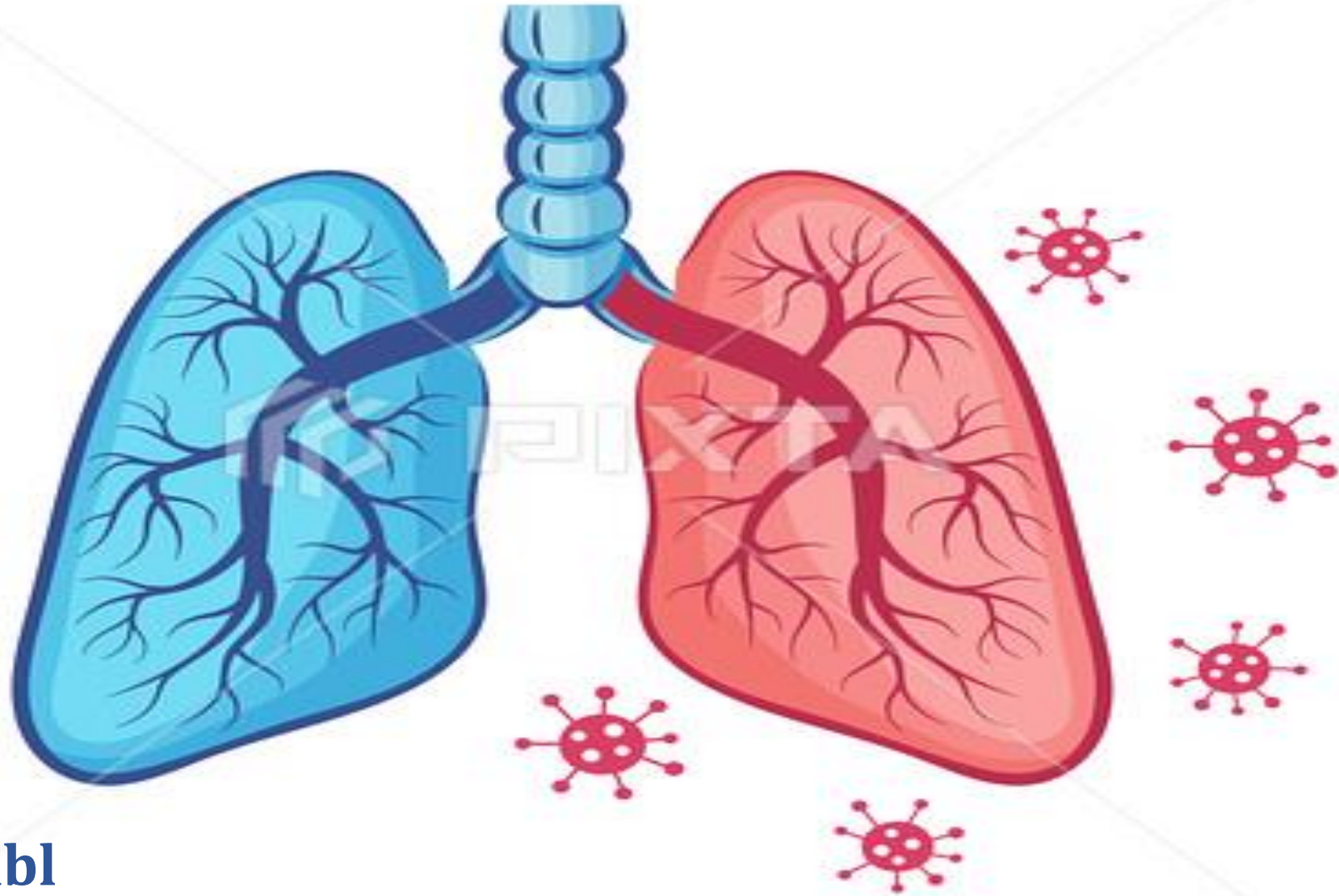


RESPIRATORY TRACT INFECTIONS - III



By
Prof. Hala Tabl

IX- Pneumonia

Community Acquired Pneumonia (CAP):

Bacterial causes:

- **Streptococcus pneumoniae** (the commonest cause of lobar pneumonia in young children and elderly).
- Haemophilus influenzae
- Staphylococcus aureus
- Streptococcus pyogenes
- **Bacillus anthracis** (pneumonic anthrax)
- Yersinia pestis (pneumonic plague)
- Mycobacterium tuberculosis & Atypical mycobacteria

Atypical pneumonia:

(Mycoplasma pneumoniae, Legionella pneumophila, Chlamydia psittaci, Coxiella burnetii).

Fungal causes:

- Histoplasma capsulatum, Aspergillus fumigatus, Coccidioides immitis, Blastomyces dermatitis, Cryptococcus neoformans, Pneumocystis jirovecii

Viral causes:

Rarely the primary cause of pneumonia and when they cause pneumonia, it is mainly in infants and immuno-compromised patients.

- Influenza
- Respiratory syncytial virus (predominant in infants).
- Para - influenza virus
- Adenoviruses

Parasitic causes:

- Paragonimus westermani
- Loeffler's syndrome (Ascaris lumbricoides, Strongyloides stercoralis, Ancylostoma duodenale).

