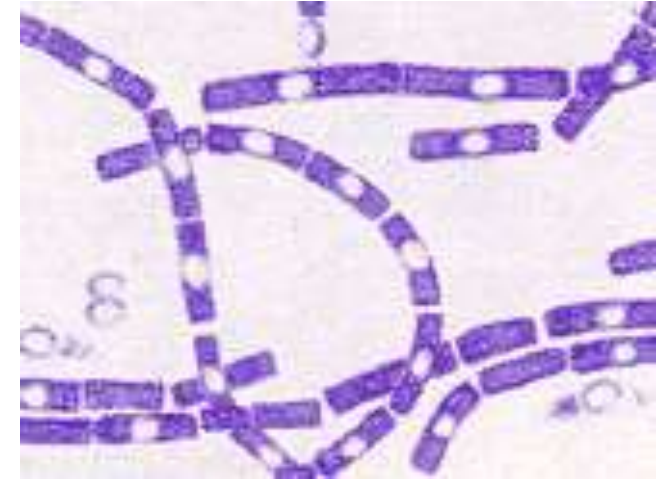
Medically Important Gram-Positive Cocci



Medically Important Gram-Positive Bacilli

Bacillus - *Bacillus anthracis*

- Large, block-shaped rods
- Central spores
- Virulence factors – polypeptide capsule/exotoxins
- 3 types of anthrax:
 - Cutaneous – spores enter through skin, black sore; least dangerous.
 - Pulmonary – inhalation of spores.
 - Gastrointestinal – ingested spores.



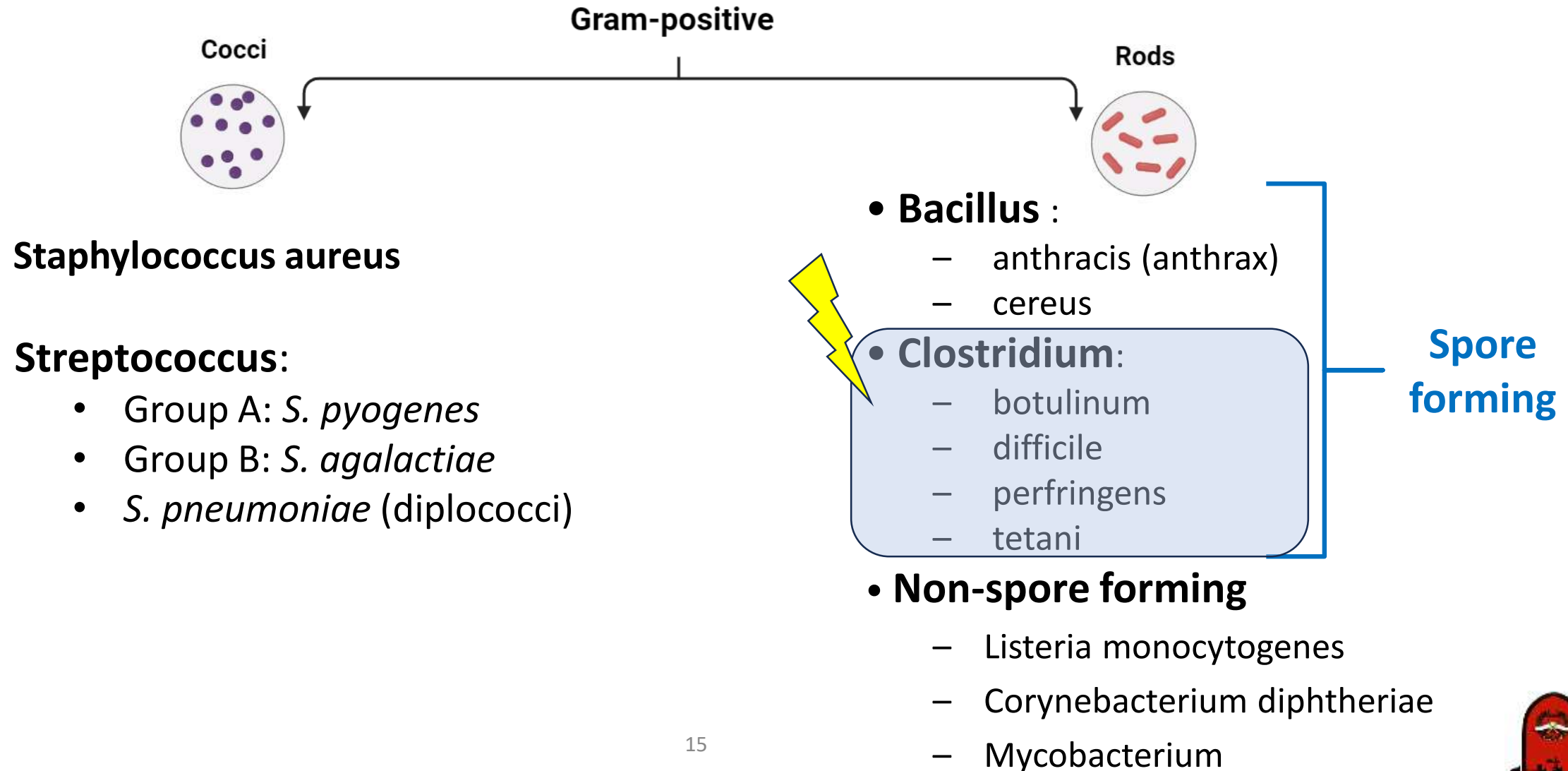
Medically Important Gram-Positive Bacilli

