

وَقُلْ رَبِّ زِدْنِي عِلْمًا



# RESPIRATORY SYSTEM

HAYAT BATCH

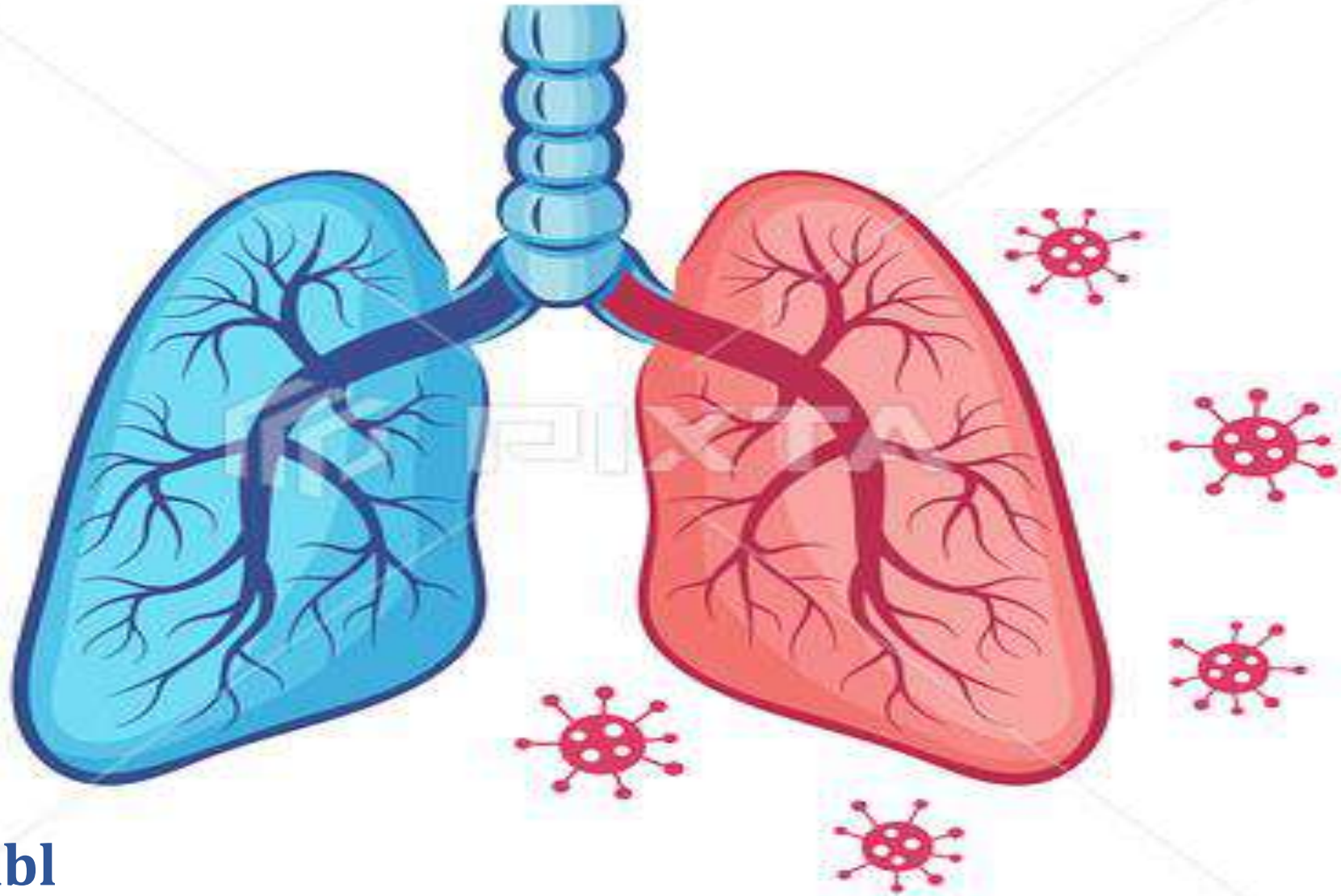


SUBJECT : \_\_\_\_\_

LEC NO. : 3 \_\_\_\_\_

DONE BY : Tabark Aldaboubi \_\_\_\_\_

# RESPIRATORY TRACT INFECTIONS - III



By  
Prof. Hala Tabl

# IX- Pneumonia

## Community Acquired Pneumonia (CAP):

### Bacterial causes:

مسؤولة عن 50٪ من الحالات

- **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

مهم جدًا

### 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) infection happen 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**.