Hospital Acquired (Nosocomial) Pneumonia (HAP):

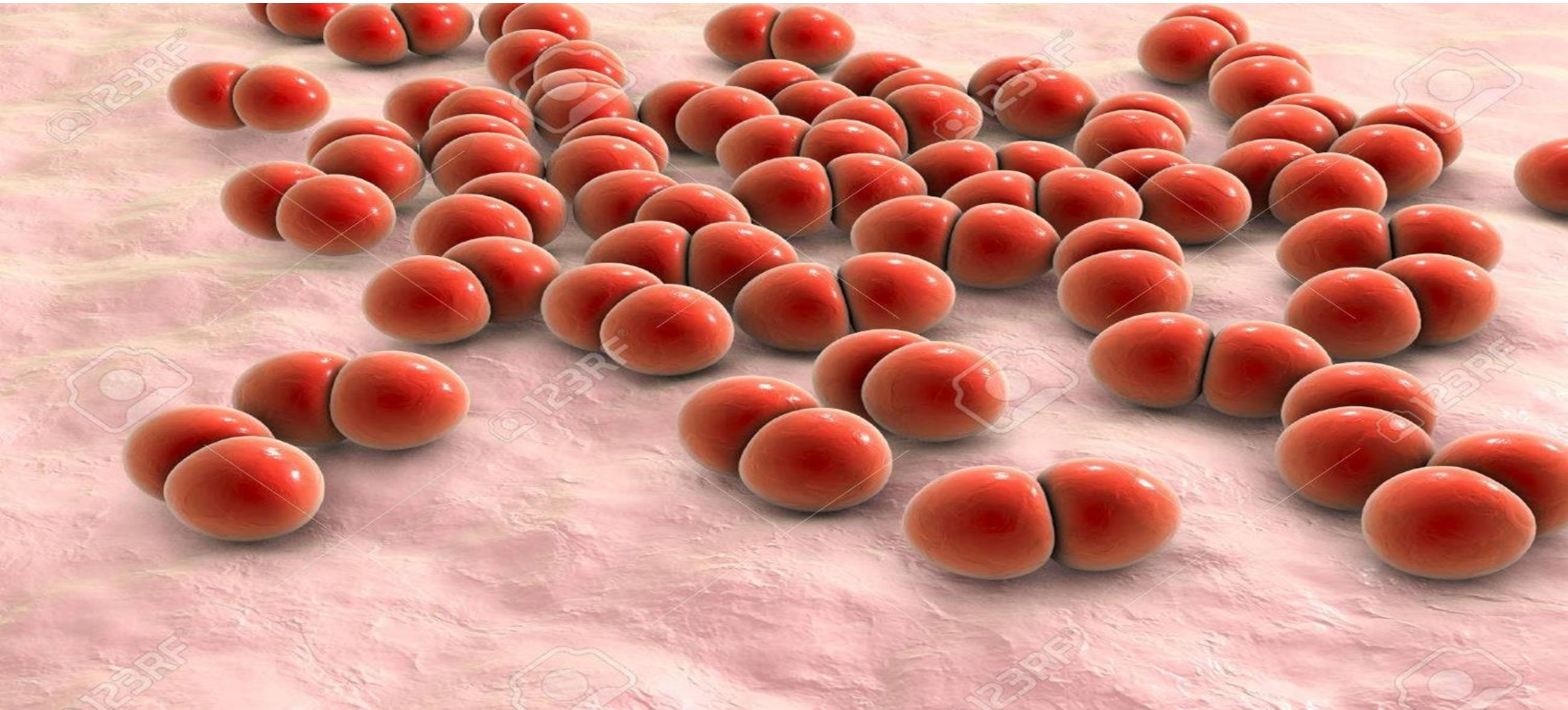
(48hs or more after admission)

(**Klebsiella pneumoniae**, **Pseudomonas aeruginosa** and **E. coli**, **Staphylococcus aureus** MRSA).

Empyema (a collection of pus in the pleural cavity): Mostly caused by pyogenic G+ve cocci especially **Staphylococcus aureus** and G-ve bacilli especially **Klebsiella pneumoniae**.

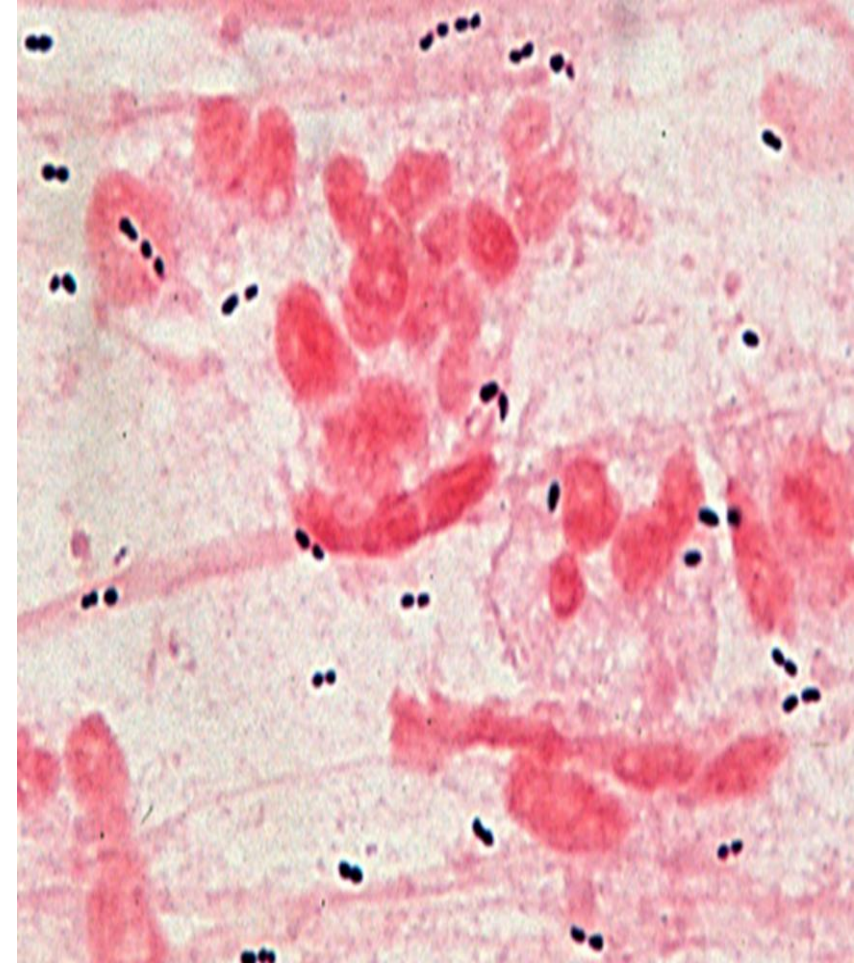
Lung Abscess: Anaerobes (Peptostreptococcus spp., Prevotella spp. and Fusobacterium), **S. aureus**, **K. pneumoniae**.

