

Bacterial Respiratory Tract Infections (A)

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Streptococcus pneumonia

Introduction

- **What is *Streptococcus pneumoniae*?**

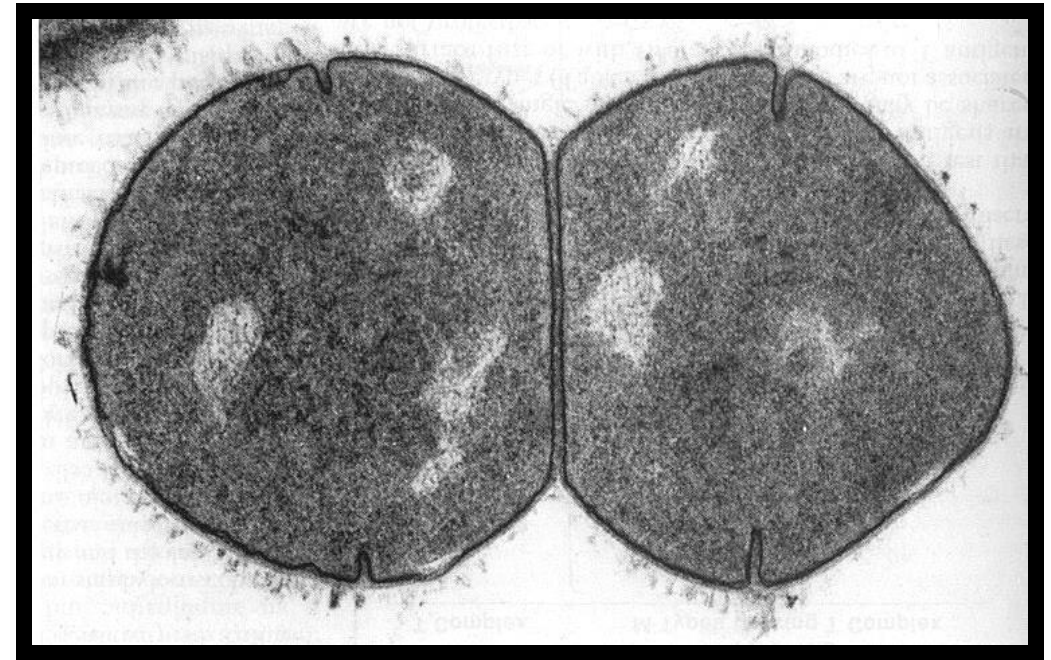
- Gram-positive, encapsulated diplococcus (in pairs)
- Grow in chains
- Most common cause of community-acquired pneumonia
- Commonly called the pneumococcus
- Classified based on capsular polysaccharide types (95 serotypes)
- 90% of cases of bacteraemic pneumococcal pneumonia and meningitis are caused by 23 serotypes