Bacillus - *Bacillus cereus*

- Grows in foods, spores survive cooking/ reheating.
- Ingestion of toxin-containing food causes nausea, vomiting, abdominal cramps, diarrhea; 24 hour duration.
- No treatment.
- Increasingly reported in immunosuppressed.



Medically Important Gram-Positive Cocci



Medically Important Gram-Positive Bacilli

Clostridium - *Clostridium difficile*

- Normal flora colon, in low numbers.
- Causes antibiotic associated colitis
- Due to treatment with broad-spectrum antibiotics that kills other bacteria: *C. difficile* overgrowth
- Enterotoxins that damage intestines.
- Major cause of diarrhea in hospitals.
- Treatment: stop antimicrobials/fluid electrolyte replacement.



Medically Important Gram-Positive Bacilli

Clostridium - *Clostridium perfringens* (Gas Gangrene)

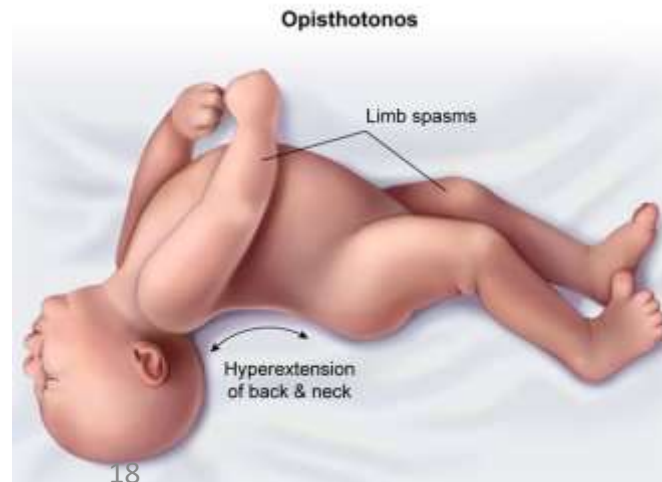
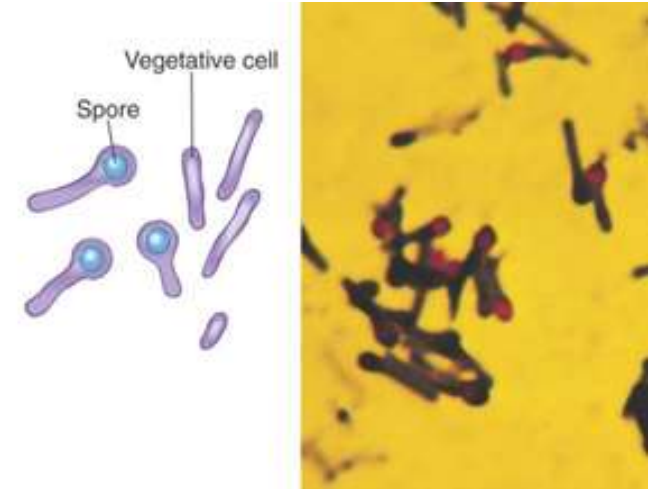
- Soft tissue :wound infections: myonecrosis
- Predisposing factors: infection of all types of wounds.
- Virulence factors (lytic enzymes)
- Treatment: antibiotics/amputation



