

# Bacterial Respiratory Tract Infections (A)

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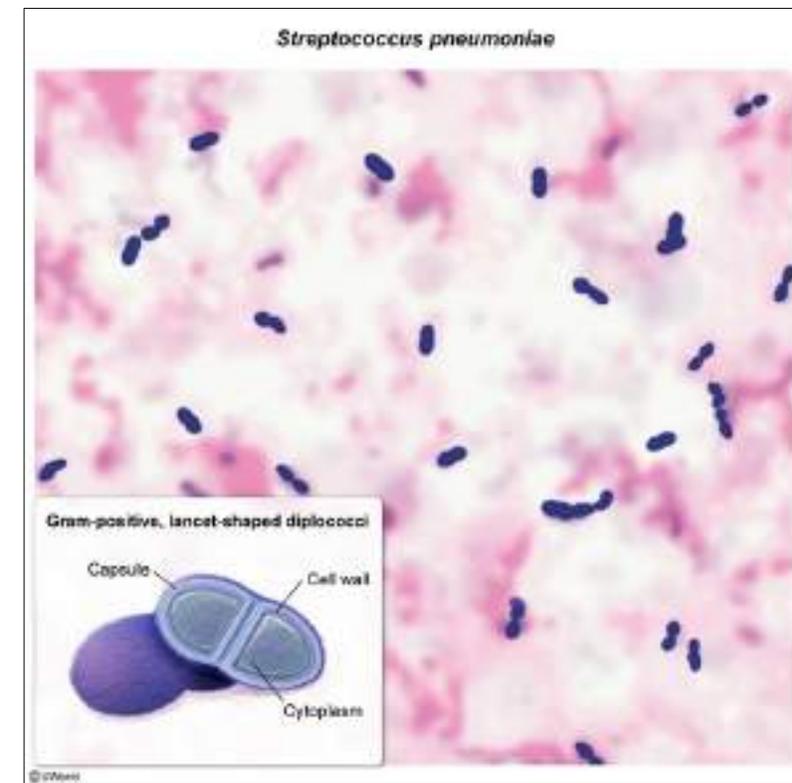


# Streptococcus pneumoniae

## 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 (> 100 serotypes)
- 90% of cases of bacteraemic pneumococcal pneumonia and meningitis are caused by 23 serotypes



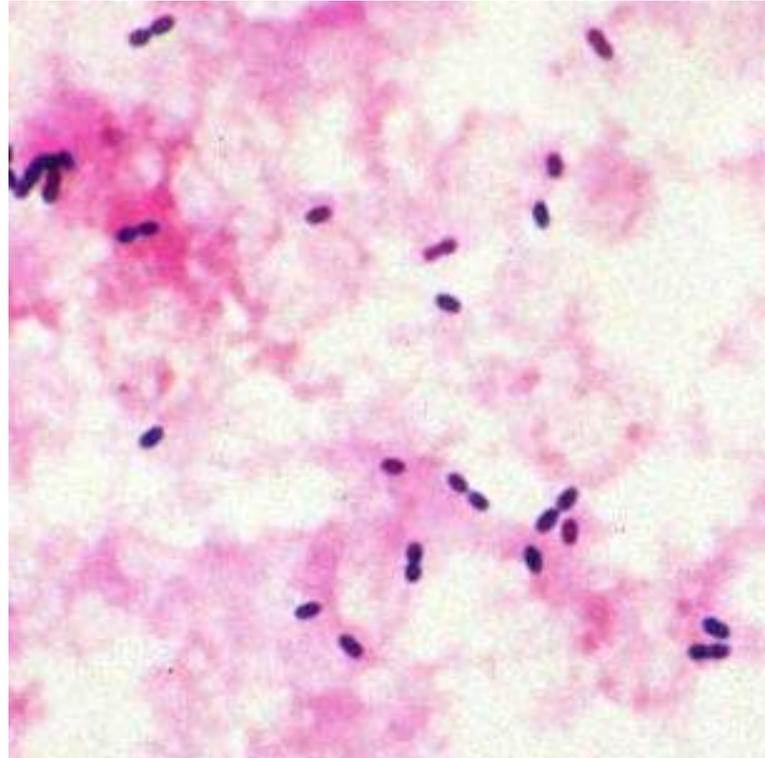
- **Clinical Significance**

- 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.