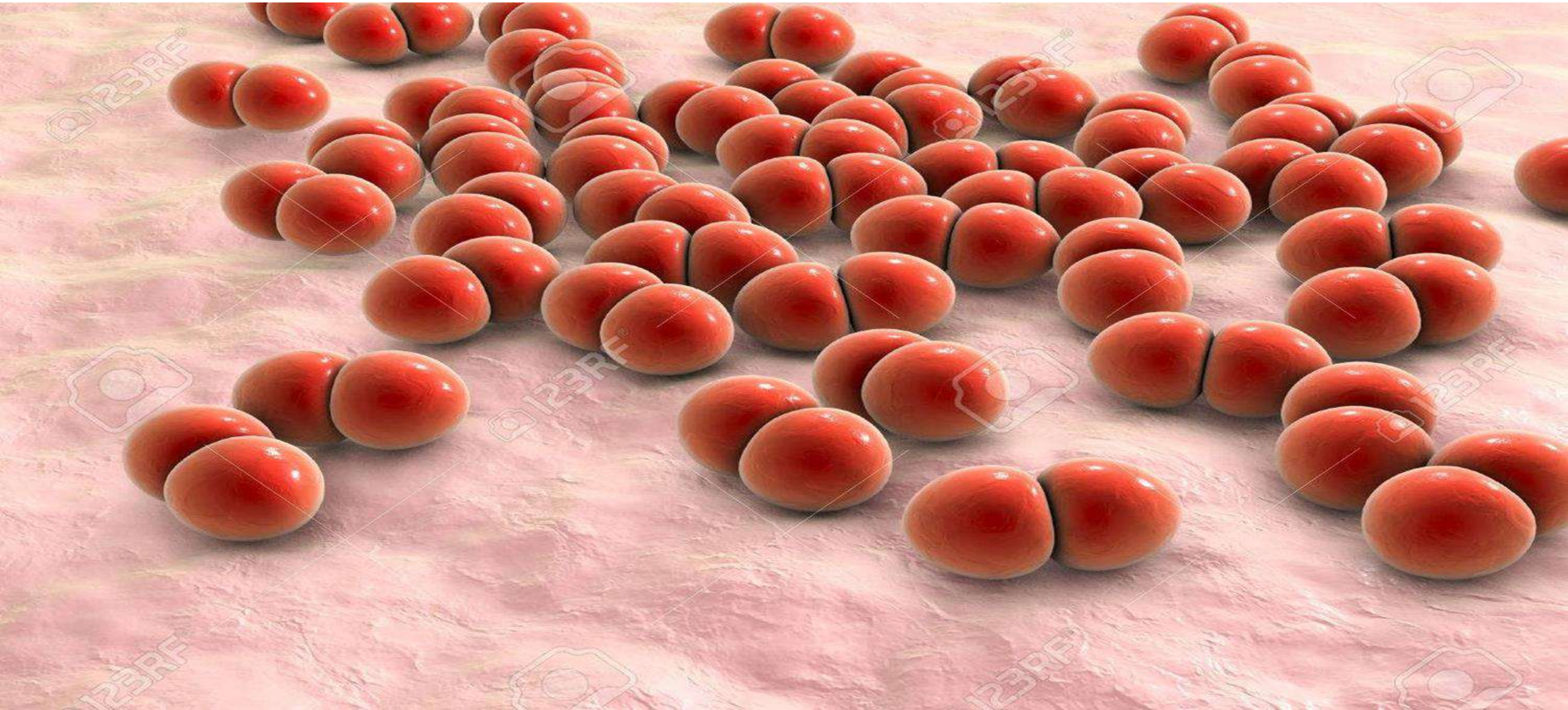
closed cavity → pus جوارح / ↓O<sub>2</sub>



Non groupable ←

# STREPTOCOCCUS PNEUMONIAE

← "PNEUMOCOCCI"





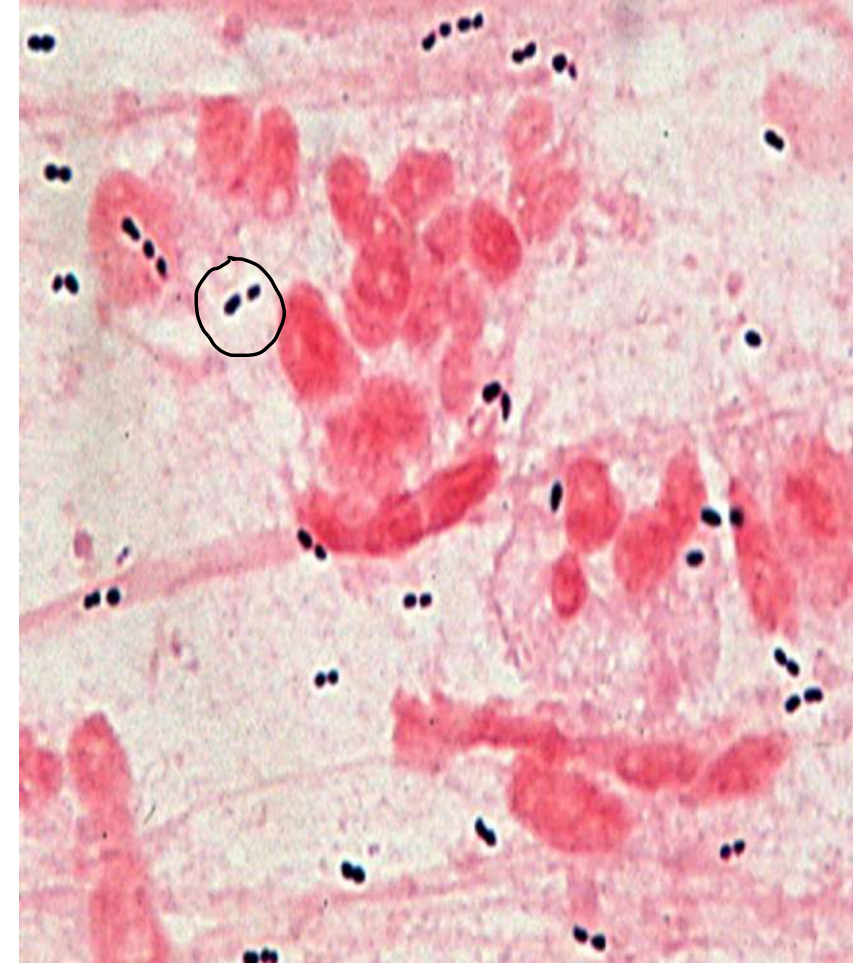
# Morphology

➤ **Gram-positive, diplococci** (arranged in pairs).

➤ **Capsulated (Polysaccharide capsule),**

capsule appears as unstained halo around the

organism. كونها ما بتوخد الصبغ كل 2 بتكونوا حوالينهم clear zone لهاي بتكون capsule



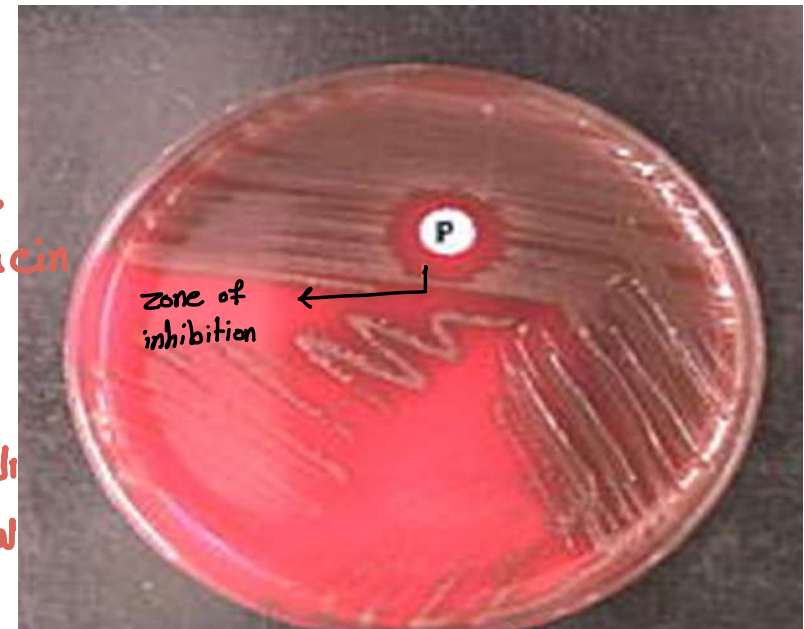
# Culture:

بحتاج blood to growth

- 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).