Medically Important Gram-Positive Bacilli

Clostridium - *Clostridium tetani* : Tetanus

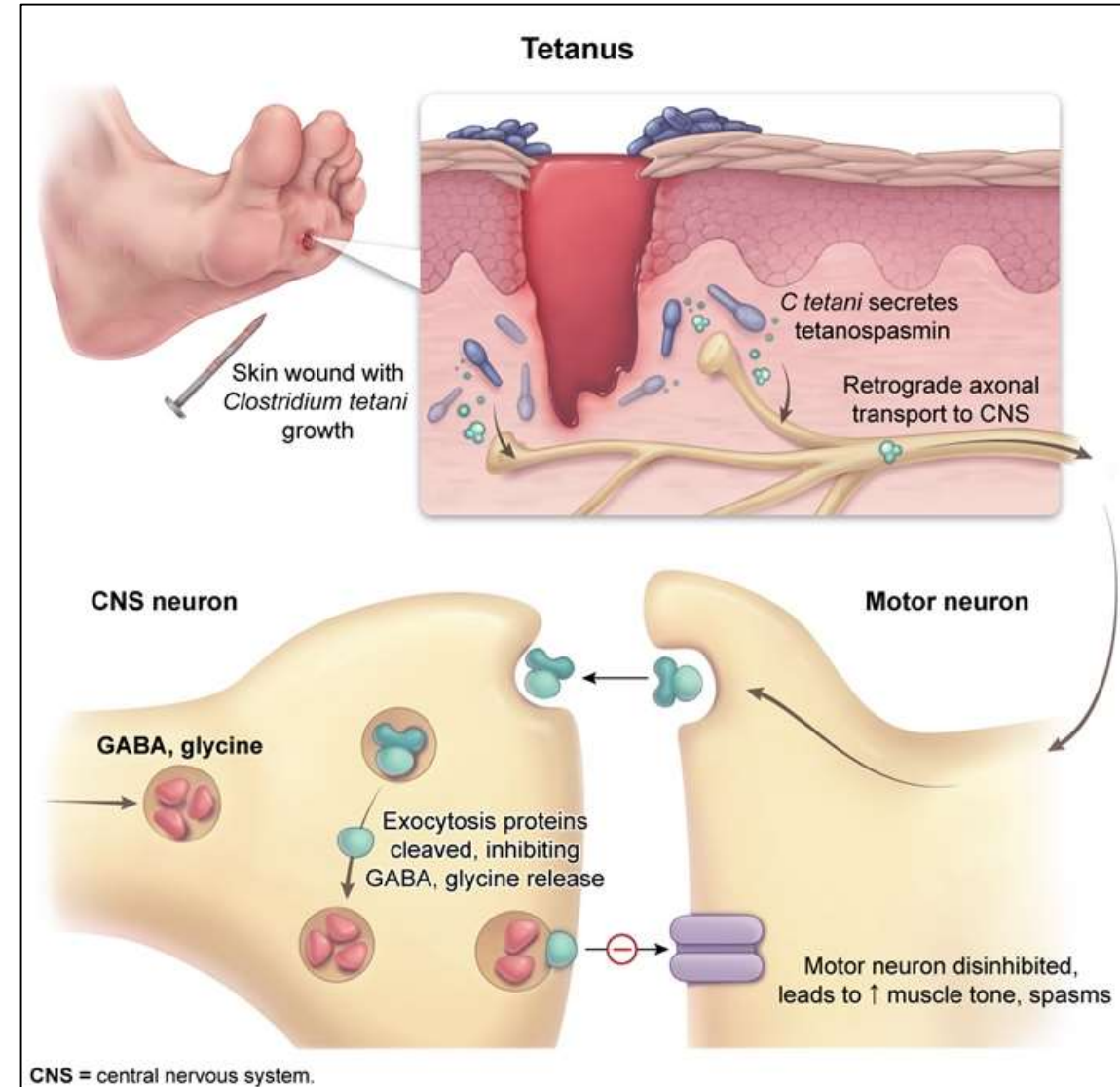
- Common resident :of soil and GI tracts of animals.
- Causes tetanus or lockjaw, a neuromuscular disease.
- Most commonly among IV drug abusers and neonates in developing countries.