- **Clinical Significance**

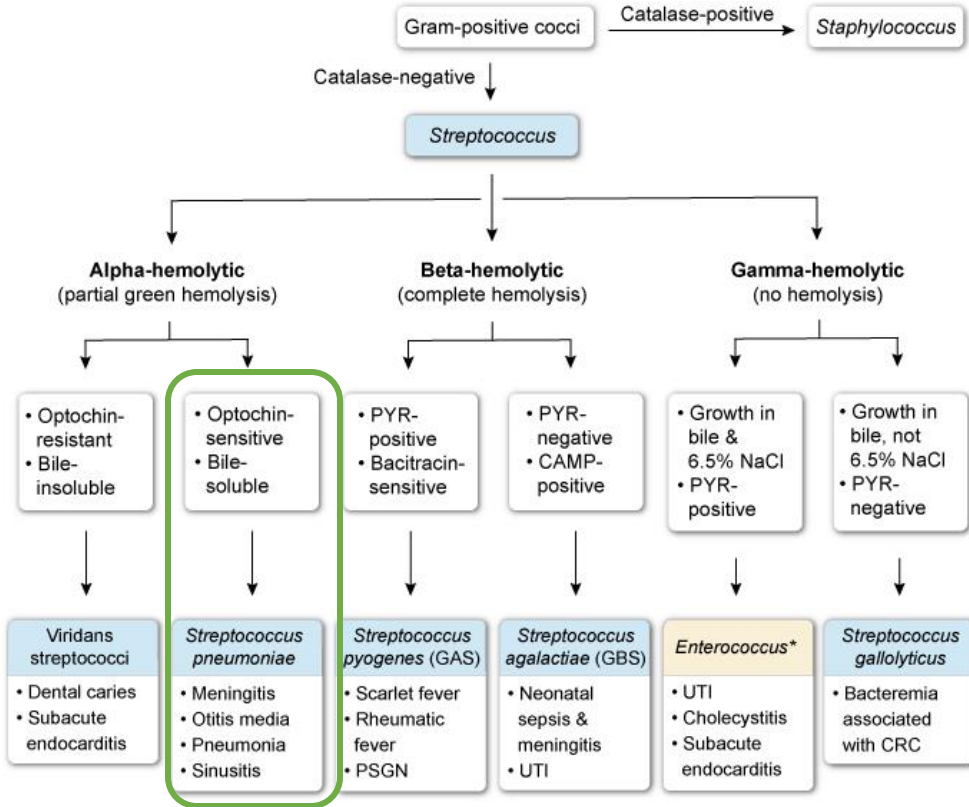
- Responsible for significant morbidity and mortality worldwide
- Causes various infections: pneumonia, meningitis, otitis media, and sinusitis
- May spread to other sites, such as the joints, peritoneum, endocardium, biliary tract and, in particular, the meninges.



- Mode of Division: *S. pneumoniae* divides by binary fission, where one bacterial cell splits into two.
- Incomplete Separation: After binary fission, *S. pneumoniae* cells often do not completely separate. The daughter cells remain attached to one another at their poles, leading to the characteristic diplococci appearance.



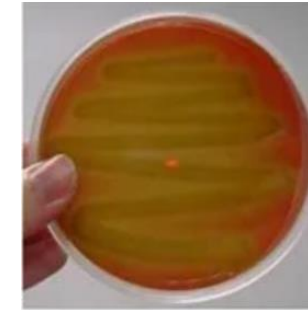
Microbiologic laboratory identification of streptococci



*Formerly group D streptococci

CAMP = Christie, Atkins & Munch-Petersen test; **CRC** = colorectal cancer; **NaCl** = sodium chloride; **PSGN** = poststreptococcal glomerulonephritis; **PYR** = pyrrolidonyl arylamidase; **UTI** = urinary tract infection.

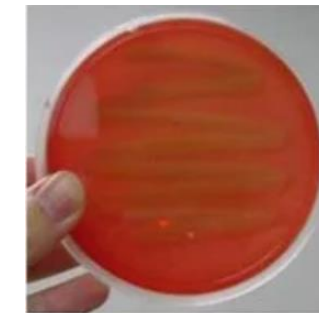
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Alpha Hemolysis