STREPTOCOCCUS PNEUMONIAE “PNEUMOCOCCI”



Morphology

- **Gram-positive, diplococci** (arranged in pairs).
- **Capsulated (Polysaccharide capsule)**, capsule appears as unstained halo around the organism.



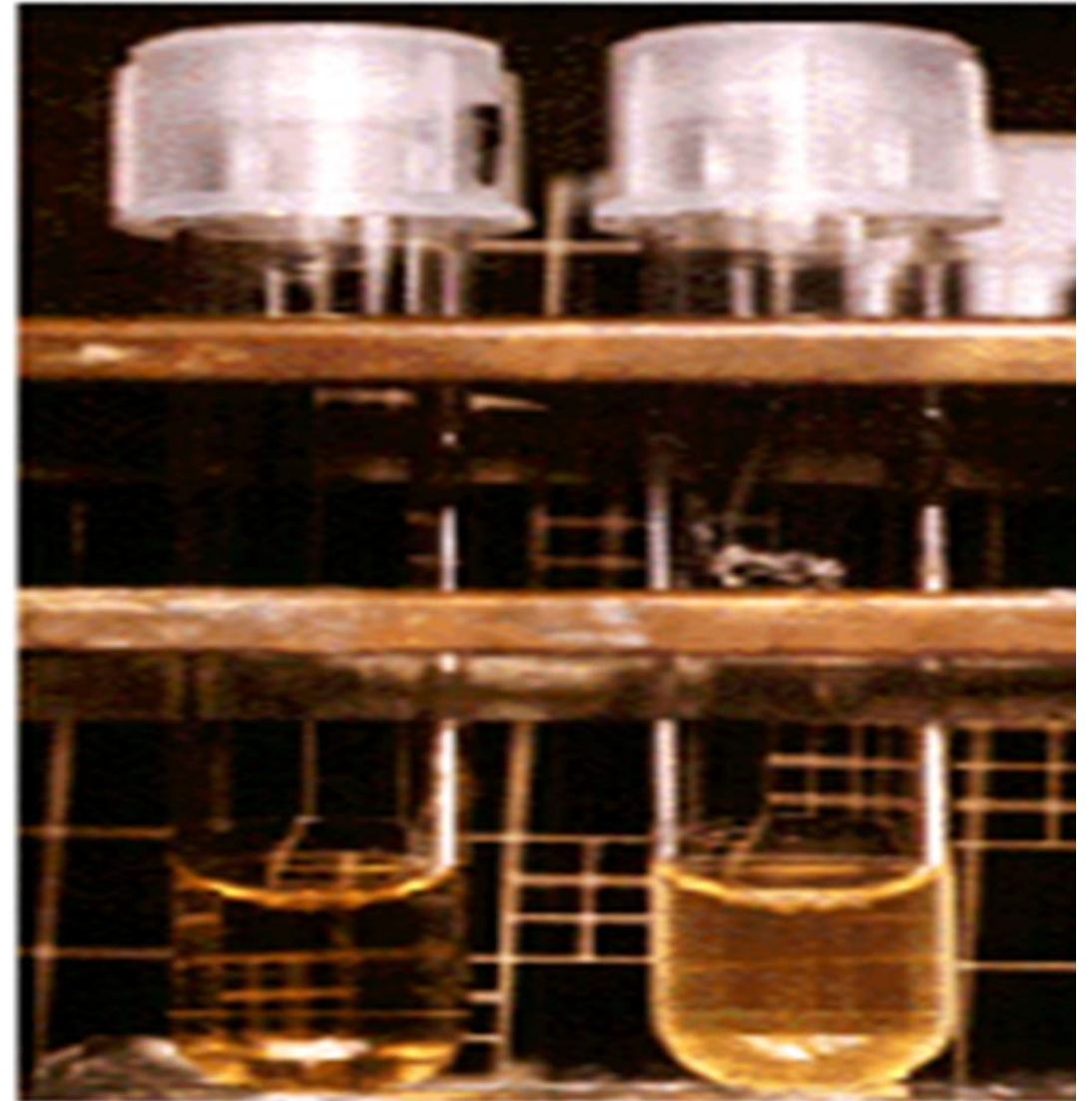
Culture:

- Aerobic and facultative anaerobe.
- Does not grow on ordinary media. Growth needs an enriched media as blood agar.
- On blood agar, colonies are surrounded by **partial** zone of haemolysis with **greenish** discoloration (**Alpha haemolysis**).
- It is **sensitive to optochin** (Antibacterial agent).
- The pneumococcus dies rapidly in cultures due to **natural autolysis**.



Biochemical reaction:

- **Ferment Inulin.**
- **Soluble in bile.**
- **Catalase-negative.**



Pneumo
+
bile

Pneumo
+
broth

Table: Differences between Strept. viridans and Pneumococci

	Pneumococci	Strept viridans
1) Capsule	Capsulated	Non - capsulated
2) Bile solubility	+	-
3) Optochin sensitivity	+	-
4) Inulin fermentation	+	-

Antigenic structure & virulence factors

- **A polysaccharide capsule:**
 - ✓ **The major virulence factor** (Anti-phagocytic).
 - ✓ Permits classification (**Typing**) of pneumococci to more than 90 types.
- **IgA protease:** enhances colonization of the respiratory tract.
- **Pneumolysin:** Pore forming toxin (the hemolysin that causes α -hemolysis).
- **Autolysin:** lyse the bacterial wall and release potentially lethal toxins.