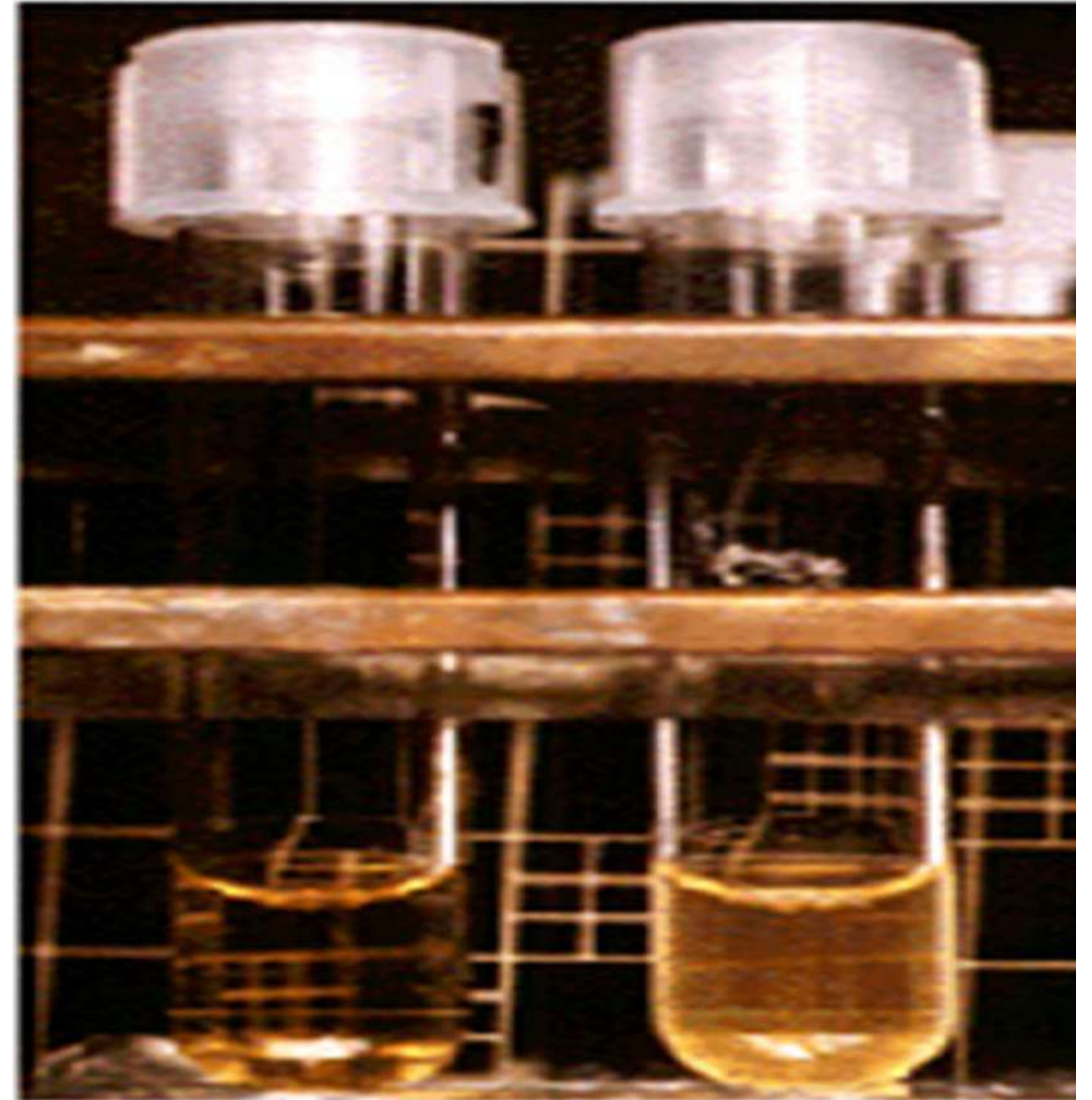
- It is sensitive to optochin (Antibacterial agent). <sup>شك</sup> *pacetracin* <sub>→ killed by optochin</sub>
- The pneumococcus dies rapidly in cultures due to natural autolysis. <sub>الorganism يحتوي على autolytic enzyme اول ما توصل لاندك stage of growth بصيرلها activation وتتعمل Autolysis</sub>



عده

## Biochemical reaction:

- Ferment Inulin.
- Soluble in bile.  
لوحظت - على bile solution بلاقي ال organism اختفى وذاب
- Catalase-negative.



Pneumo  
+  
bile

Pneumo  
+  
broth

بجيب انبوتات وفيها saline ويزرع عليها colonies بحيث الانبوتات تمس kirbed بقسمها لتصبين و يصفى على نهن few drop of bile بعد ربع ساعة بلاقي الهاي الالنبوت هماردت Complete clearance



وَلَعَلَّ مَا تَخْشَاهُ لَيْسَ بِكَائِنٍ  
وَلَعَلَّ مَا تَرْجُوهُ سَوْفَ يَكُونُ

**Table: Differences between Strept. viridans and Pneumococci**

	<b>Pneumococci</b> <i>α hemolysis</i>	<b>Strept viridans</b> <i>α hemolysis</i>
<b>1) Capsule</b>	Capsulated	Non - capsulated
<b>2) Bile solubility</b>	+	-
<b>3) Optochin sensitivity</b>	+	-
	<i>Zone of inhibition</i>	<i>Can grow in optocin</i>
<b>4) Inulin fermentation</b>	+	-



# 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  $\alpha$ -hemolysis).

*rupture* جعل اللها بتعل pore in cell wall بجدين بصير

➤ **Autolysin:** lyse the bacterial wall and release potentially lethal toxins.

*Necrozing* ← جدين بتعل و inflammation

# Pathogenesis & clinical findings:

➤ Pneumococci are **the most common** cause of:

1. **Otitis media and sinusitis.**

2. **Community Acquired Pneumonia.** It is **typical** **lobar pneumonia** (Fever, chills, cough with red brown “rusty” sputum, dyspnea and tachypnea).

