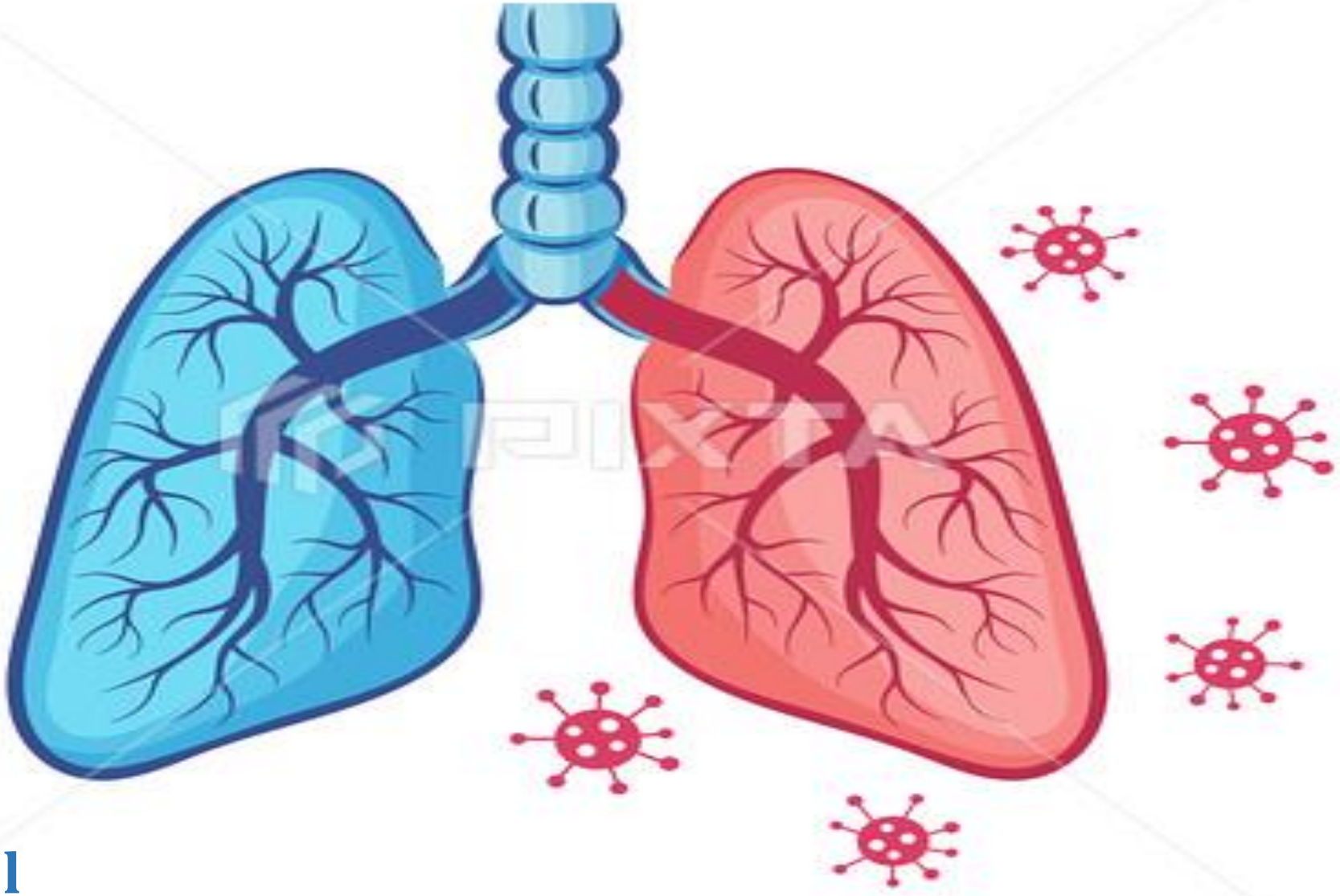
RESPIRATORY TRACT INFECTIONS - II



By
Prof. Hala Tabl

III- Infections of the ear:

Otitis Externa:

- **Pseudomonas aeruginosa.**
- **Aspergillus niger**

Otitis media:

- **Strep. pneumoniae**
- **Haemophilus influenzae**
- Moraxella catarrhalis
- Streptococcus pyogenes
- Staphylococcus aureus

IV- Sinusitis:

- **Strept. pneumoniae**
- **Haemophilus influenzae**
- Moraxella catarrhalis
- Streptococcus pyogenes
- Staphylococcus aureus

V- Acute Epiglottitis:

Haemophilus influenza

VI- Laryngitis and croup: Mostly viral

Parainfluenza, Influenza, Adenovirus.

VII- Tracheitis & Bronchitis:

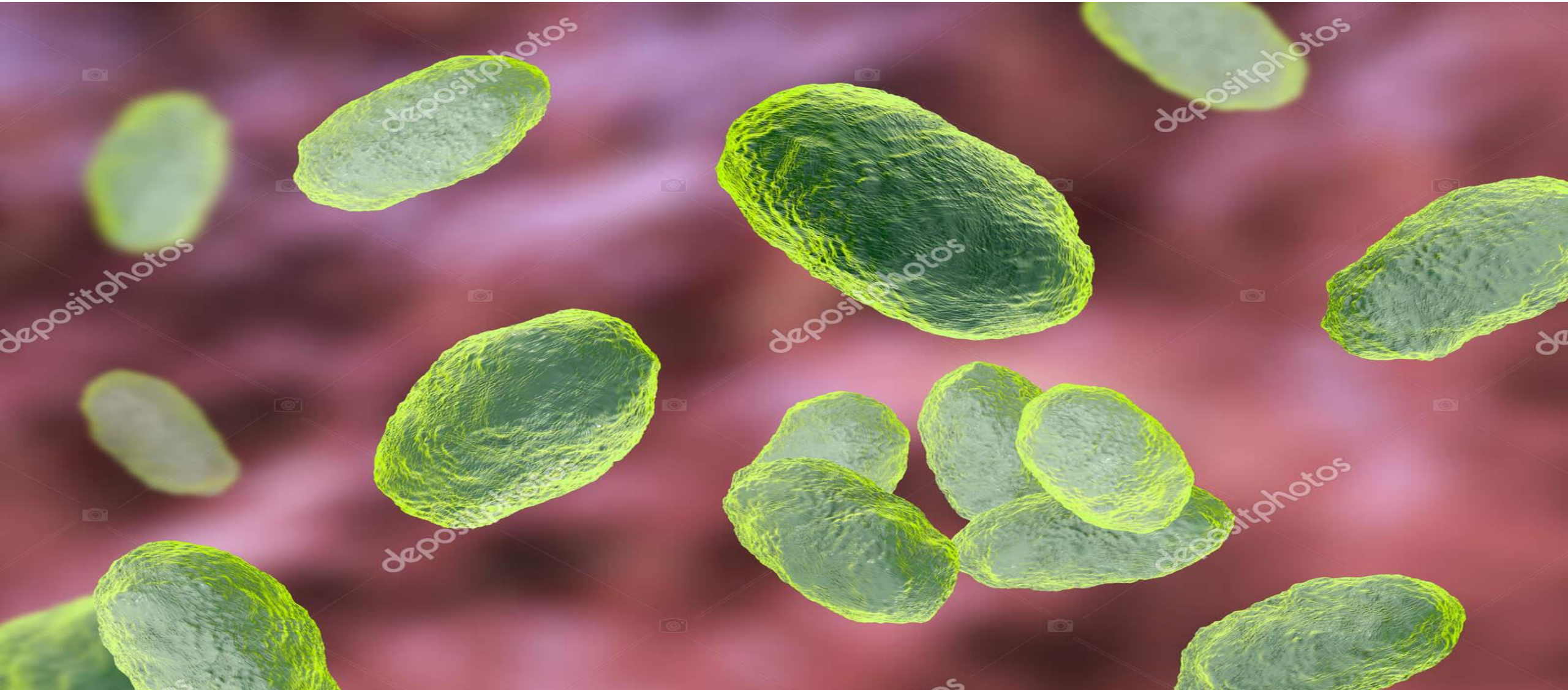
* **Mostly viral:** Parainfluenza, Influenza, Adenovirus and RSV.
* **Bacteria: Bordetella pertussis,** Haemophilus influenza, Mycoplasma pneumonia, Chlamydia pneumonia and Streptococcus pneumonia.