Pathogenesis & clinical findings:

- Pneumococci are **the most common** cause of:
 - **Otitis media and sinusitis.**
 - **Community Acquired Pneumonia.** It is **typical lobar pneumonia** (Fever, chills, cough with red brown “rusty” sputum, dyspnea and tachypnea).
 - **Bacteremia.**
 - **Meningitis.**
- **Predisposing factors:**
 - Children < 2 ys and elderly > 65 ys.
 - Smokers and alcoholics (depress the cough reflex)
 - **Asplenia**
 - Immunocompromized e.g., HIV, cancers,...
 - Abnormality of the respiratory tract (viral infections, chronic lung diseases,..)



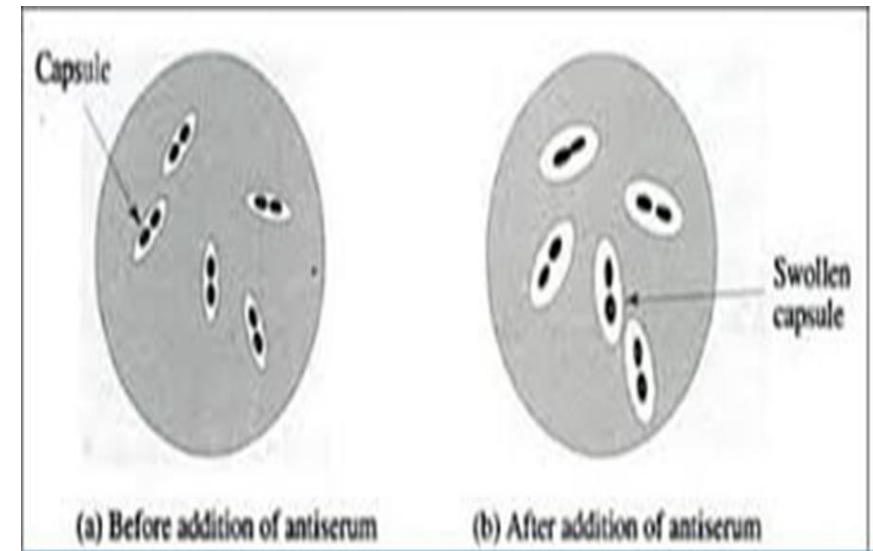
Diagnosis:

Specimen: Sputum, CSF, Blood,...

- 1) Gram Stained smears (**Gram-positive diplococci** with unstained halos).
- 2) Detection & typing of capsule: Capsule swelling test (**quellung reaction**).

3) Culture on blood agar:

- **Alpha haemolysis.**
- **Soluble in bile.**
- **Optochin sensitive.**



4) **Blood cultures** are positive in 15% to 25% of pneumococcal infections.

Prophylaxis: Two types:

1) **Capsular polysaccharide vaccine**

2) **Pneumococcal conjugate vaccine:** (Capsular polysaccharides + protein carrier).

➤ They are recommended for:

- All children less than 2 years of age.
- Elderly more than 65 years.
- Adults with **certain medical conditions** (e.g. immunocompromised, chronic lung disease, **asplenia**,..).

KLEBSIELLA PNEUMONIAE
“FRIEDLANDER’S BACILLUS”



Morphology:

- It is **Gram-negative bacilli, Non-motile.**
- **Capsulated** both in tissue and in vitro culture.

Culture:

- On MacConkey's medium, it produces **rose pink** colonies due to **lactose fermentation.**
- Colonies are big, high convex with a striking characteristic **muroid appearance** due to the production of a very large polysaccharide capsule.