بتصوير لobar  
كامل من ال lung

3. **Bacteremia.** → thick , old blood (redish color بظري لون)

4. **Meningitis.**

➤ **Predisposing factors:** → patient infected to s.pneumonia (unhealthy people)

- Children < 2 ys and elderly > 65 ys. ↓ immunity
- Smokers and alcoholics (depress the cough reflex)
- **Asplenia**
- Immunocompromized e.g., HIV, cancers,...
- Abnormality of the respiratory tract (viral infections, chronic lung diseases,..)





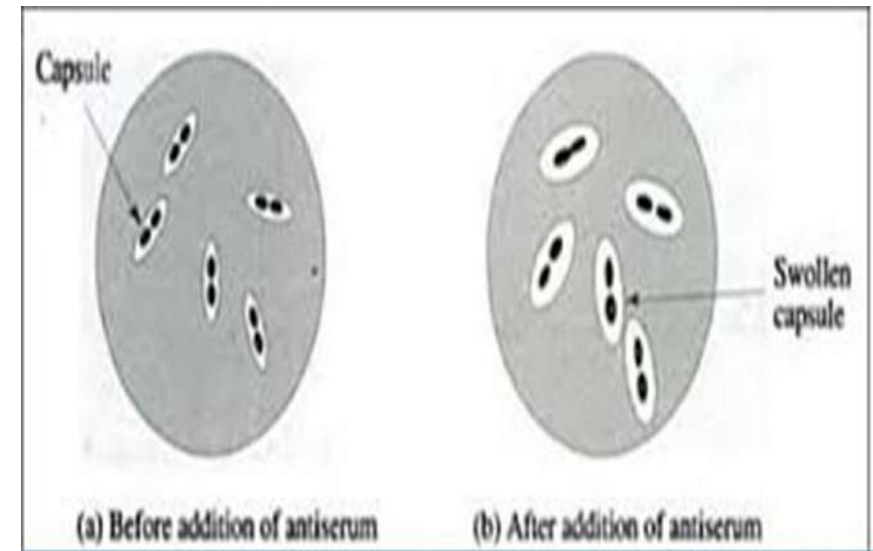
# Diagnosis:

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.  
*associated to bacteremia*

## **Prophylaxis:** Two types:

### 1) **Capsular polysaccharide vaccine**

### 2) **Pneumococcal conjugate vaccine:** (Capsular polysaccharides + protein<sub>3</sub> carrier). *Stimuli to immuno respons against to capsule*

*مش اجباری*

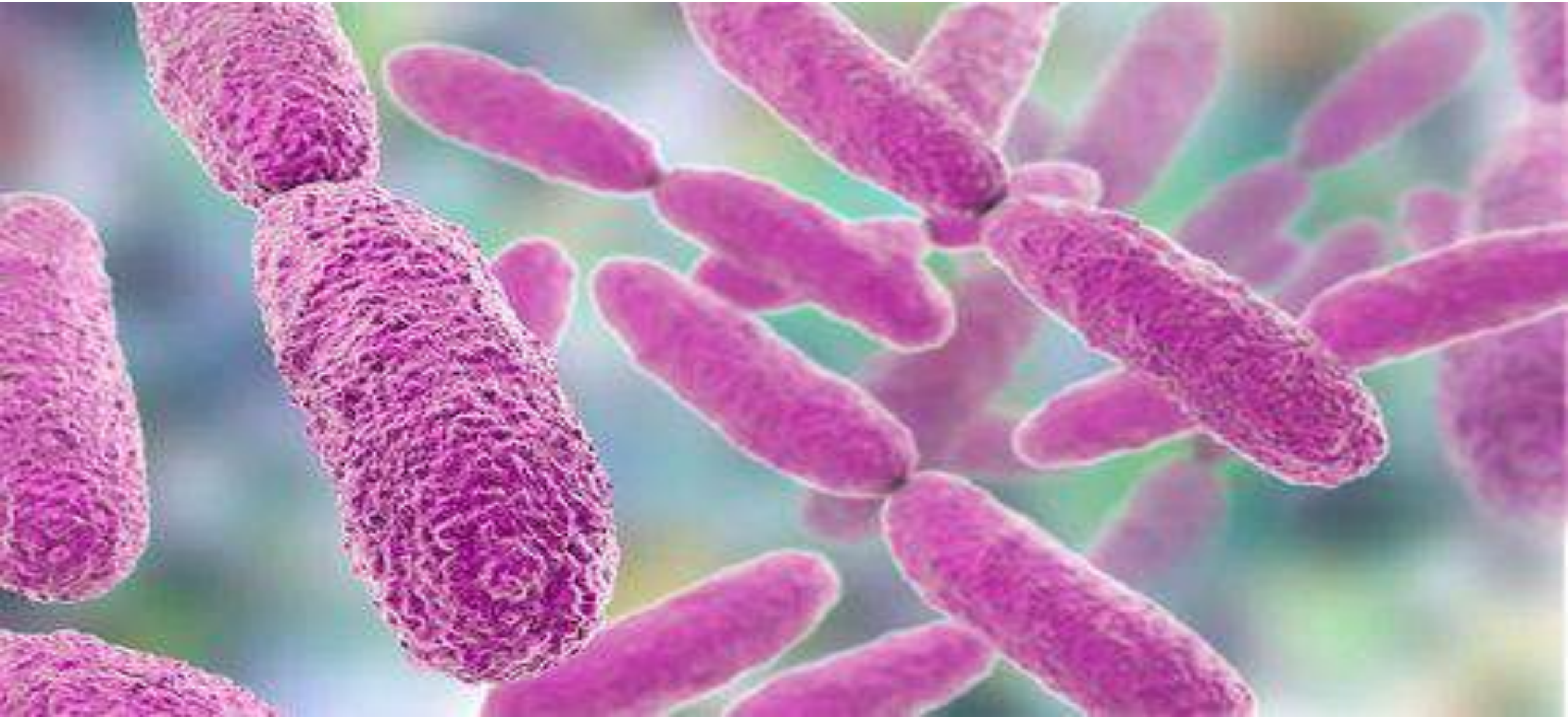
➤ They are recommended for:

- 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

الاسم القديم ← "FRIEDLANDER'S BACILLUS"



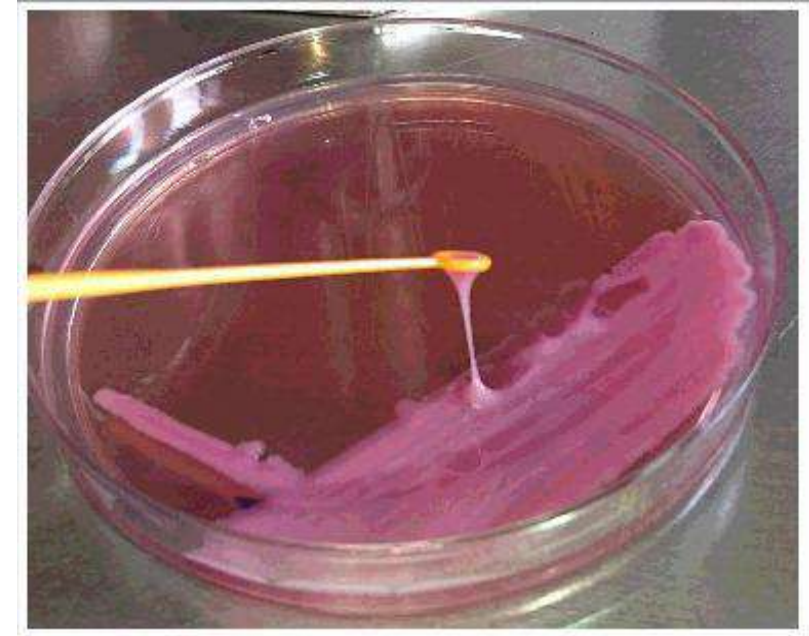
## Morphology:

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

ملاحظة

## 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.  
من نفخة عن سطح ال agar





# Pathogenesis & Clinical findings:

➤ It is important cause of nosocomial infections:

❖ **Pneumonia** (sever form of lobar pneumonia which can progress to abscess formation & empyema).

Necrotizing

فمن خطر انه يفسد

Sputum characterized by being thick, mucoïd, bloody

نوع من انواع العنب الاحمر

“**currant jelly sputum**”.

مظهر مميز بين نوع ال sputum لكل organism



❖ **Urinary tract infections.**

❖ **Bacteremia.**

(e.g. immunocompromised, chronic lung disease,

➤ Infections frequently have predisposing conditions??

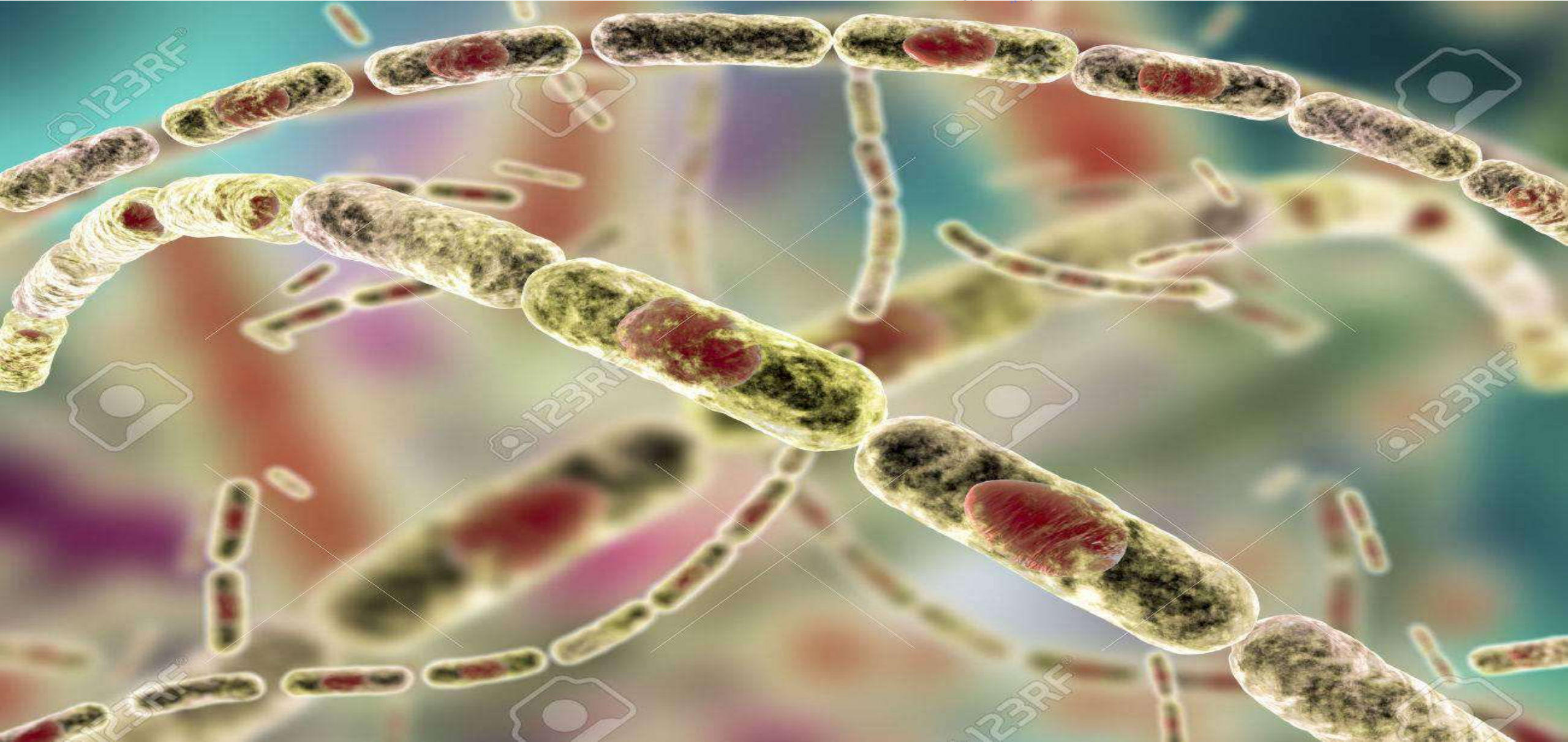
➤ Isolates carry **high degree of antibiotic resistance**.

gen transfer لانه بيتك المستشفى بسهل عليه ال ↑ resistance يكون nosocomial دائما ال strain of bacteria بيتك

لعلم مرض الحمرة الخبيثة

# BACILLUS ANTHRACIS

جاءت من كلمة الفحص.