Medically Important Gram-Positive Bacilli

Clostridium - *Clostridium tetani* : Tetanus

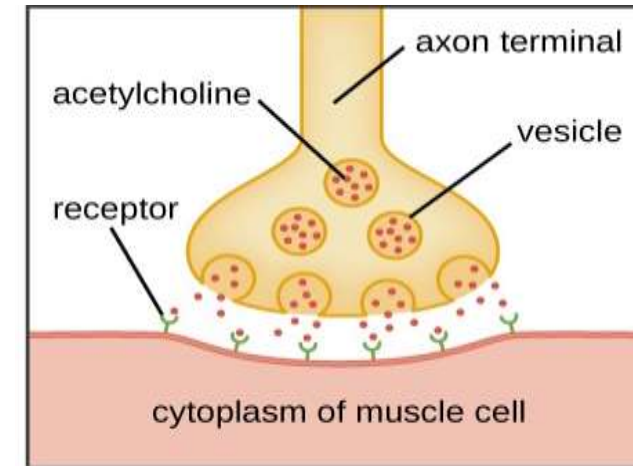
C tetani causes disease not through tissue invasion but by producing a potent metalloprotease **exotoxin** (tetanospasmin) that is deadly in nanogram quantities. The toxin first binds to receptors on the presynaptic membranes of peripheral motor neurons. From there, it migrates by **retrograde axonal transport** to central inhibitory neurons in the spinal cord and brain stem and prevents release of the inhibitory neurotransmitters **glycine** and **gamma-aminobutyric acid (GABA)**. Suppression of inhibitory nerve activity results in **increased activation** of motor nerves, causing **muscle spasms** and **hyperreflexia**.



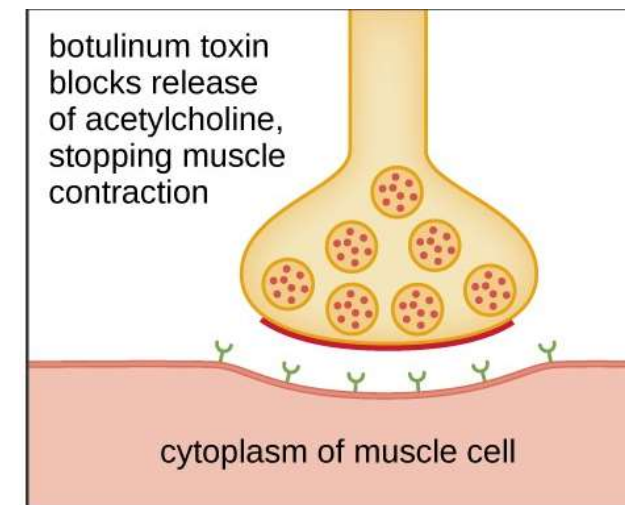
Medically Important Gram-Positive Bacilli

Clostridium - *Clostridium Botulinum*: Flaccid paralysis

- Botulism—intoxication associated with inadequate food preservation
- Toxin carried to neuromuscular junctions: blocks the release of acetylcholine: necessary for muscle contraction to occur.
- Clinically
 - Double or blurred vision
 - Difficulty swallowing
 - Neuromuscular symptoms