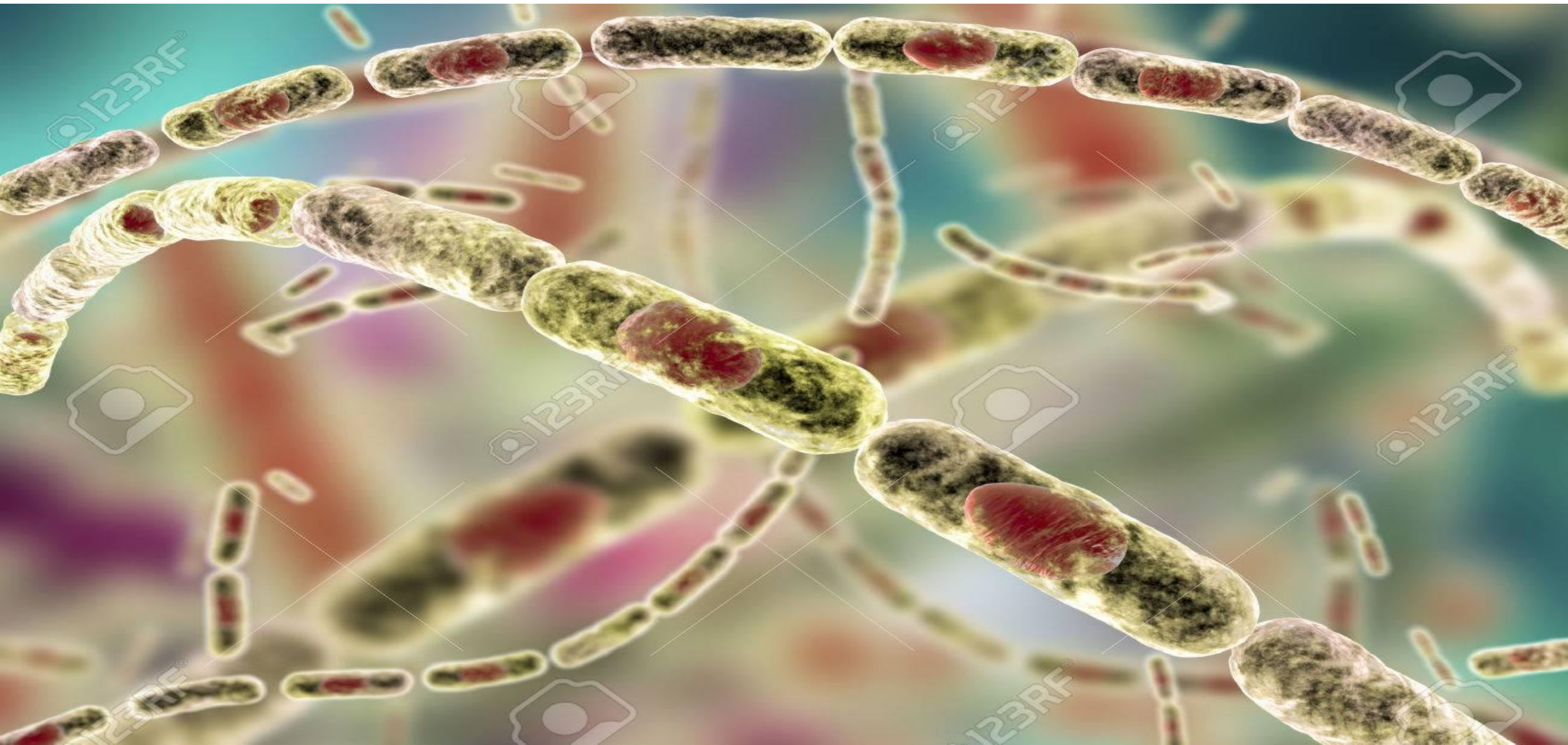


Pathogenesis & Clinical findings:

- It is **important cause of nosocomial infections:**
 - ❖ **Pneumonia** (sever form of **lobar pneumonia** which can progress to **abscess formation & empyema**). Sputum characterized by being thick, mucoid, bloody “**currant jelly sputum**”.
 - ❖ **Urinary tract infections.**
 - ❖ **Bacteremia.**
- Infections frequently have predisposing conditions??
- Isolates carry **high degree of antibiotic resistance.**

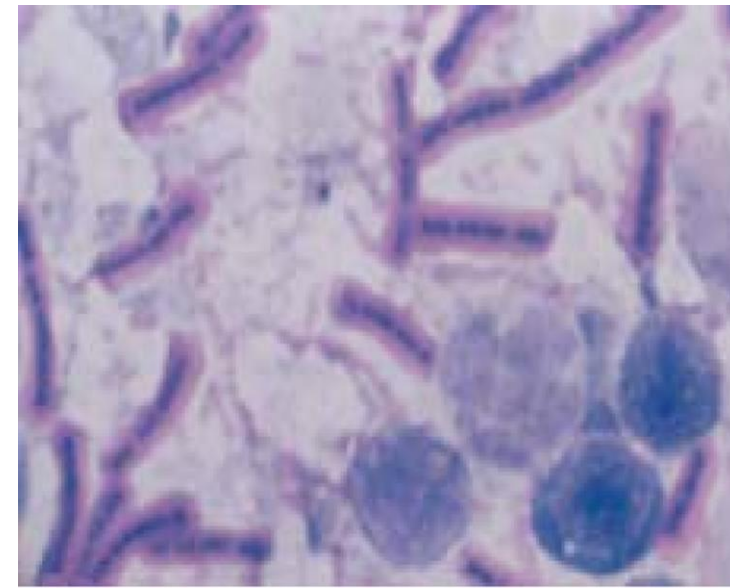
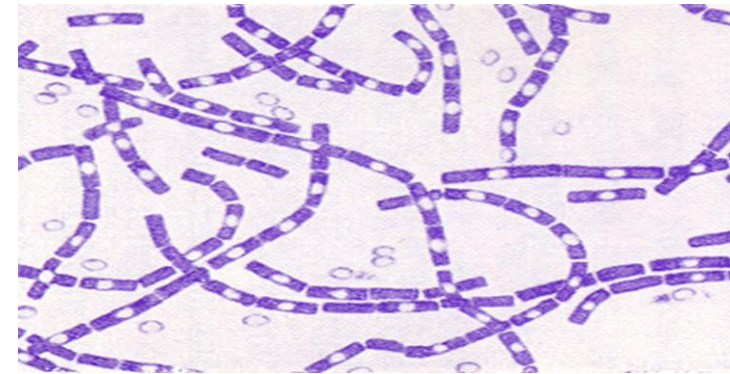
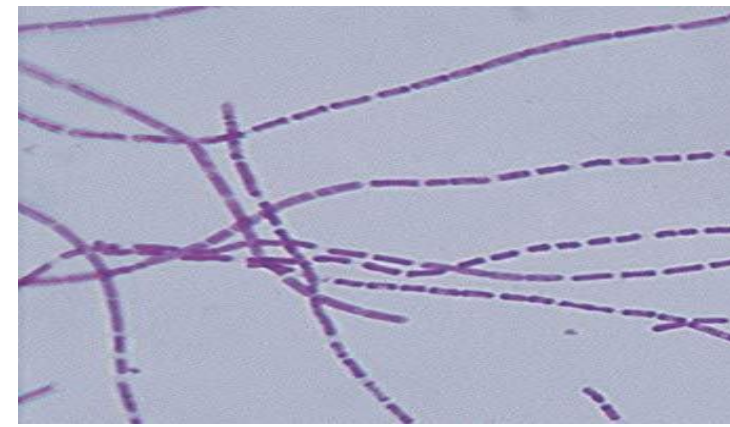


BACILLUS ANTHRACIS



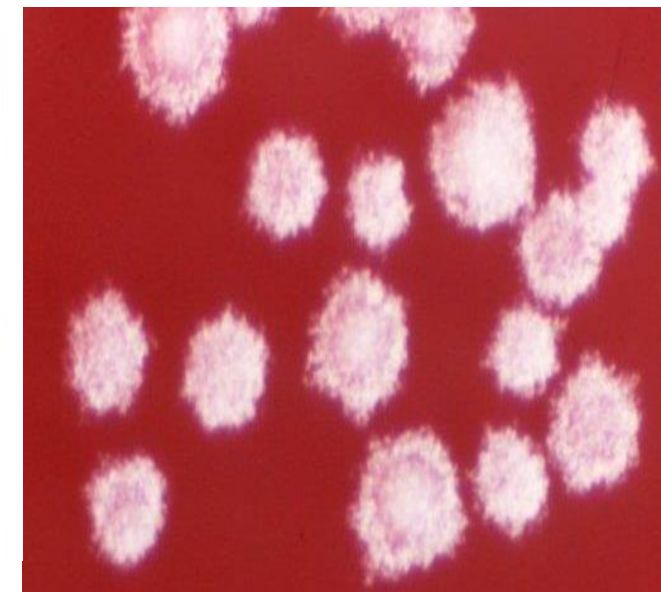
Morphology:

- **Gram positive bacilli**, non-motile, arranged in **chains**.
- **Sporulated** in vitro. The spores are **oval, central** and not stained with Gram stain.
- The organism is capsulated (**Polypeptide capsule, “D-Glutamic acid”**) only inside the body, appears as unstained hollow in gram stain).
- When the organism is stained with **polychrome methylene blue**, the organism stains blue while the capsule purplish. (**McFadyean’s reaction**)



Culture:

- Aerobes; grow on ordinary media.
- Colony is large opaque disc with rough granular surface and irregular fimbriate edge (**medusa head colony**).
- Colonies on blood agar are non-hemolytic
- It liquefies gelatin (proteolytic activity) giving an **inverted fire tree** appearance.



Virulence factors:

A) Very powerful exotoxin.

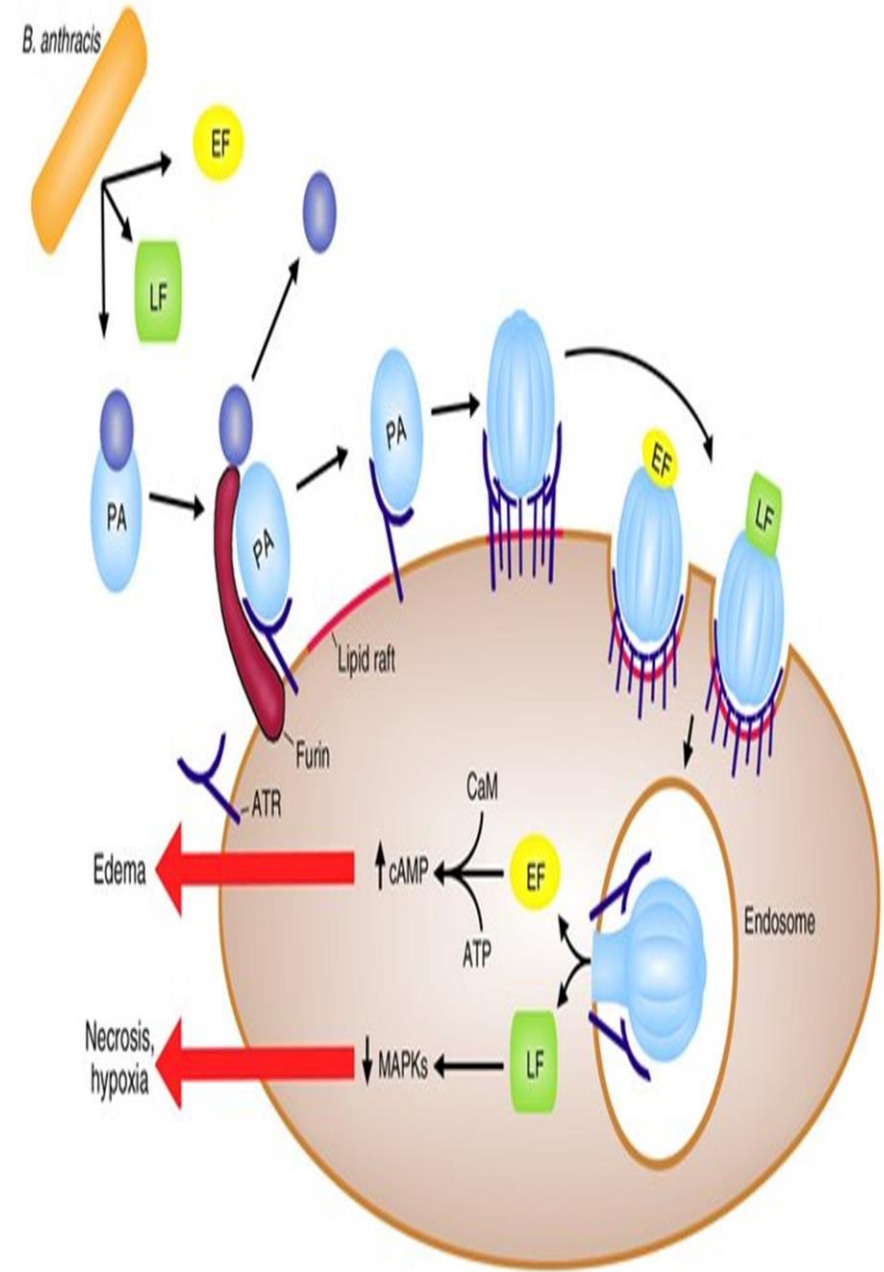
The toxin consists of 3 domains:

Protective antigen (PA): binds to specific receptor on host cell with its **proteolytic activity** producing membrane channel and permits entrance of:

Edema factor (EF) with its **adenyl cyclase activity** → loss of water → →edema.

Lethal factor (LF) which cause **tissue necrosis**.

B) Protein capsule: Antiphagocytic.