VIII- Bronchiolitis:

RSV, Parainfluenza virus

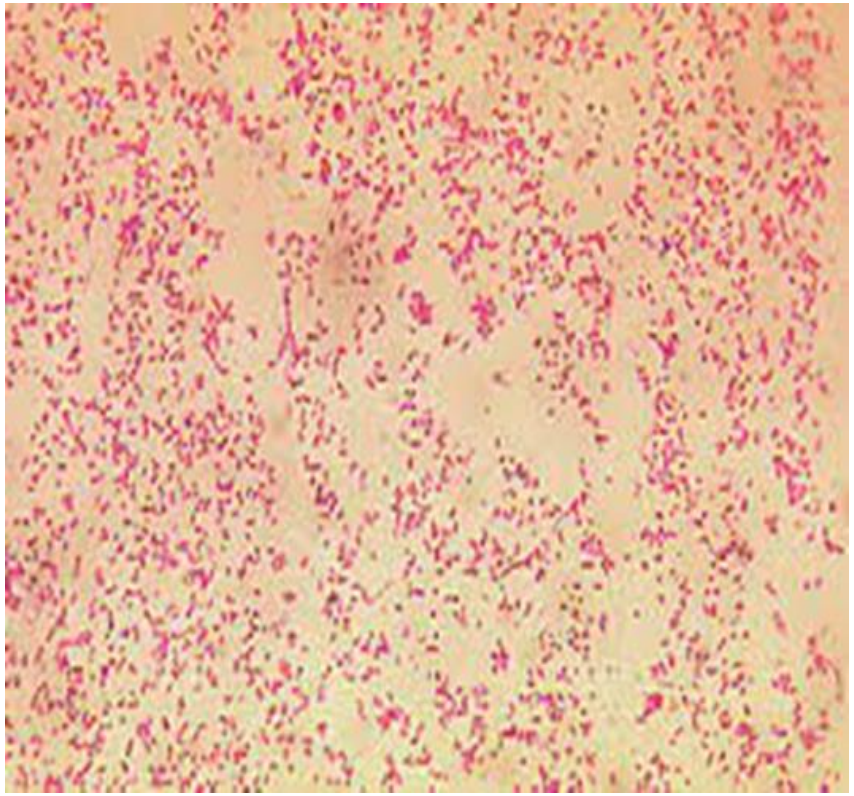
HAEMOPHILUS INFLUENZA

“Blood Loving”



Morphology:

- **Gram negative coccobacilli**.
- Non - motile, non - spore forming.
- Some types are capsulated.



Culture:

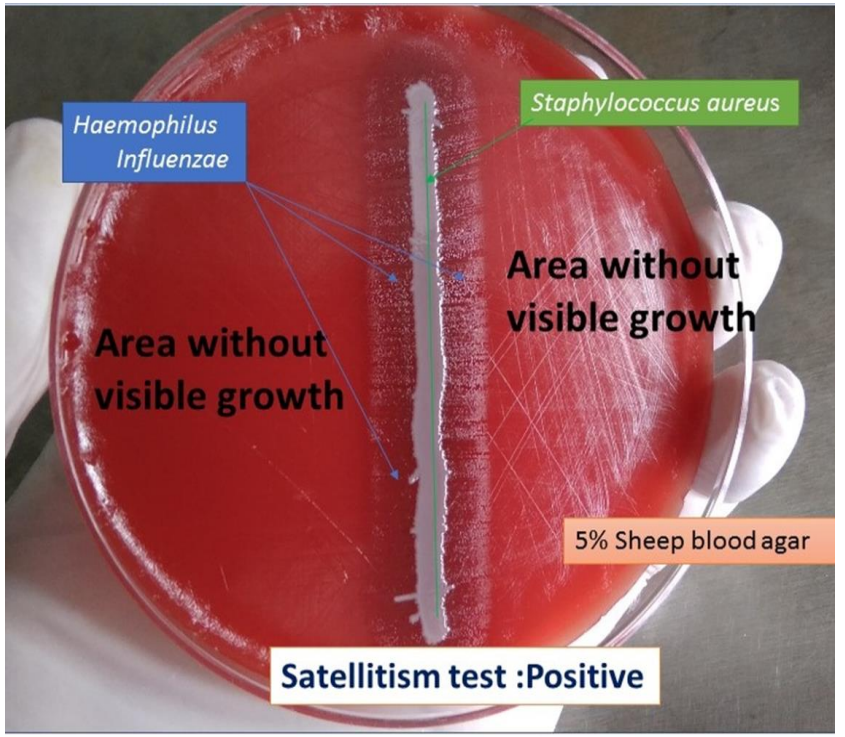
- Grows aerobically, requires extra CO2 (5-10%).
- Requires certain growth factors called **X factor (hemin)** and **V factor (Coenzyme e.g. NAD).**
- Grows on blood agar in the following conditions:

1) On blood agar supplemented with e.g. IsoVitalex.

2) On heated blood agar (**Chocolate agar**) where V & X factors released from RBCs.

2) Close to colonies of Staph aureus (**Satellitism**).

- Produce **NO** hemolysis.



Virulence factors:

1) **Polysaccharide capsule:** **The major virulence factor (antiphagocytic activity**).

- Capsulated strains can be classified into **6 types** (a-f).
- H. Influenzae **type b (Hib)** is the most pathogenic and its capsule composed of (**polyribitol phosphate**) (PRP).

2) **Outer membrane:** ↓↓ mucociliary clearance → colonization.