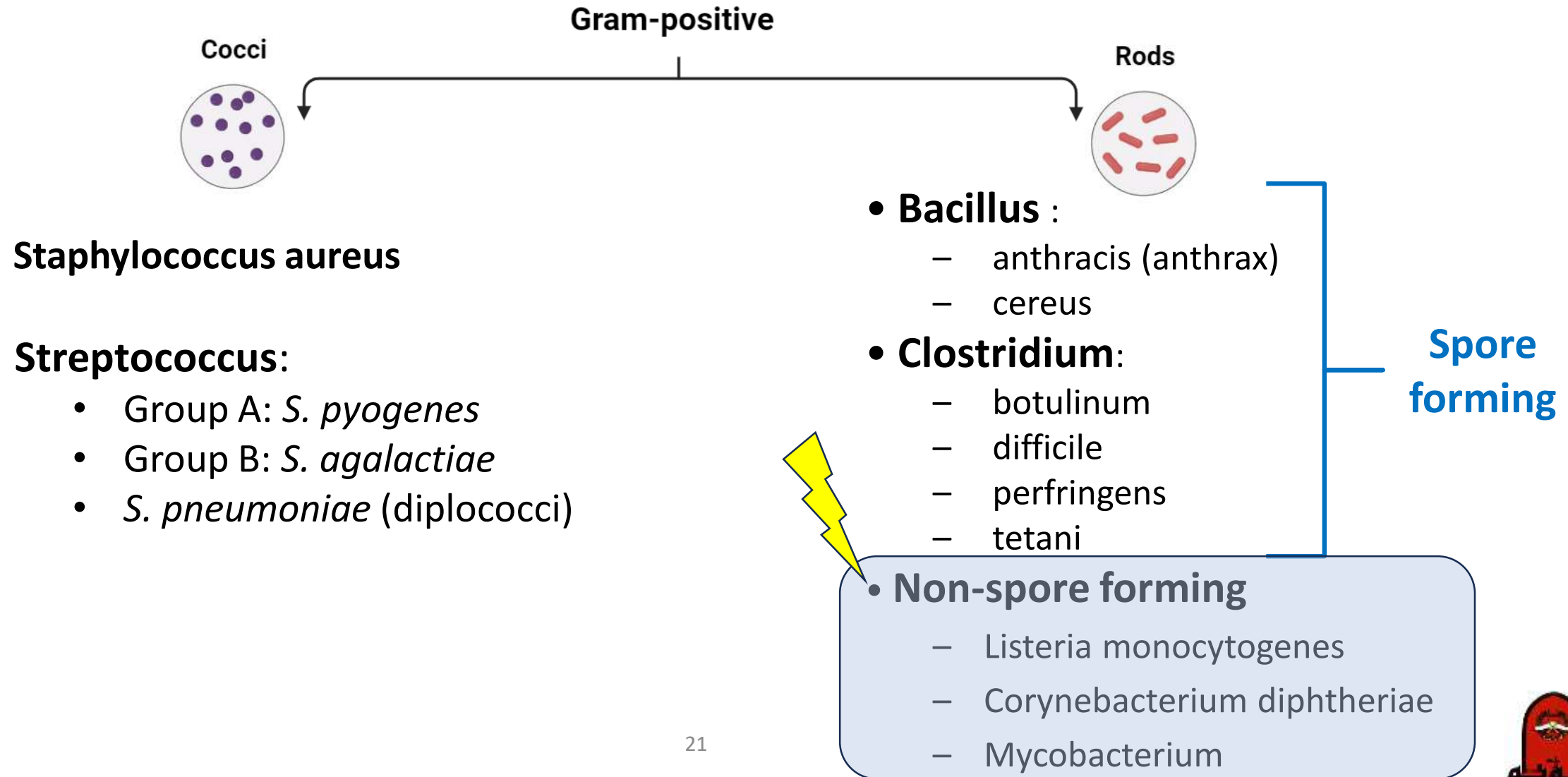


normal mechanism



abnormal mechanism

Medically Important Gram-Positive Cocci



Medically Important Gram-Positive Bacilli

Gram Positive Non-Spore-Formers

Listeria monocytogenes

- Found in soil, water, luncheon meats, hot dogs, cheese.
- Resistant to long storage and refrigeration, heat, salt, pH extremes and bile.



Medically Important Gram-Positive Bacilli

Gram Positive Non-Spore-Formers

Corynebacterium diphtheriae

- Virulence factors: diphtherotoxin.
- Vaccine (DPT).
- Causes a pseudomembrane which can cause asphyxiation.
- Acquired via respiratory droplets from carriers or actively infected individuals.



Medically Important Gram-Positive Bacilli

Gram Positive Non-Spore-Formers

Mycobacterium

- Gram-positive irregular bacilli.
- Acid-fast staining: mycolic acids.
- Strict aerobes.
- Grow slowly.
- Virulence factors -contain complex waxes that prevent destruction by lysosomes or macrophages.