Anthrax

- It is a disease of farm animals e.g. cattle and sheep (**Zoonotic disease**).
- Man infected by coming in contact with diseased animals or their dead bodies.
- Farmers, butchers, wool sorters and veterinarians are more liable to infection.
- Infection could occur in different forms, the commonest forms are:

1- Cutaneous anthrax (malignant pustule)

2- Pulmonary anthrax (wool sorters disease)

3- Intestinal anthrax



Pathogenesis

Spores on animal products, such as hides, bristles, and wool, enter through
(Skin abrasion, Inhalation, Ingestion)



Phagocytosed and germinate in Macrophages



Bacteria produce capsule & toxins



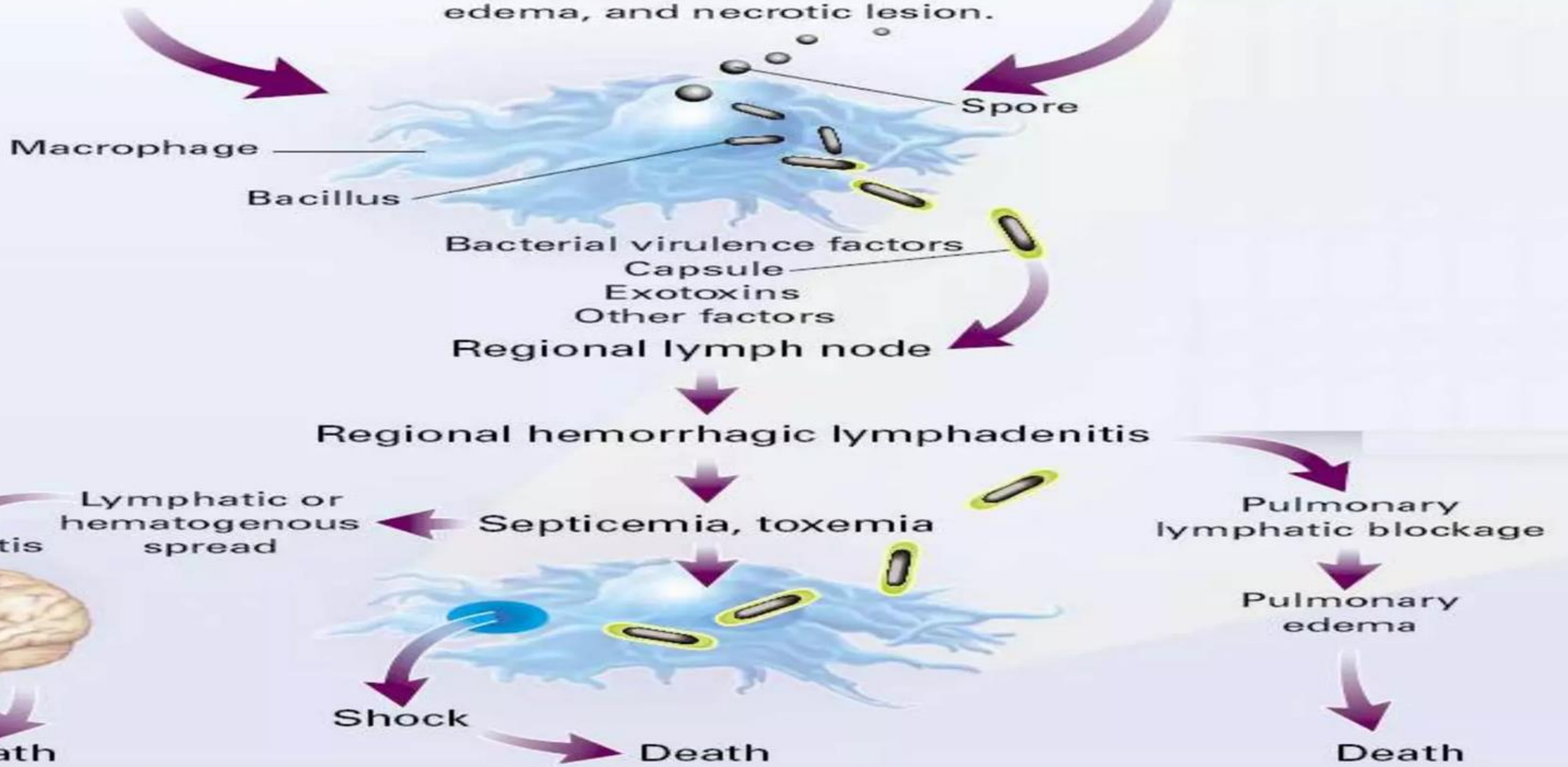
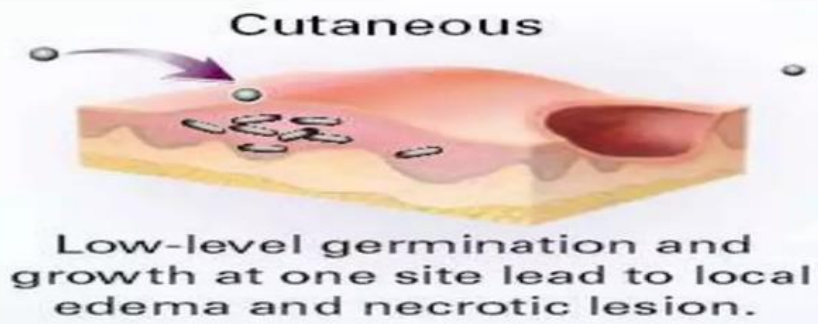
Regional lymph nodes → Hemorrhagic lymphadenitis



Toxin → local tissue destruction and edema (lung, intestine or skin)