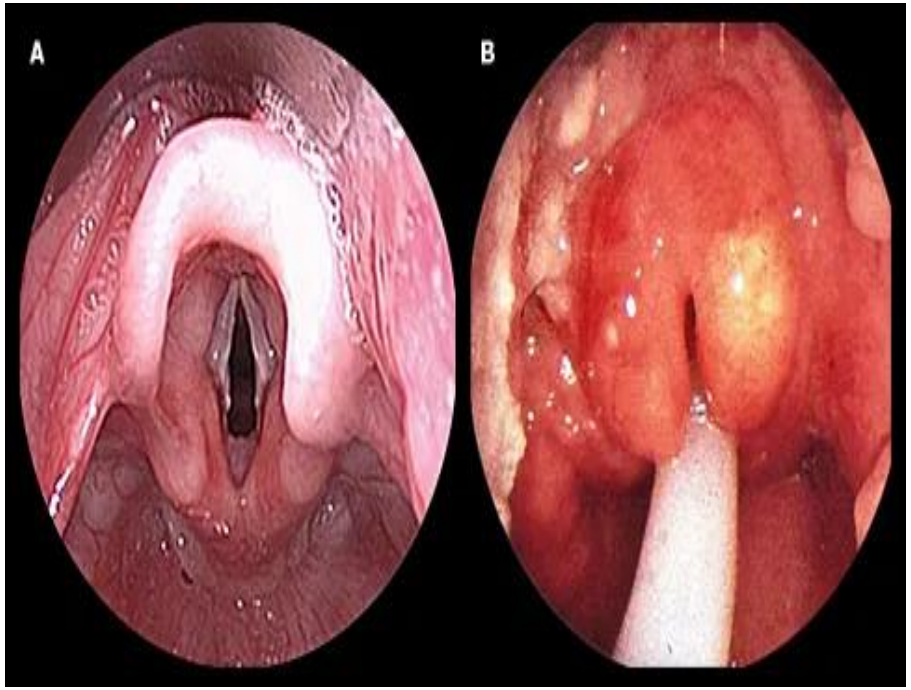
3) **IgA protease:** degrades secretory IgA, thus facilitating attachment to the respiratory mucosa.

Pathogenicity:

Transmission: droplet infection.

A. Capsulated types (invasive) particularly type b (Hib) cause:

1- Epiglottitis: This life-threatening disease of young children which can **obstruct the airway (medical emergency),** is caused almost exclusively by H. influenzae. A **swollen "cherry-red" epiglottis** is seen. **Tracheostomy or endotracheal intubation is life saving**.



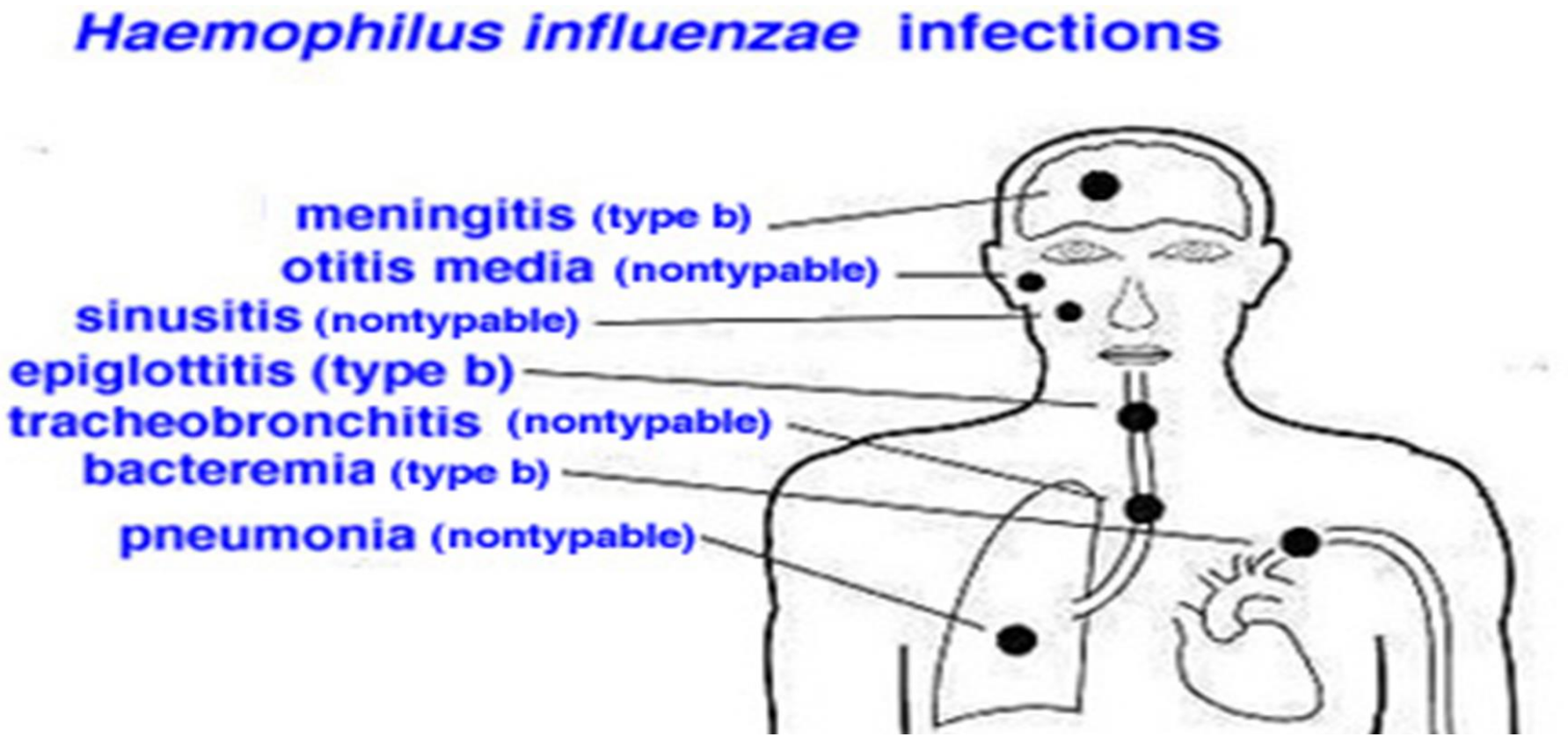
2- Bacteraemia, Meningitis, Septic arthritis.

N.B. Asplenia (anatomical or functional) is important risk factor for infection with encapsulated organisms.

B. The non-capsulated (non-typable) (non-invasive) strains cause:

1- Otitis media and sinusitis: (**next to** *Streptococcus pneumoniae*).

2- Tracheobronchitis & Pneumonia: in adults and elderly, in **presence of predisposing factors** e.g. viral infections, malignancy COPD, cystic fibrosis…