Beta Hemolysis

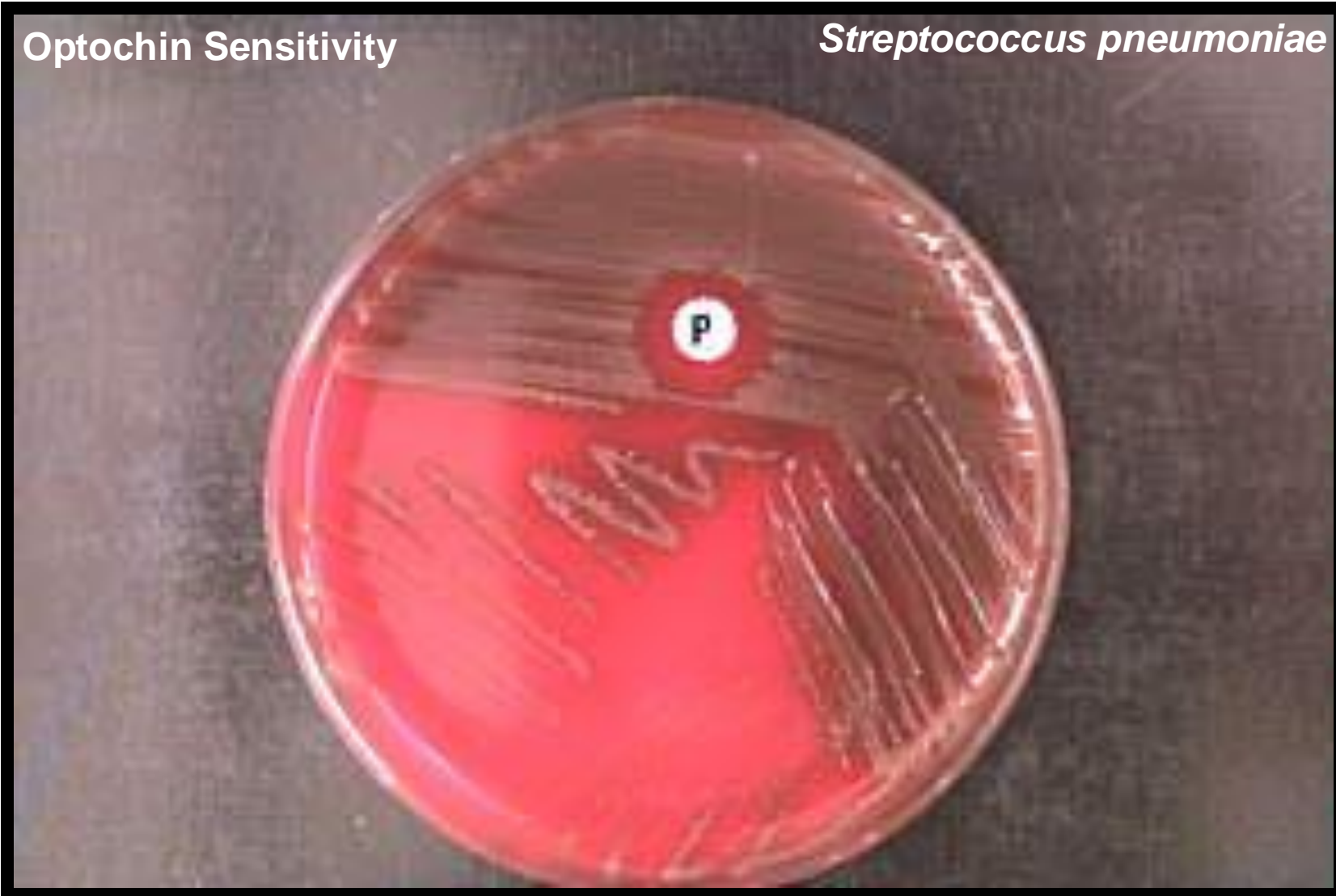


Gamma Hemolysis



Optochin Sensitivity

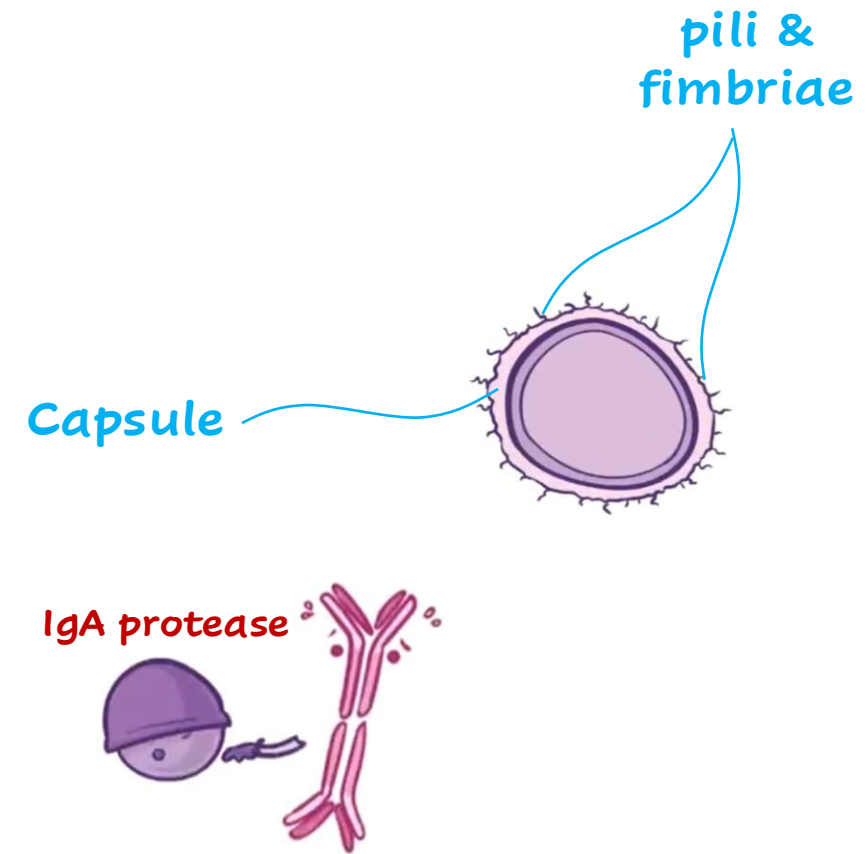
Streptococcus pneumoniae



Streptococcus pneumoniae

Virulence Factors

- **Polysaccharide capsule**
 - The major virulence factor
 - Has pili and fimbriae (to attach to the host cell)
 - Inhibits phagocytosis
- **IgA protease**
 - Cleaves human IgA in the hinge region
 - Helps the bacteria to evade the immune system
- **Autolysin**
 - Breakdown of the bacteria and release of the internal components
 - Facilitates release of pneumolysin
- **Pneumolysin**
 - Lyses host cells of immune system
 - Facilitates colonization



Streptococcus pneumonia

Epidemiology

- **Source:**

- Humans are the reservoir of pneumococci, which are commonly found in the upper respiratory tract of healthy persons throughout the world.
- It is a member of the oropharyngeal microbiota of 5-70% of population

- **Incidence:**

- Pneumococcal infections are among the leading causes worldwide of illness and death for young children, persons who have underlying debilitating medical conditions and the elderly.
- Pneumonia → The estimated global annual incidence is 1-3 per 1000 of the population, with a case fatality rate > 5%.

- **Mode of Transmission:**

- Spread via respiratory droplets, direct oral contact, and indirectly through contaminated objects.



Streptococcus pneumonia

Predisposing factors

- Pneumonia results from aspiration of pneumococci contained in upper airway secretions into the lower respiratory tract; for example:
 - Loss of consciousness: general anesthesia, convulsions, alcoholism, epilepsy or head trauma
- Respiratory viral infections, such as influenza, chronic bronchitis
- Young and elderly people.
- Immune suppressed people (e.g Chronic diseases, **asplenia**)
 - Because the spleen produces opsonizing antibodies that are important for clearing **encapsulated bacteria** from the blood, asplenia is associated with significant risk of fulminant bacterial infections. ***Streptococcus pneumoniae*** is the leading pathogen, but *Neisseria meningitidis* and *Haemophilus influenzae* are also frequently isolated.
 - Vaccination (pneumococcal and Haemophilus influenzae type b) is recommended to reduce risk of future infection.
- Structural respiratory abnormalities.