# Streptococcus pneumoniae

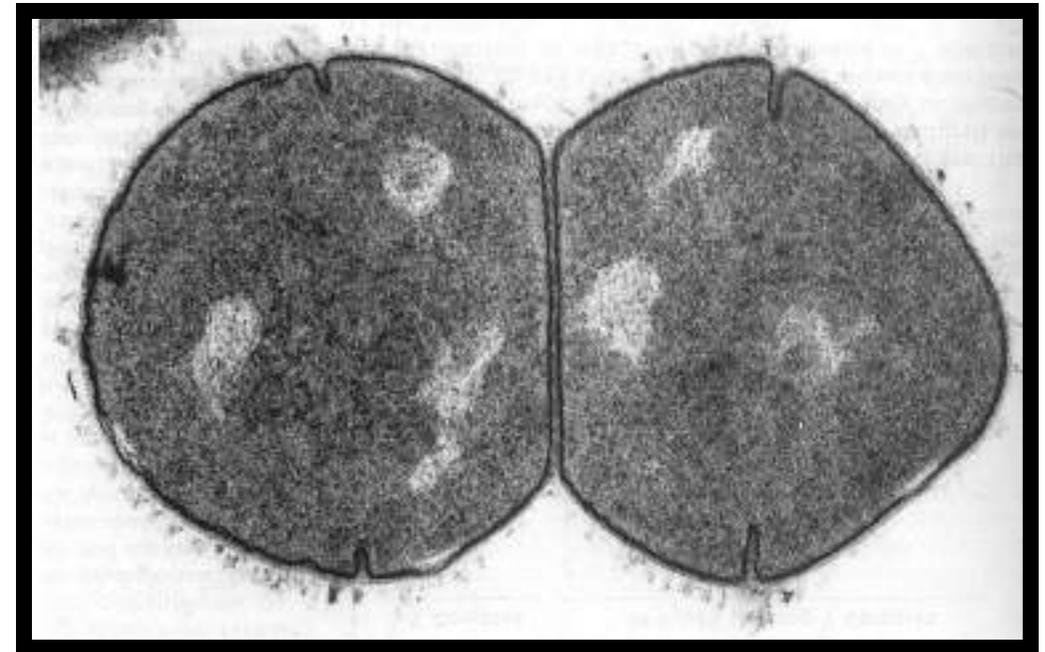
## Introduction



# Streptococcus pneumonia

## Introduction

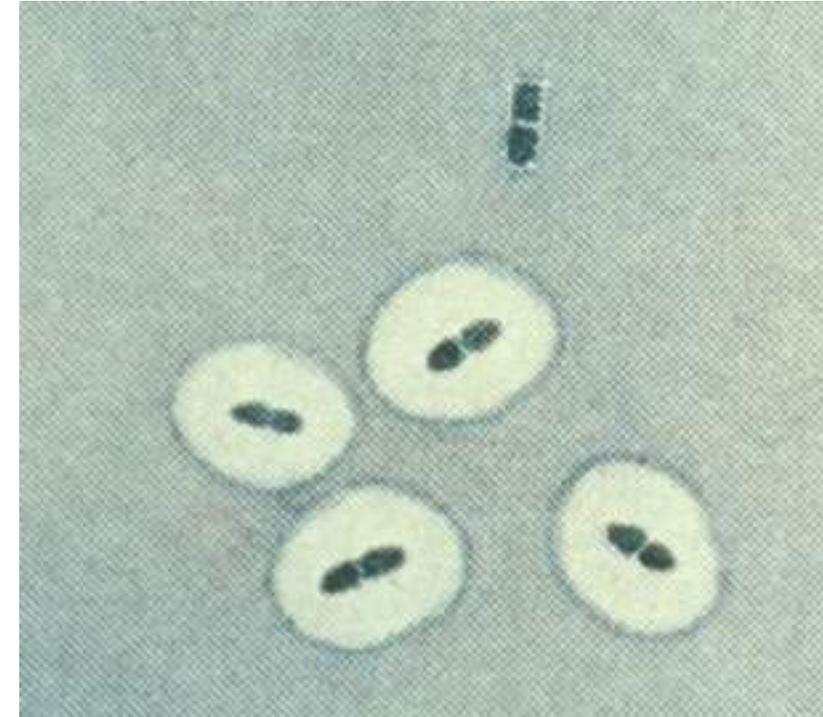
- Incomplete Separation: After binary fission, *S. pneumoniae* cells often do not completely separate. The daughter cells remain attached to one another at their poles, leading to the characteristic diplococci appearance.