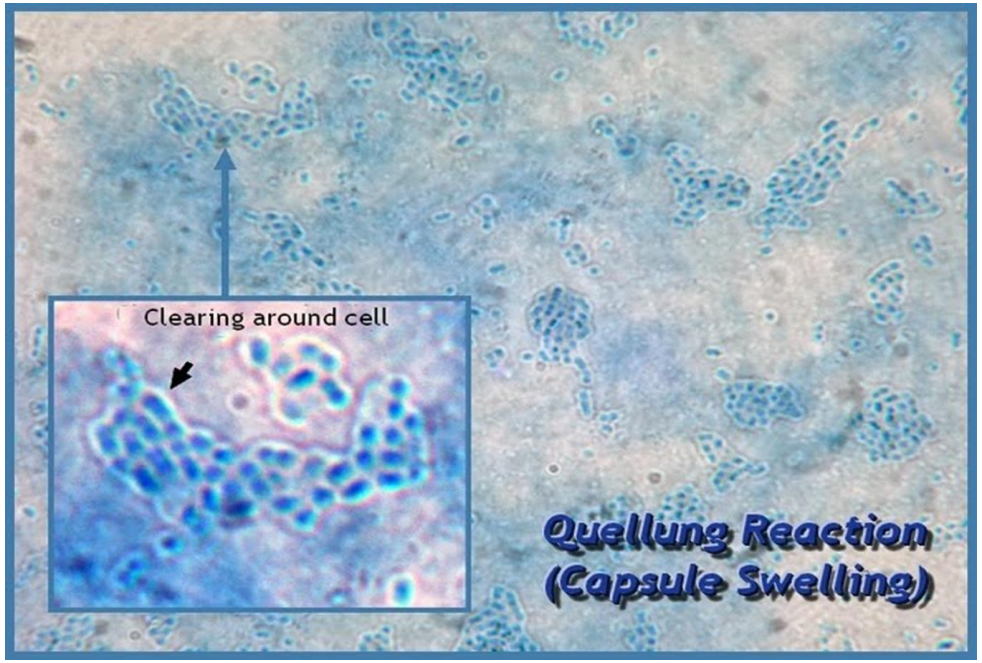


Laboratory diagnosis:

A. Specimens: CSF, blood, sputum, ear swab,…

B. Microscopic examination:

Gram-negative coccobacilli.

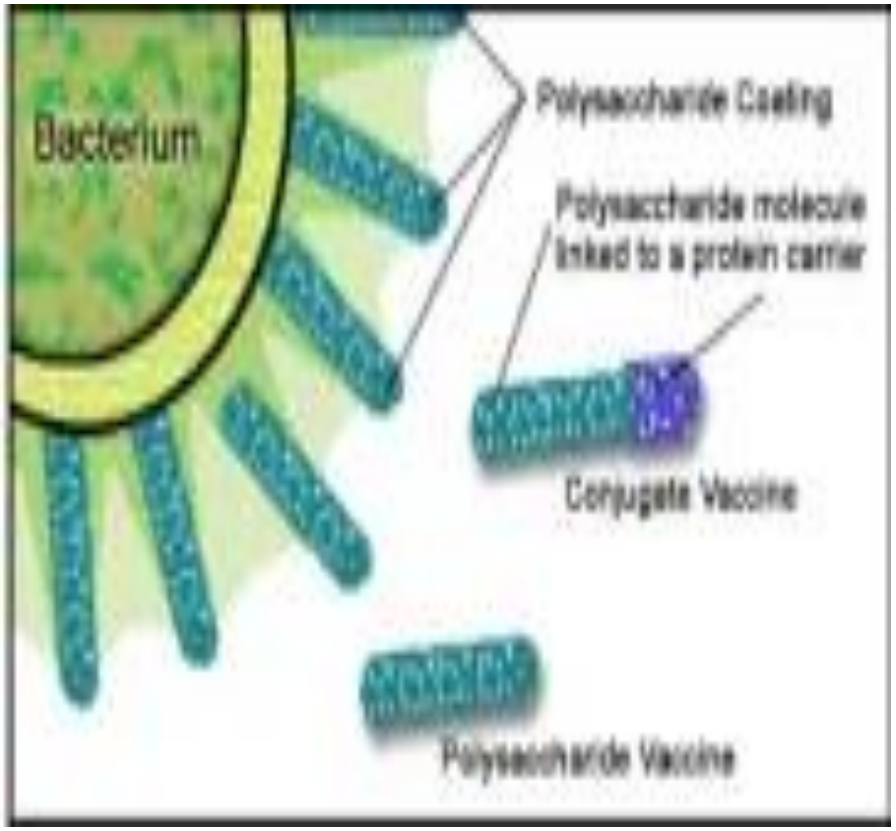


C. Detection and typing of capsule: **Quellung reaction.**

D. Cultivation: on **chocolate agar**.

E. X&V factor test: (**It requires both factors**).

Prophylaxis:



- **H. influenza type b vaccine (Hib vaccine):**

1- Polysaccharide vaccine.

2- **Conjugate** vaccine (capsule + carrier protein).

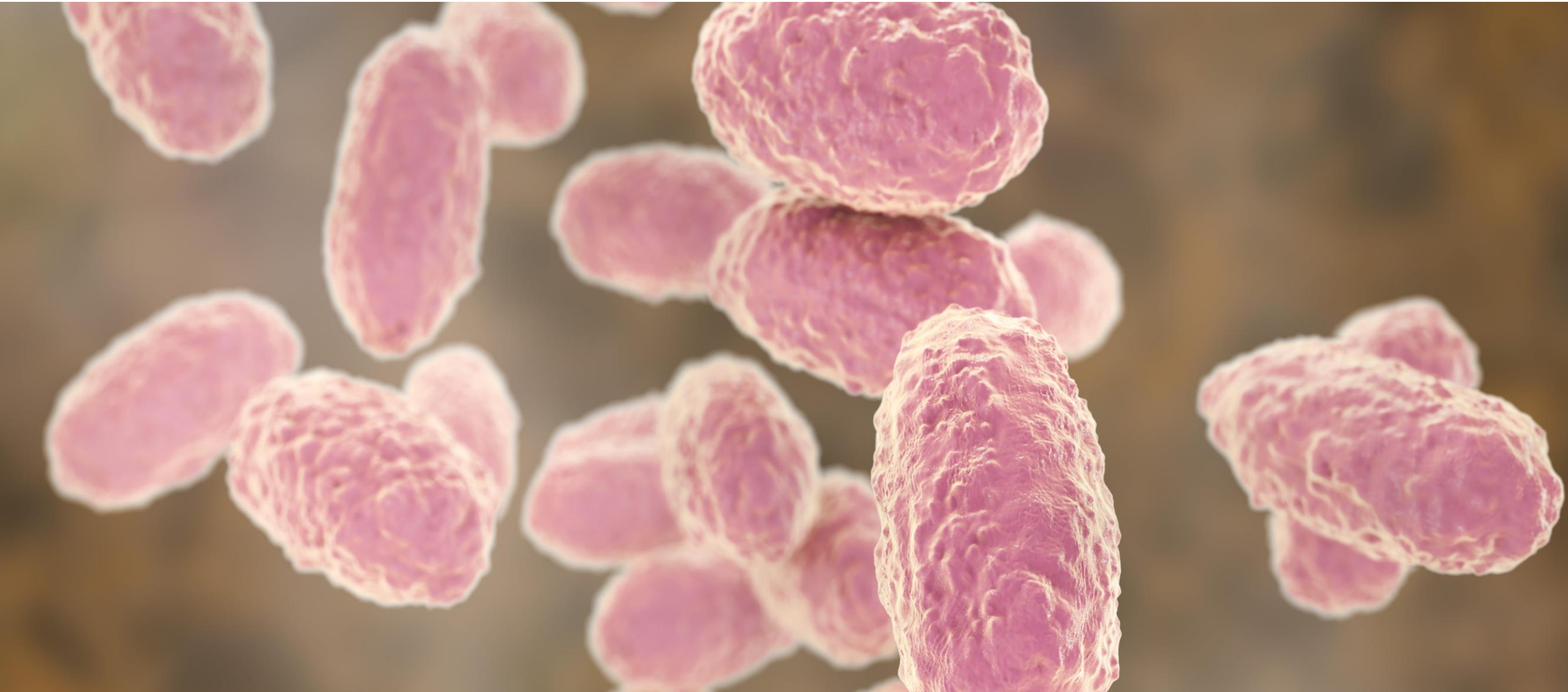
(given in 3 doses at 2, 3 and 4 months of age)

Succeeded in reducing cases to near zero level.