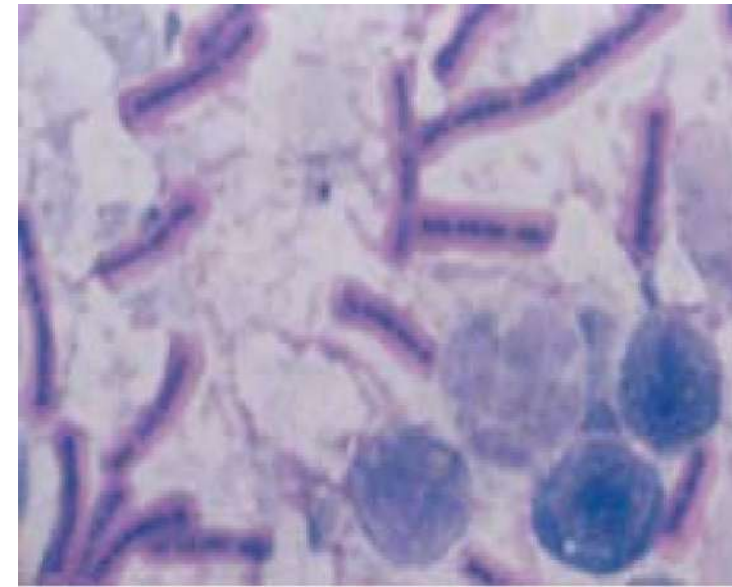
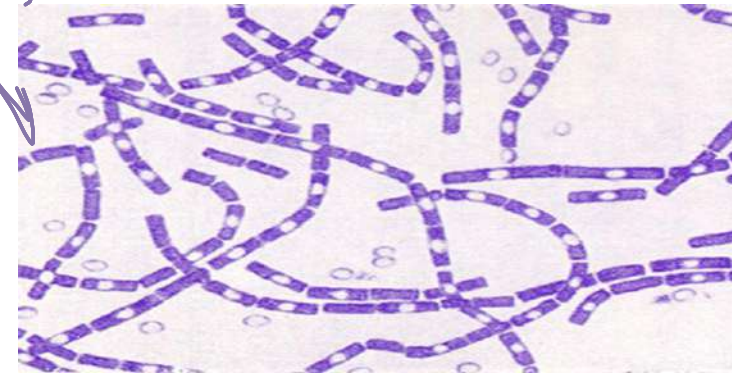
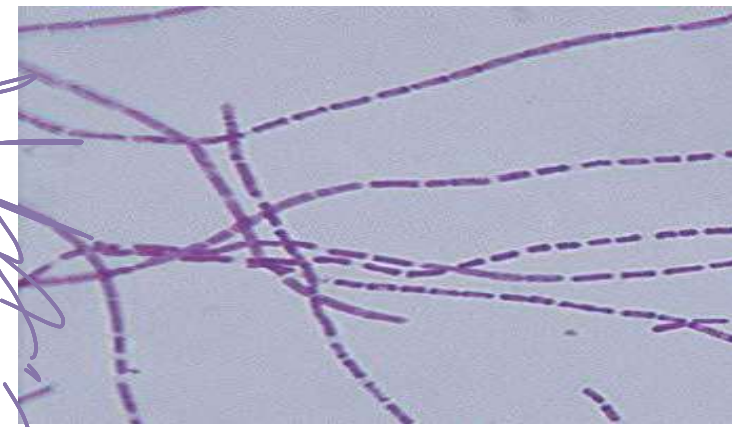
## Morphology:

➤ **Gram positive bacilli**, non-motile, arranged in **chains**.

➤ **Sporulated in vitro**. The spores are **oval, central** and not stained with Gram stain.

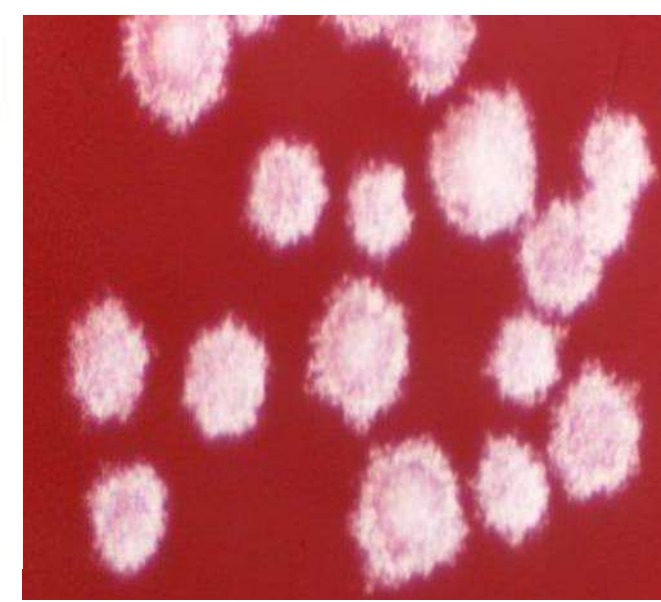
➤ The organism is <sup>مختلفة عن الباقية</sup> capsulated (**Polypeptide capsule**, <sup>فرد</sup> “**D-Glutamic acid**”) only inside the body, appears as unstained hollow in gram stain).