Streptococcus pneumonia

Clinically

- Pneumonia
- Otitis media
- Meningitis
- Bacteraemia (15 % of pneumonia)
- Peritonitis
- Septicemia
- Conjunctivitis



Streptococcus pneumonia

Clinically - Pneumonia

- Pneumonia is defined as an acute respiratory illness associated with recently developed radiological pulmonary shadowing which may be segmental, lobar or multilobar.
- *Streptococcus pneumonia* is a frequent cause of pneumonia where vaccination is not available.
- Contiguous spread commonly results in complications such as:
 - Inflammatory involvement of the pleura, Empyema and Pericarditis.
- Bacteraemia may complicate pneumococcal pneumonia in up to 15% of patients. This can result in metastatic involvement of the meninges, joints and, rarely, the endocardium.



Streptococcus pneumonia

Clinically – Pneumonia (cont 1)

Signs and symptoms:

- The patient rapidly becomes more ill with a high temperature (up to 39.5°C), pleuritic pain and a dry cough (initially dry).
- A day or two later, **rusty-coloured sputum** is produced
- The patient breathes rapidly and shallowly, the affected side of the chest moves less, and signs of consolidation may be present.
- The mortality rate from pneumococcal pneumonia in those admitted to hospital is approximately 15%.

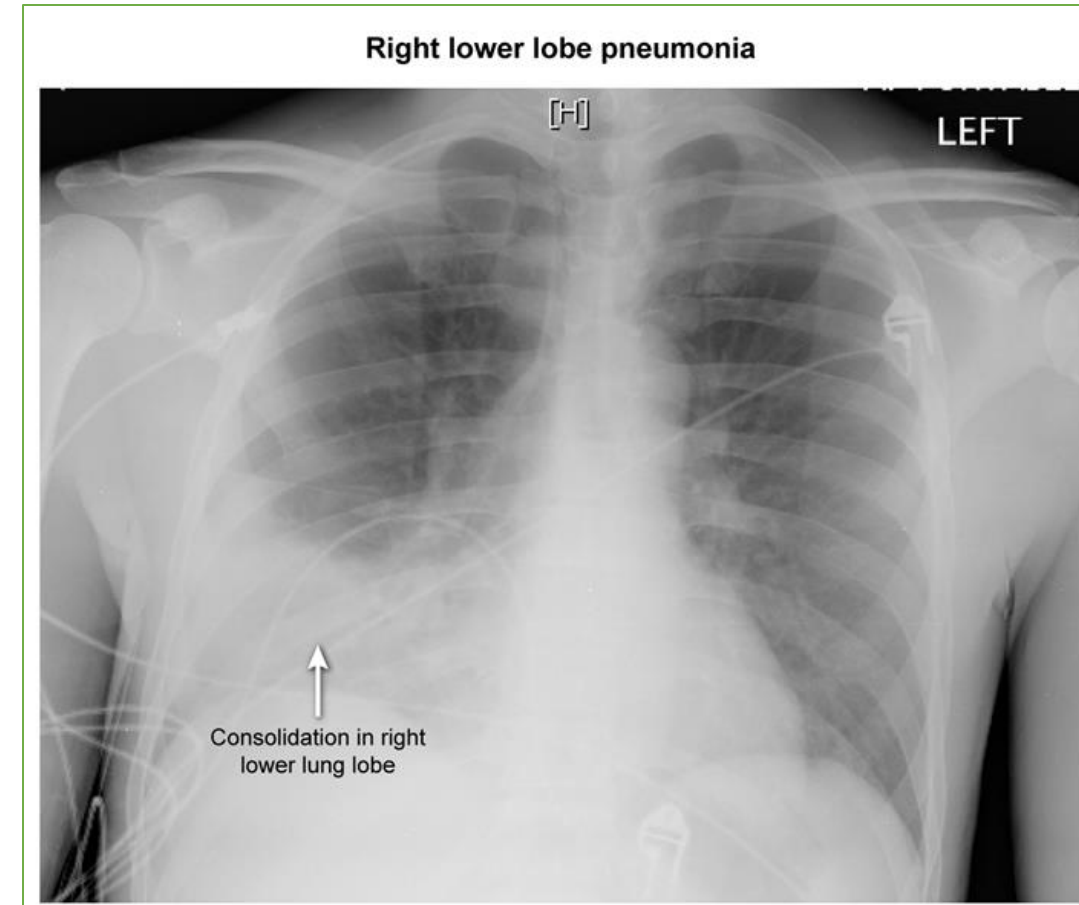


Streptococcus pneumoniae

Clinically – Pneumonia (cont 2)

Chest X-ray findings:

- Chest X-ray confirms the area of consolidation (lobar), but radiological changes lag behind the clinical course;