- **Rifampicin:** is used for chemoprophylaxis of unvaccinated close contacts of cases of Hib meningitis (decreases respiratory carriage of the organism).

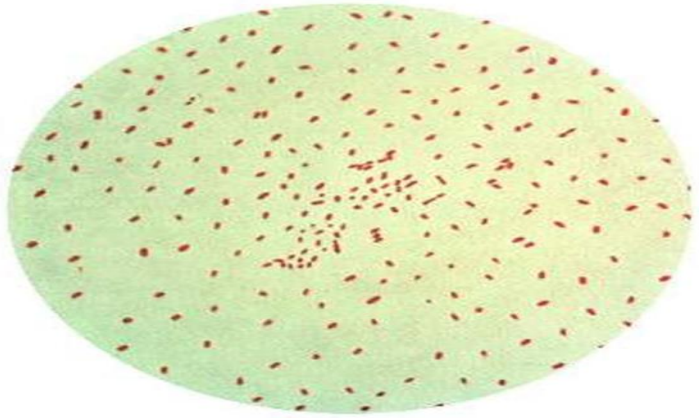
BORDETELLAE PERTUSSIS

“The causative agent of Whooping cough (Pertussis)”



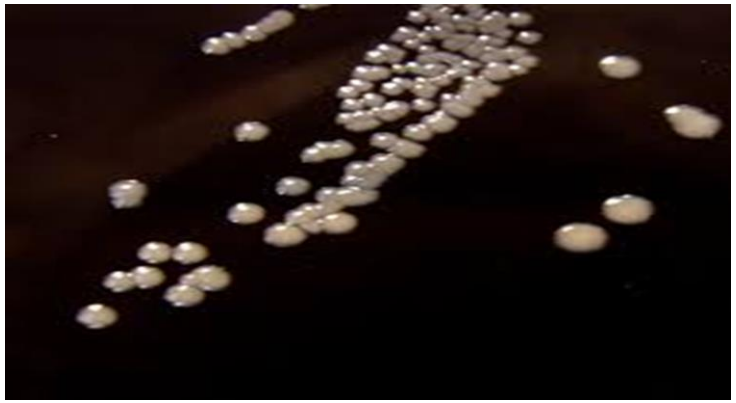
Morphology:

It is **Gram negative coccobacillus**.



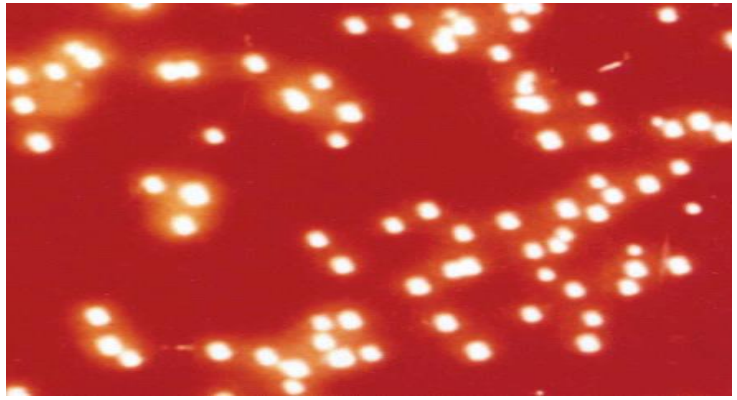
Culture:

- It is a strict aerobe.
- It grows on complex enriched media e.g. **Bordet Gengou medium** or **charcoal-cephalexin blood agar.**



Charcoal-cephalexin blood agar

- Colonies are greyish white with shiny convex surface "**Mercury drop**" appearance.
- **It does NOT require X and V factors.**
- Virulent strains produce **haemolysis** on blood agar.



Bordet Gengou medium

Virulence factors:

- **Filamentous hemagglutinin (FHA):**

- Colonization factor that **promote attachment** of the organism to the cilia of the epithelial cells of respiratory mucosa.

- **Pertussis toxin (PTx):**

- Colonization factor.

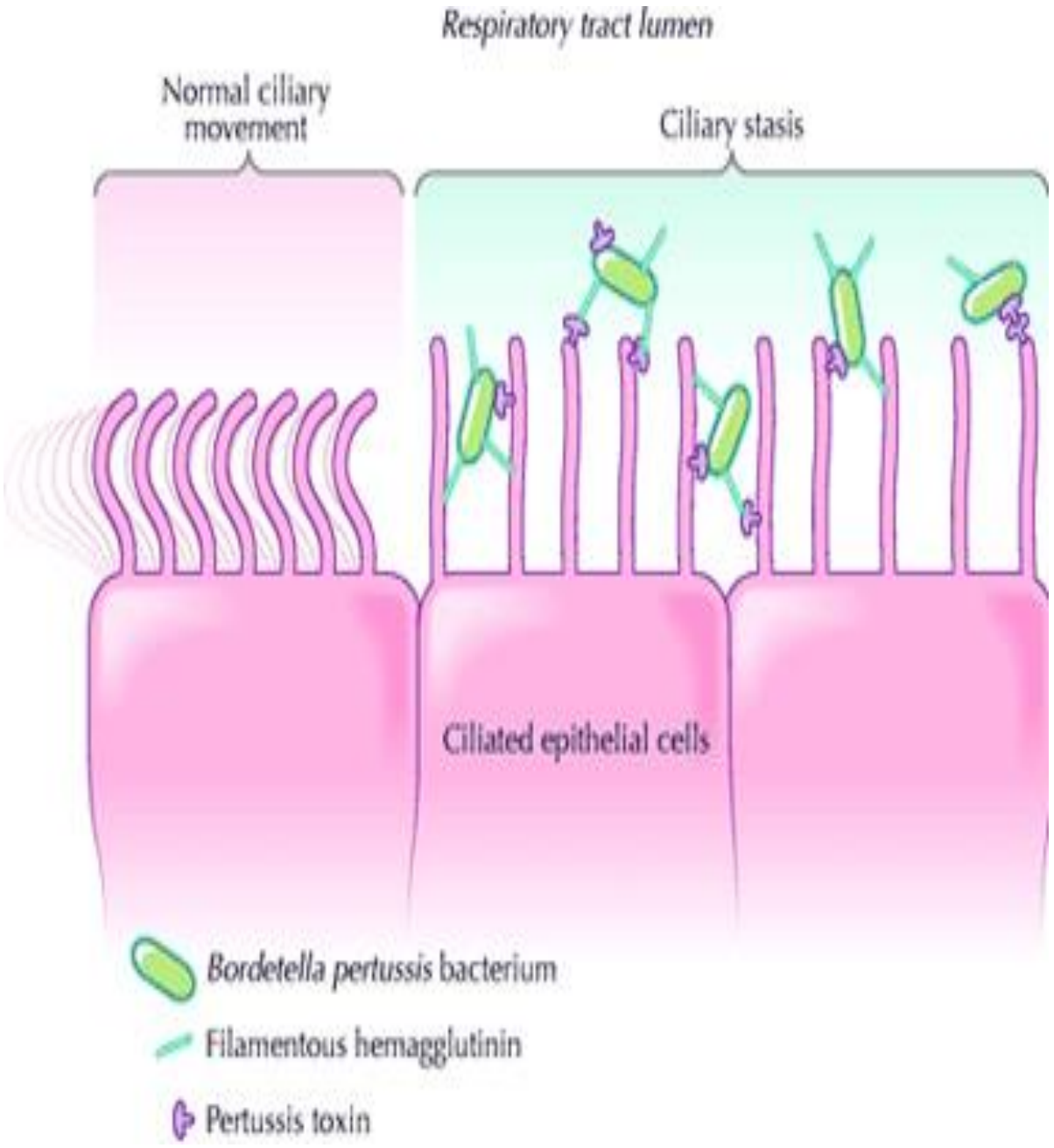
- It has **adenyl cyclase activity** → ↑↑cAMP → **edema** of the respiratory mucosa.