➤ When the organism is stained with <sup>سيف</sup> **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.



inverted fire tree . proteolytic activity قویہ لہا بزروا عکای protein مثل gelatin بتحول اس سائل بیگونشکا زی .  
(Solid media)

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  
المسؤول انه يعمل بيلك binding لل Toxin. Specific receptors. Poor in cell membrane ليل  
LF و EF يسمح بدخول ال

on host cell with its **proteolytic activity** producing

membrane channel and permits entrance of:

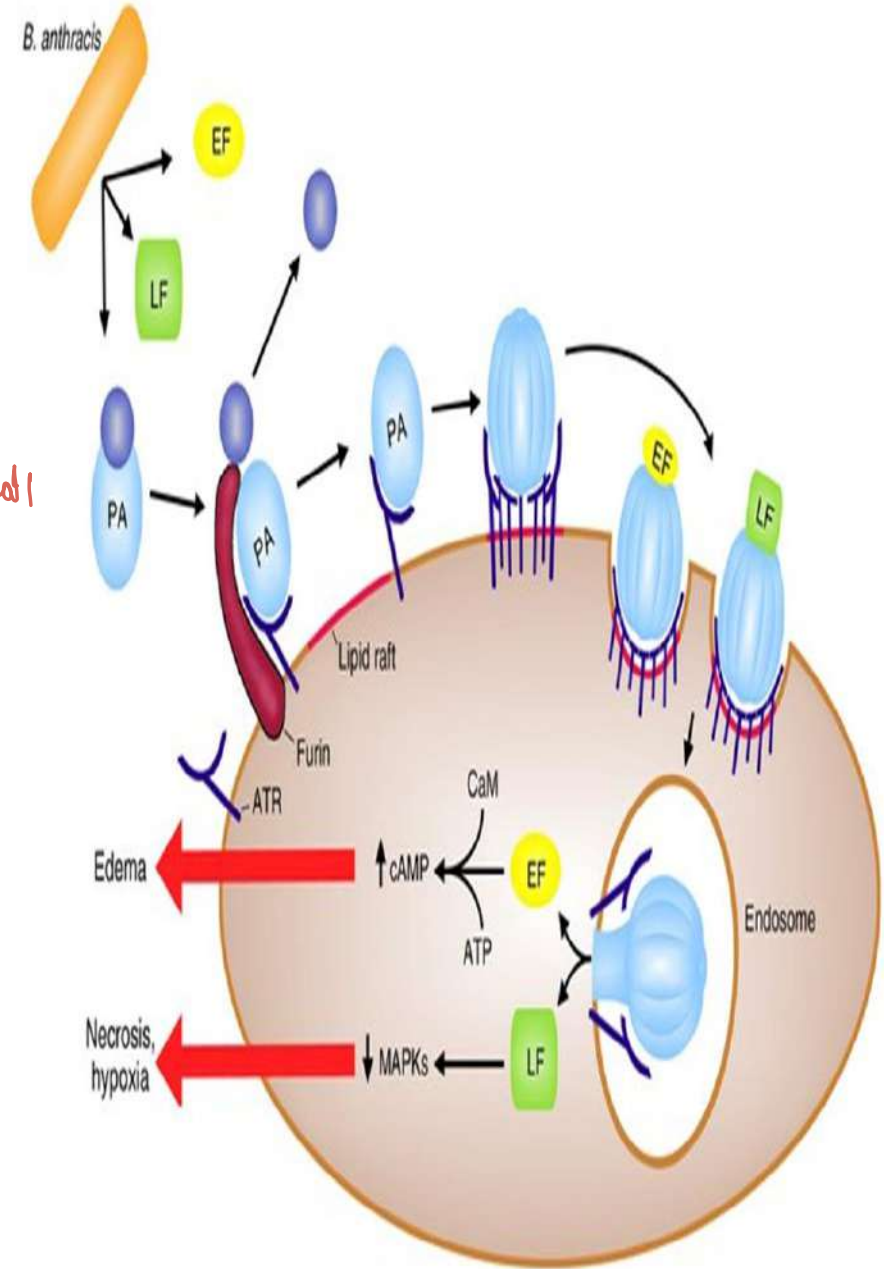
**Edema factor (EF)** with its **adenyl cyclase**

خروج الميه من الخليات  
**activity** → loss of water → → edema.

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

cell death

**B) Protein capsule:** Antiphagocytic.





# Anthrax

هو بالأصل مرض حيوانات أو host اللباسية تاعه حيوان ينتقل للإنسان عن طريق التعامل مع اجسام الحيوانات الميتة

- 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.  
الفتاة الأكثر عرضة للإصابة
- 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)