- So that X-ray changes may be minimal at the start of the illness. Conversely, consolidation may remain on the chest X-ray for several weeks after the patient is clinically cured.
- The chest X-ray usually returns to normal by 6 weeks



Streptococcus pneumonia

Clinically – Pneumonia (Treatment)

Community-acquired pneumonia	
Setting	Recommended therapy
Outpatient	<ul style="list-style-type: none">• Healthy patients<ul style="list-style-type: none">• Amoxicillin or doxycycline• Comorbid conditions (eg, diabetes, malignancy)<ul style="list-style-type: none">• Fluoroquinolone or beta-lactam + macrolide
Inpatient (non-ICU)	<ul style="list-style-type: none">• Fluoroquinolone <p>OR</p> <ul style="list-style-type: none">• Beta-lactam + macrolide
Inpatient (ICU)	<ul style="list-style-type: none">• Beta-lactam + macrolide <p>OR</p> <ul style="list-style-type: none">• Beta-lactam + fluoroquinolone

ICU = intensive care unit.



Streptococcus pneumonia

Clinically - Otitis media and sinusitis

- Middle ear infections (otitis media) affect approximately half of all children between the ages of 6 months and 3 years.
- Approximately one-third of cases are caused by *Str. pneumoniae*. Disease occurs after acquisition of a new strain to which there is no pre-existing immunity.
- The prevalence is highest among children attending primary school, where there is a constant exchange of pneumococcal strains.
- Pain, fever, ear discharge...