- It suppress phagocytic activity (immune evasion).

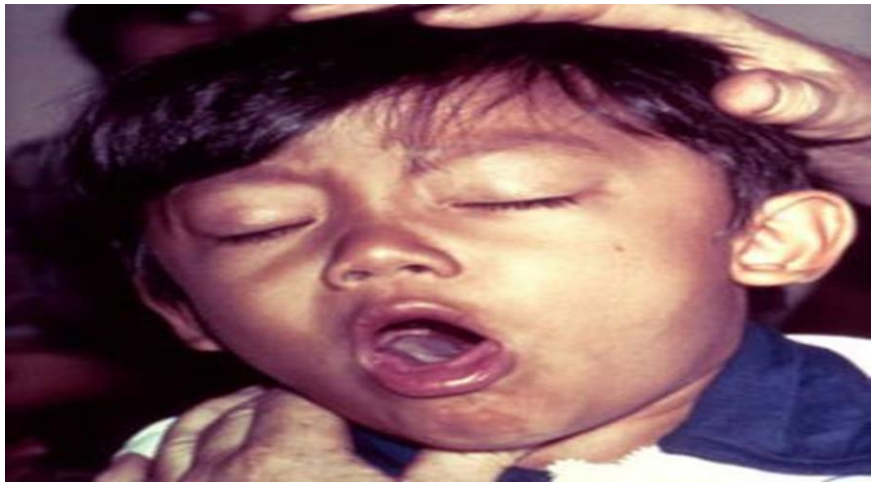
- **Tracheal cytotoxin (TCT):**

- **Necrosis (cell death) of ciliated cells** of the respiratory mucosa.

After the bacterium adheres to and colonizes the ciliated epithelium of the respiratory tract, it secretes toxins that lead to the death of these epithelium cells, a ciliary stasis, edema of the mucus membrane and an accumulation of mucus and cell debris that triggers coughing.



Whooping cough (Pertussis)



- It is highly communicable disease that occurs primarily in **infants and young children**.
- Infection transmitted by **droplet** infection.
- Disease occurs in three stages:

1- Catarrhal stage: (1-2 weeks): Fever, anorexia, malaise, rhinorrhea, sneezing.

2- Paroxysmal stage: (2-4 weeks): **Repetitive cough with explosive character** followed by a high-pitched intake of breath that sounds like **"whoop“**. This may be associated with vomiting, cyanosis and convulsions.

3- Convalescent stage: Gradual recovery over weeks **(followed by long lasting immunity).**

- **Complications:** (pneumonia, subconjunctival or cerebral haemorrhage, encephalopathy, Rib Fracture).

Laboratory diagnosis:

- **Specimen**: Nasopharyngeal swab.
- **Culture**: a-Direct plating on Bordet-Gengou medium

  b- The cough plate method.
- **Direct fluorescent antibody (FA) test.**
- **Serologic detection of antibodies**

Collection directly distance of 12-18"
on cough plate

Treatment:

- **Supportive care:** (e.g., oxygen therapy and suction of mucus) during the paroxysmal stage is important, especially in infants.
- **Antibiotic** (Azithromycin): reduces the number of organisms in the throat and decreases the risk of secondary complications but has little effect on the course of the disease at the “prolonged cough” stage because the toxins have already damaged the respiratory mucosa.

Prophylaxis: Two types of vaccines:

A- Killed whole cell vaccine.

It is suspected of causing various side effects, including **post-vaccine encephalopathy** at a rate of 1 case/million doses. It is still in use in many countries other than the United States.

B- Acellular vaccine: (**fewer side effects than killed vaccine**), a combination of:

- Pertussis toxoid (genetically inactivated toxin).
- Filamentous hemagglutinin.
- Other virulence factors.

It is usually administered in combination with toxoid of diphtheria and tetanus as follow:

DPT or DTaP: Primary series: 2,4 and 6 months followed by two boosters at 15-18 months and at 4-6 years.

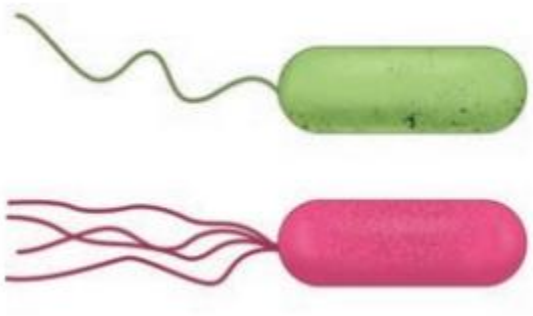
Td or Tdap: Boosters of every 10 years are recommended.

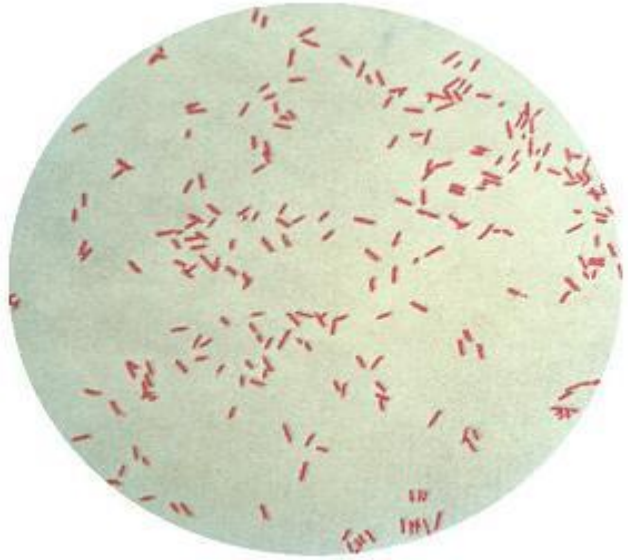
PSEUDOMONAS AERUGINOSA

“One of the top antimicrobial resistance threats world-wide”

“One of the most important causes of nosocomial infections”

Morphology:

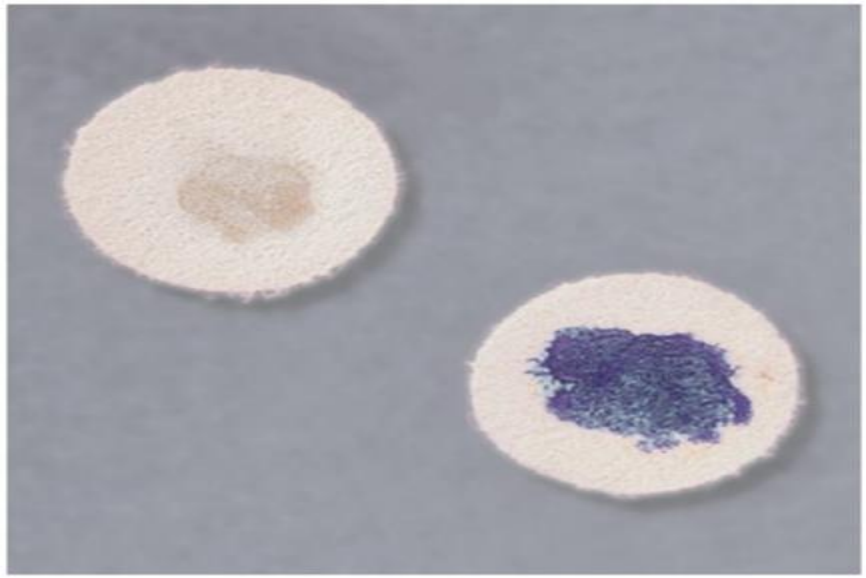




Gram negative bacilli.

Motile with single or multiple polar flagella.

Biochemical Reaction:



- It is **oxidase positive**.

- It does not ferment sugars (non-fermenters).

Culture:

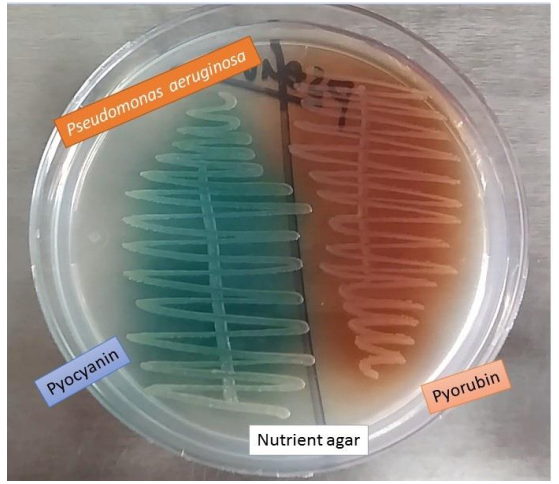
- Obligate (strict) aerobe.
- Grow well between **37ºC-42ºC**, its growth at **42ºC** differentiate it from other pseudomonads.
- Produce **a sweet or grape like odor** (fruity aroma).
- On MacConkey's →**non–lactose-fermenting (pale yellow)** colonies.
- Produce **exopigment** (**useful in clinical and laboratory diagnosis**):

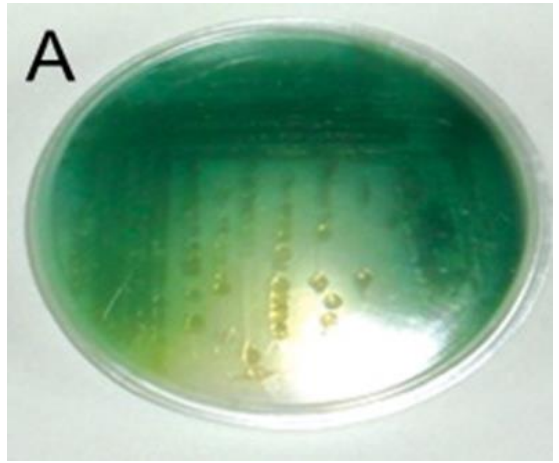
(1)Pyocyanin, blue-green pigment.

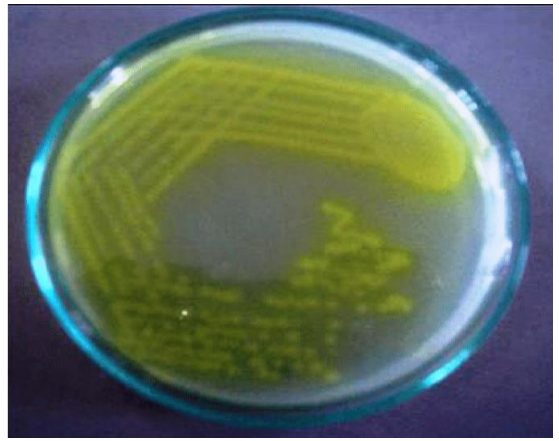
(2)Pyoverdin, a yellow-green pigment (fluoresces under UV light).

(3)Pyorubin, a red pigment.

(4)Pyomelanin, a brownish black pigment.







Virulence factors:

1- Pili (fimbriae).

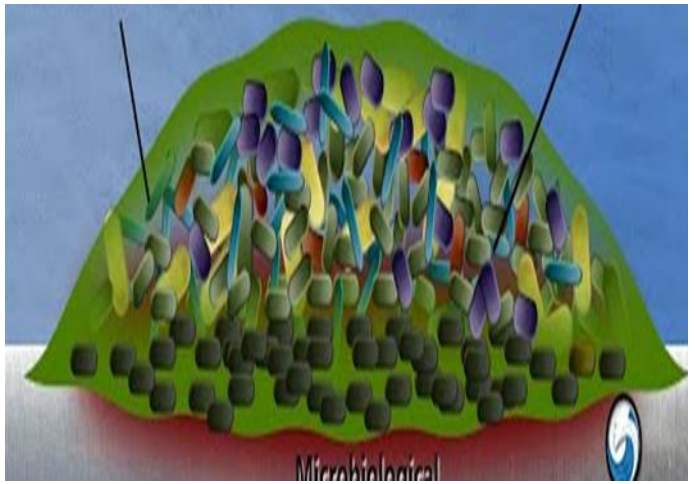
2-Endotoxin (Lipopolysaccharide): causes septic shock.

3- Exotoxin A: Inhibit protein synthesis and causes tissue necrosis.

4- Extracellular enzymes: e.g., elastases, facilitate invasion into the blood.

5- Pyocyanin: damages the cilia and cause cell death.

6- Alginate (glycocalyx): **(Mucoid strains)** that forms adherent **Biofilm** protecting from antibodies, complement, and antibiotics.



7- Broad antibiotic resistance: (intrinsic and acquired).

Medical importance of P. aeruginosa:

- It flourishes in wet environments and can grow in **simple aqueous solutions** (only traces of nutrients) (e.g., tap water, swimming pool, spa and jacuzzi, sinks, contact lens solution, …).
- It has a remarkable ability to **withstand disinfectants**, it has been found growing in soap solutions, in antiseptics, and in detergents.
- All these factors favor their persistence in the hospital environment and hence, account for their role in **hospital-acquired (nosocomial) infections**.
- P. aeruginosa is an **opportunistic pathogen** that causes infections in :

- In whom skin host defenses are destroyed (e.g., **extensive burns**).
  - In those with chronic respiratory disease (e.g., **cystic fibrosis**).
  - In those who are **immunosuppressed** and with neutropenia.
  - With **medical devices** e.g. catheters, ventilators, I.V line, ….