جرح بالجلد نال spores يتدخل من خلاله  
عن طريق الشفم  
الأكل

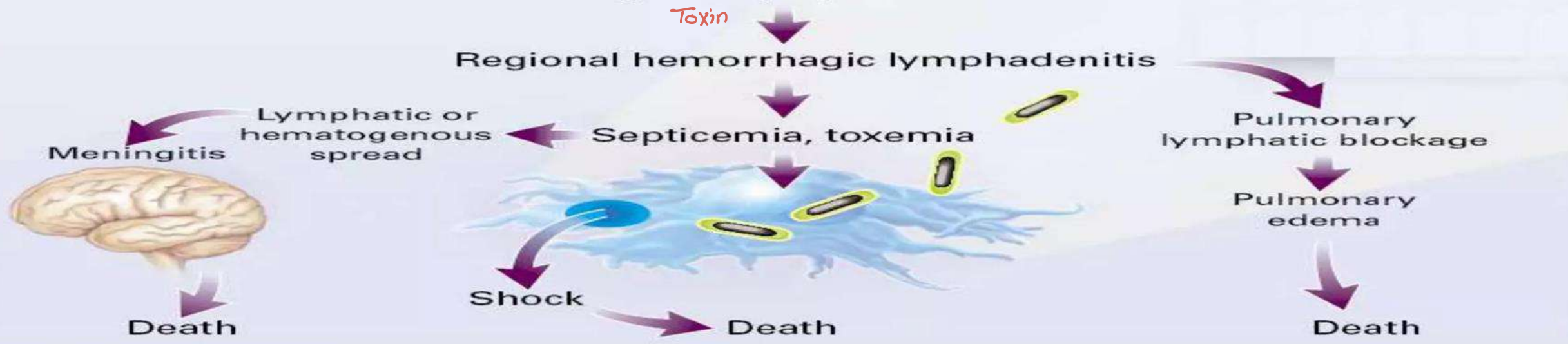
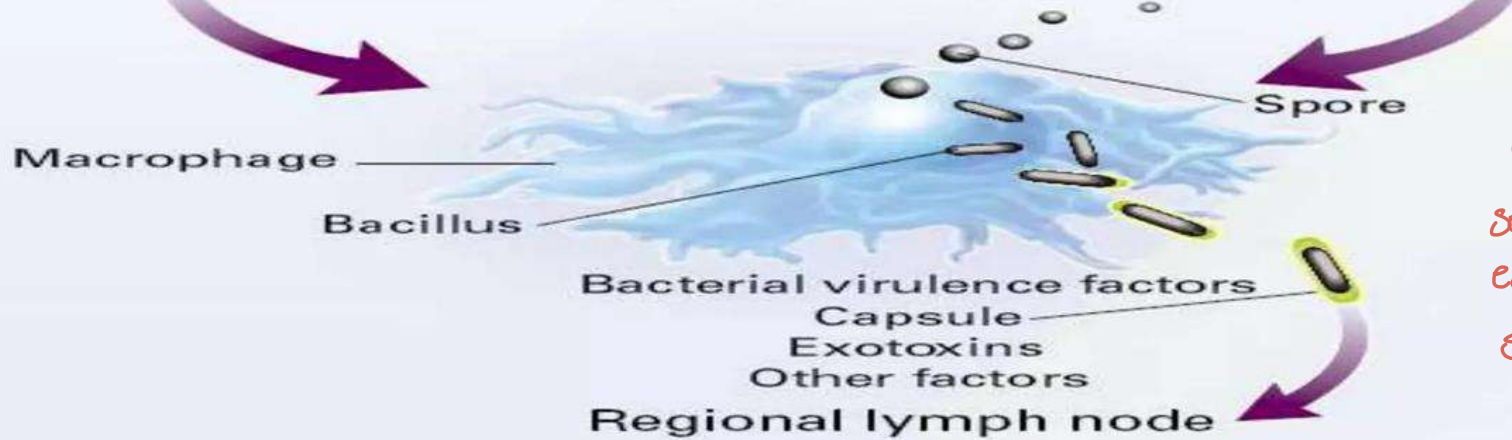
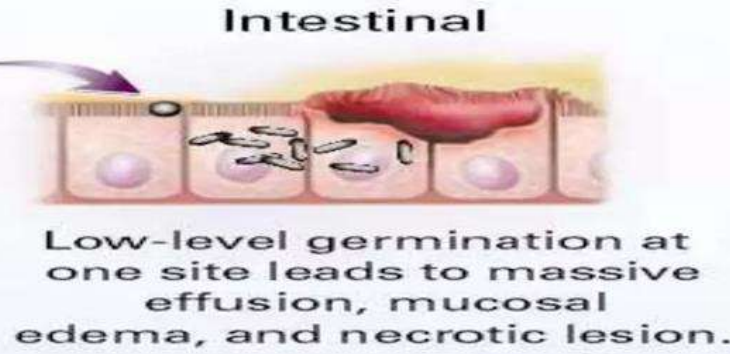
↓  
Phagocytosed and germinate in Macrophages

↓  
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

بتهيب عمال الڤيستفلوا بصوف الحيوانات  
“Wool sorters disease”

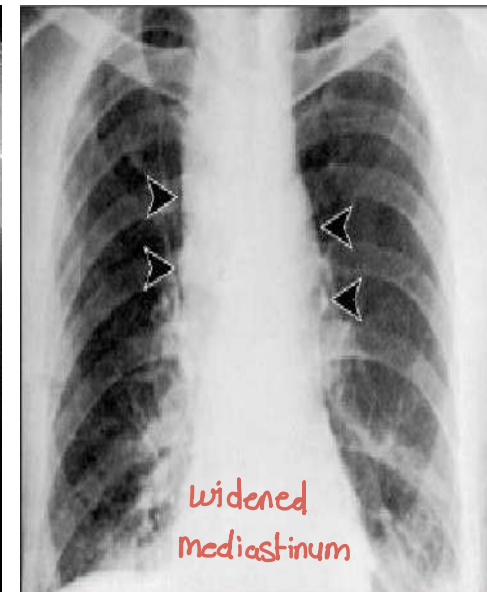




- Pulmonary anthrax occurs when spores are inhaled into the lungs.
- After inhalation, the organism moves rapidly to the mediastinal lymph nodes.  
Because it leaves the lung so rapidly, it is **not transmitted from person to person** by respiratory route (**not contagious**).
- **Begins** with nonspecific 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%**).

السبب انه ال macrophag عطول يتوخذ ال organism و ينقله لل lymph node

اهم اشئ بالسلايد ↖



## 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.

كونه فاش موجود بال air space فغالبا بعطيني negative فيجند عن ال blood احسن

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

Protective Antigen



# 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.  
ما بنوعه لالكل .

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

lymph node يوصل الـ organism ما الـ بكون فعال اذا اعطيت قبل



# Anthrax as a Biological Weapon

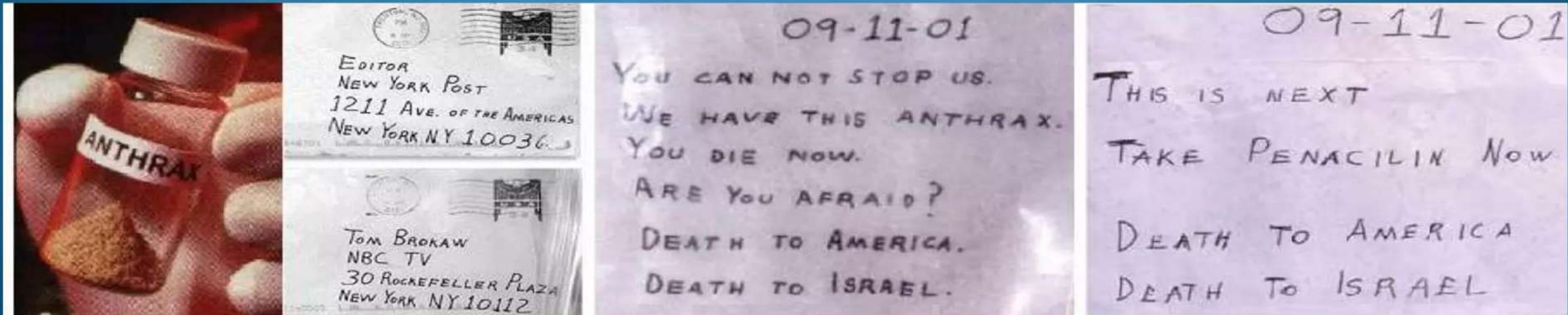


من الامم ال organism التي تستخدم كسلاح بيولوجي

- 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)





سَتَبَيِّنُ لَكُمْ  
عَنْ قَرِيبٍ...  
لَنَا فِي اللَّهِ  
ظَنًّا لَا يَخِيبُ...