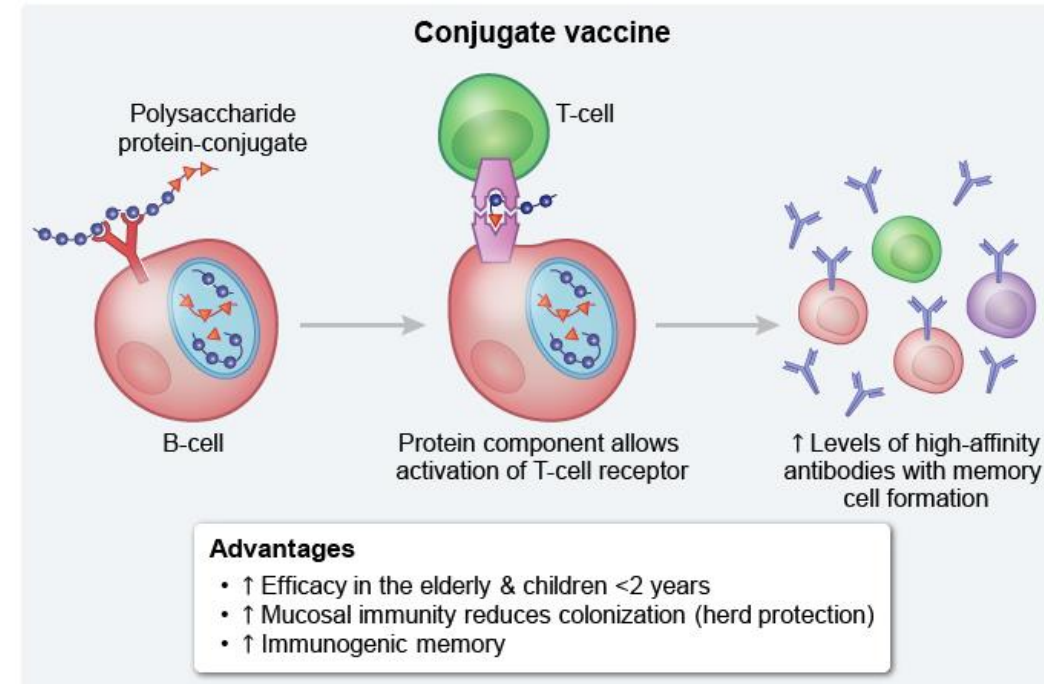
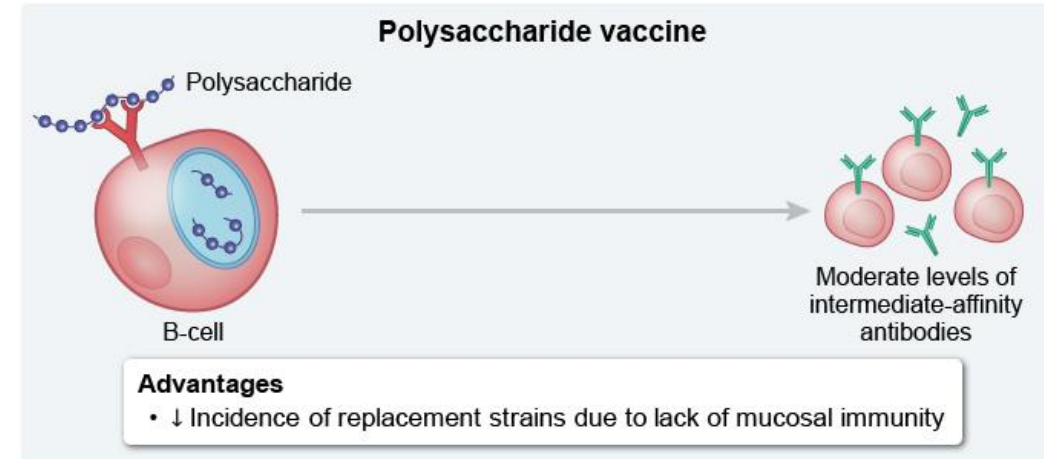
Streptococcus pneumoniae Vaccines

- **Pneumococcal Polysaccharide Vaccine (PPSV23):**

- PPSV23: Protects against more strains (23) but produces a weaker, short-term immune response and is not effective in infants.

- **Pneumococcal Conjugate Vaccine (PCV13):**

- PCV13: Protects against fewer strains (13), but creates a stronger and longer-lasting immune response due to T-cell involvement and is effective in infants.