Clinical findings:

1- Respiratory infections:

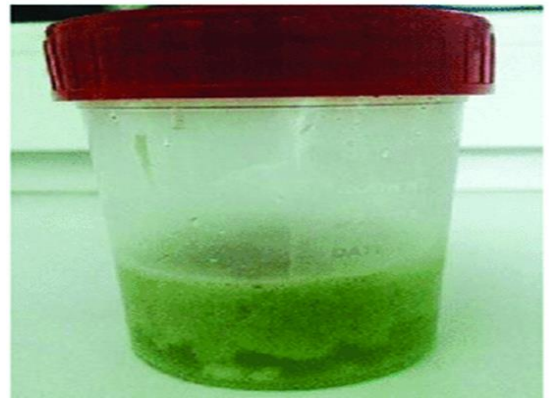
Hospital-acquired pneumonia (especially **ventilator-associated pneumonia** and in **cystic fibrosis** patients).

2- External ear infections:

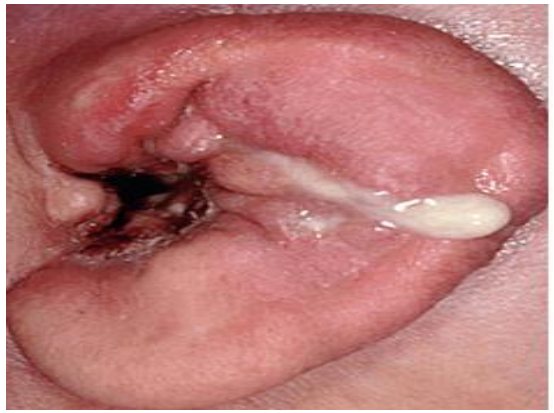
Malignant otitis externa (esp. in diabetics), **swimmer's ear**.

3- Eye infections:

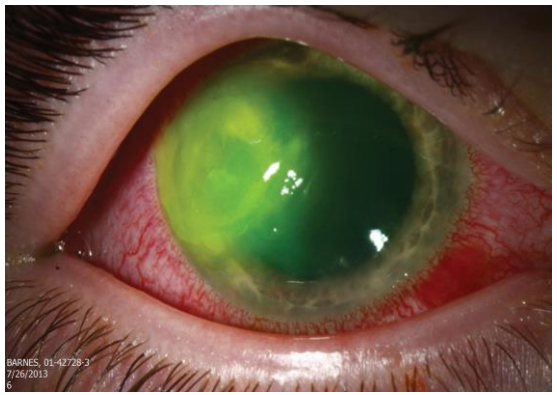
Corneal ulcer usually follow minor trauma to the cornea (frequently associated with contact lens use).



Greenish colour of sputum



malignant otitis externa



Corneal ulcer

4- Folliculitis (hot tub rash).

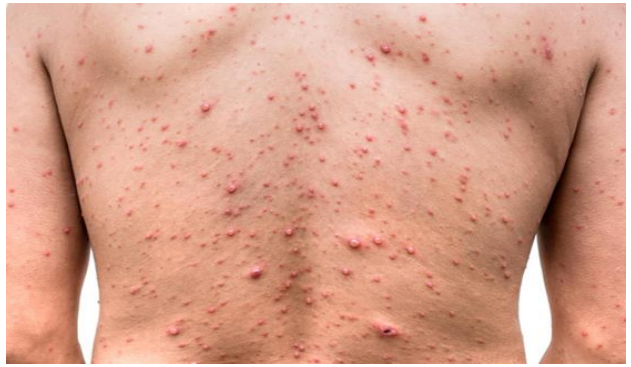
5- Skin & wound infections:

(e.g. Ecthyma Gangrenosum, green nail syndrome).

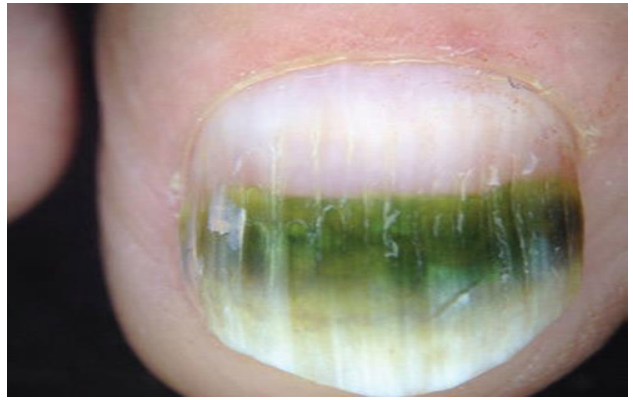
6- Urinary tract infections:

in those with indwelling catheters.

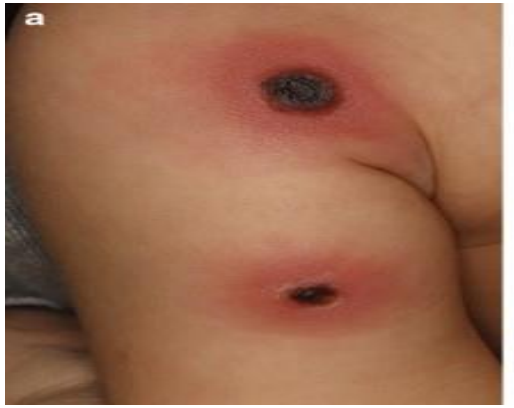
7- Meningitis: following lumbar puncture.



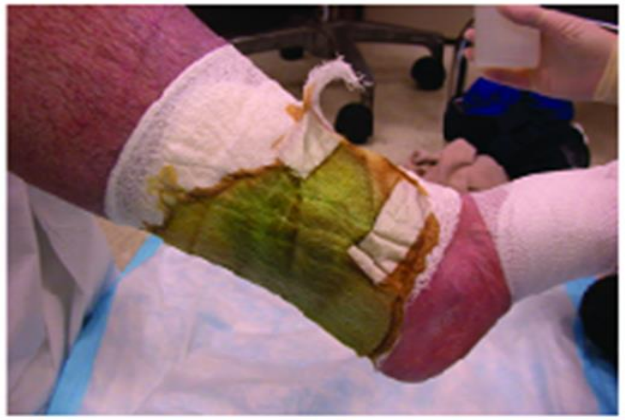
Folliculitis



Green nail syndrome



Ecthyma Gangrenosum



Green drainage in diabetic foot

Laboratory diagnosis:

1-Specimens: Sputum, ear discharge,….

2- Smear: Gram negative bacilli.

3- Culture: On different media. The organism identified by:

- **Its odor.**
- **Exopigment production.**
- **Ability to grow at 42ºC.**
- **Oxidase-positive.**

Treatment:

- Because *P. aeruginosa* is **resistant to many antibiotics (MDR),** treatment must be tailored to the sensitivity of each isolate and monitored frequently; resistant strains can emerge during therapy.
- **Combinations** of active antibiotics generally required.

Thank you