Blood stream → Septicemia → Death



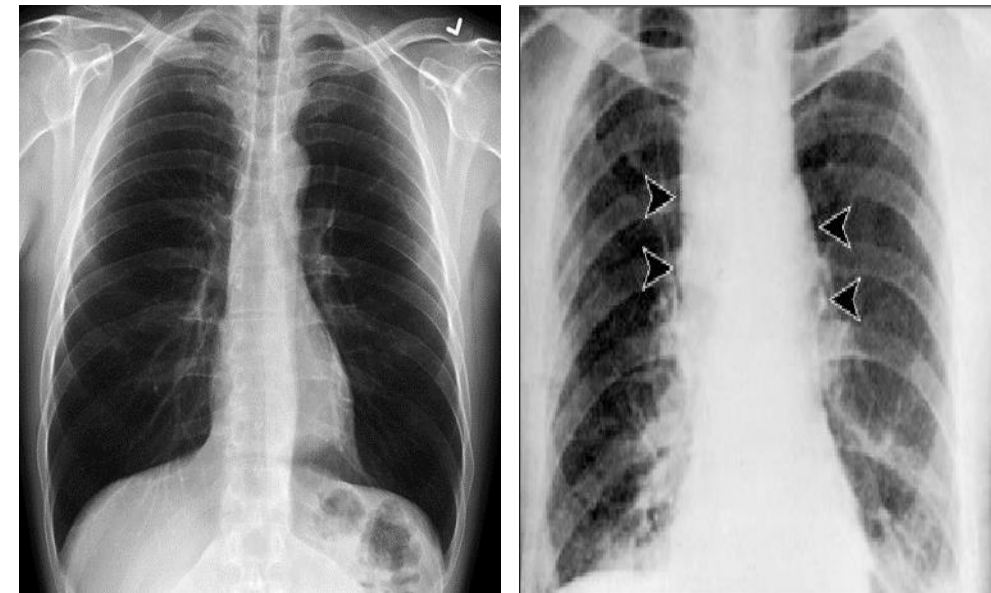
Pathophysiology of Anthrax.

PULMONARY ANTHRAX

“Wool sorters disease”



- Pulmonary anthrax occurs when spores are inhaled into the lungs.
- After inhalation, the organism moves rapidly to the mediastinal lymph nodes. Because it leaves the lung so rapidly, it is **not transmitted from person to person** by respiratory route (**not contagious**).
- Begins with nonspecific respiratory symptoms resembling influenza.
- This **rapidly** progresses to **hemorrhagic mediastinitis** (fever, chest pain, RDS and widened mediastinum on chest X-Ray).
- End by septic shock and death (**Mortality rate is very high > 95%**).



Diagnosis:

1- Chest X- Ray or CT scan: widening of mediastinum or pleural effusion.

2- Detection of the organism in:

- **Blood:** blood cultures is positive in most cases. The organism identified by Gram stain, subculture or PCR.
- **Sputum:** Not useful and seldom yields positive smears or cultures.

3- Detection of toxin in blood: (test specific for the PA component of the toxin e.g. ELISA, IF).

Treatment & Prevention:

Active immunization:

a) Pasteur's vaccine & Live spore vaccine: given only to animals.

b) **Protective antigen vaccine:** It is used for humans. Given to people at high risk.

***Antibiotics** effective only if given before the lymphatic spread or septicemia.



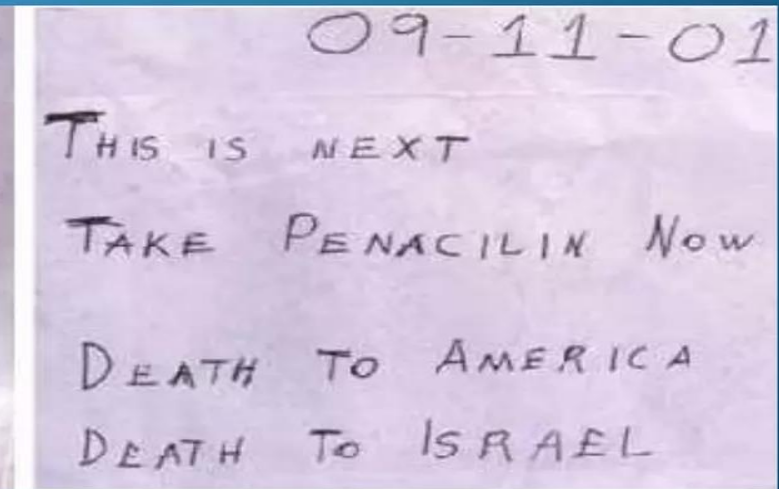
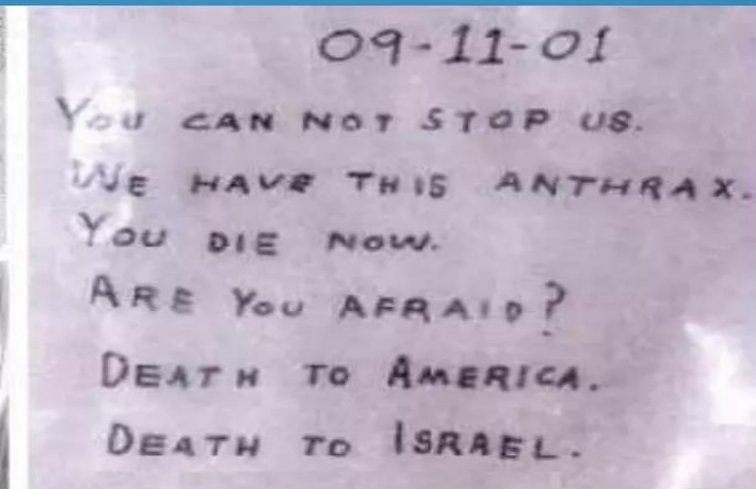
Anthrax as a Biological Weapon



- Biological weapons are germs that can sicken or kill people, livestock, or crops.
- Anthrax is one of the most likely agents to be used because:
 - ❖ Virulent organism with high fatality.
 - ❖ Forms spores which:
 - ✓ Can be produced in lab and put into powders, sprays, food, and water.
 - ✓ Very small so, you may not be able to see, smell, or taste them.
 - ✓ Can last for years in the environment.

BIOTERRORISM-anthrax as a bioweapon

- Anthrax was used by Scandinavian rebels against Russians
- Operation vegetarian by Royal Air Force against Germany in 1944 ,an anti-livestock operation
- In 1997-accidental release of anthrax spores from biological weapons complex in Russia infected 94 people ,68 died
- In Oct.2001 anthrax attacks in USA termed Amerithrax(FBI)
22 cases- 11 inhalation(5 deaths),11 cutaneous(no deaths)



Thank

you