Bordetella pertussis



Bordetella pertussis

Introduction

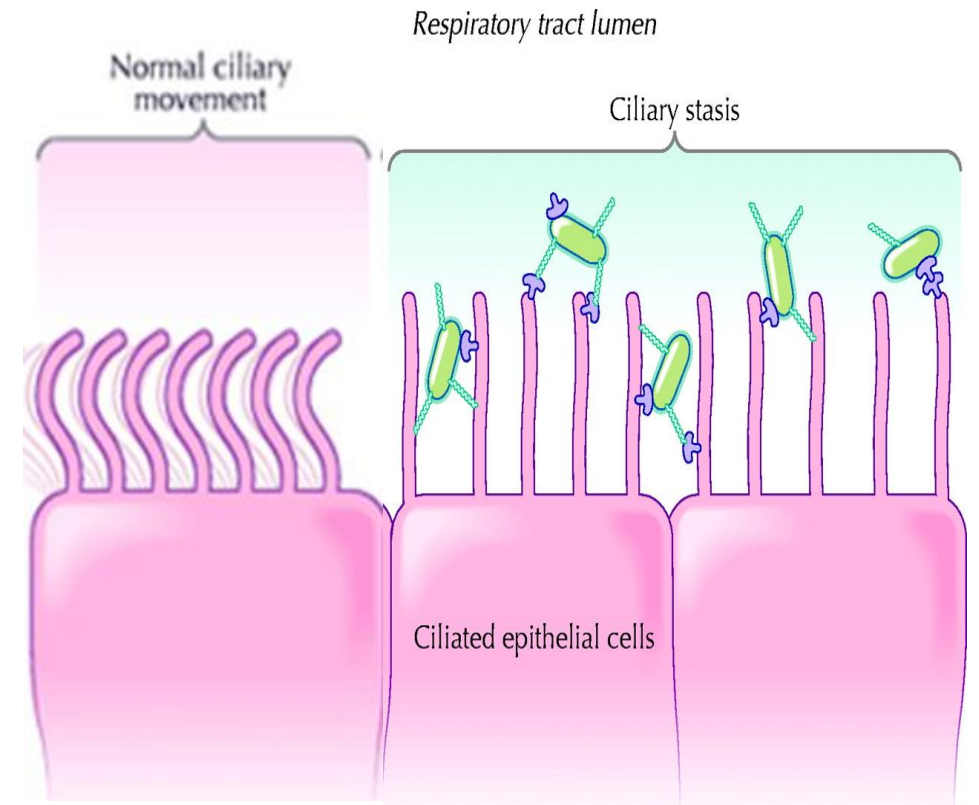
- Gram-negative coccobacillus or bacillus arranged singly, in pairs or in small groups
- They are obligate respiratory tract pathogens, therefore, they are unable to survive outside their hosts
- Aerobic and encapsulated.
- Reservoir is humans (Specific to Humans)



Bordetella pertussis

Pathogenesis

1. *B. pertussis* has an affinity for ciliated bronchial epithelium
2. Adherence is by pili
3. Produces toxins that immobilize the cilia and destroy the ciliated cells
4. This produces an epithelium devoid of the ciliary blanket, which moves foreign matter away from the lower airways



Bordetella pertussis

Clinical Manifestations

- **Incubation Period**
 - 7–10 days (range: 5–21 days)
- **Catarrhal Stage (1–2 weeks)**
 - Mild cough, rhinorrhea, low-grade fever
 - Highly communicable period
- **Paroxysmal Stage (2–6 weeks)**
 - Severe, spasmodic coughing fits
 - Characteristic "whoop" during inspiration
 - Post-tussive vomiting and exhaustion
- **Convalescent Stage (weeks to months)**
 - Gradual reduction in coughing episodes



Bordetella pertussis

Prevention

1. Vaccines

- The best way to prevent pertussis among babies, children, teens, and adults is to get vaccinated (DTaP).

2. Antibiotics

- If you or a member of your household has been diagnosed with pertussis, your doctor or local health department may recommend preventive medication

3. Hygiene

- Like many respiratory illnesses, pertussis spreads by coughing and sneezing while in close contact with others, who then breathe in the bacteria.
 - Cover your mouth and nose with a tissue when you cough or sneeze.
 - Put your used tissue in the waste basket.
 - Cough or sneeze into your upper sleeve or elbow, not your hands, if you don't have a tissue.
 - Wash your hands often with soap and water for at least 20 seconds.



Bordetella pertussis

Treatment

- **Antibiotic Therapy**

- **First-line:** Macrolides (azithromycin, clarithromycin, erythromycin)
 - Azithromycin preferred due to better tolerance
- **Alternative:** Trimethoprim-sulfamethoxazole for macrolide intolerance

- **Efficacy of Antibiotics**

- Most effective if started during catarrhal stage



Thank You

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