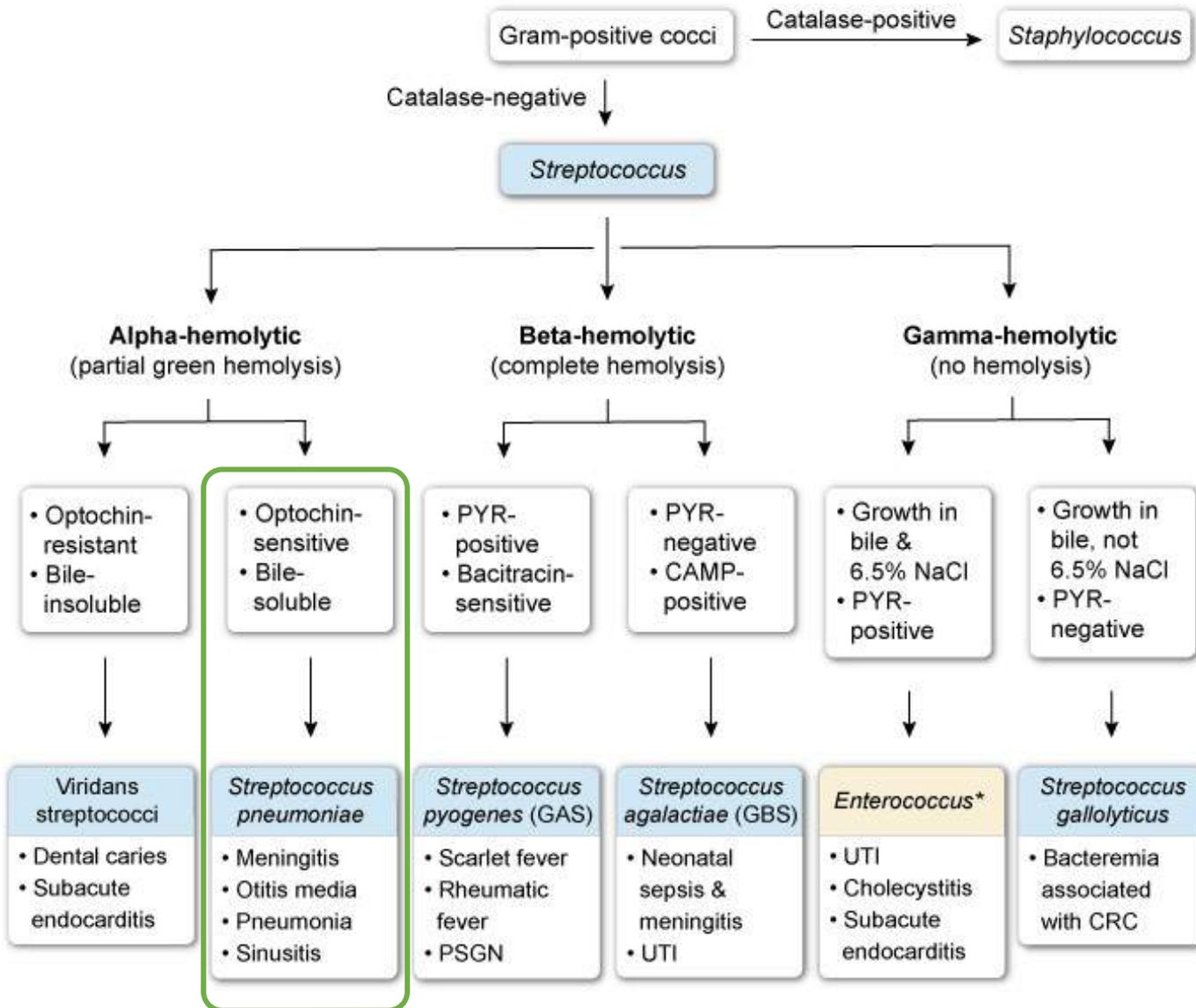
# Streptococcus pneumoniae

## Introduction

- Photomicrograph of streptococcus pneumoniae (Neufeld test)
- Four of the five diplococci visible are encapsulated, as indicated by the white rim (halo) surrounding them. The Neufeld-Quellung test used here uses antibodies that react with the polysaccharide bacterial capsule, causing it to appear thick and opaque
- Under the microscope, the capsule swells and appears as a halo around the blue-stained bacterial cells when specific anti-capsular antibodies and methylene blue dye are added ("quellung reaction").



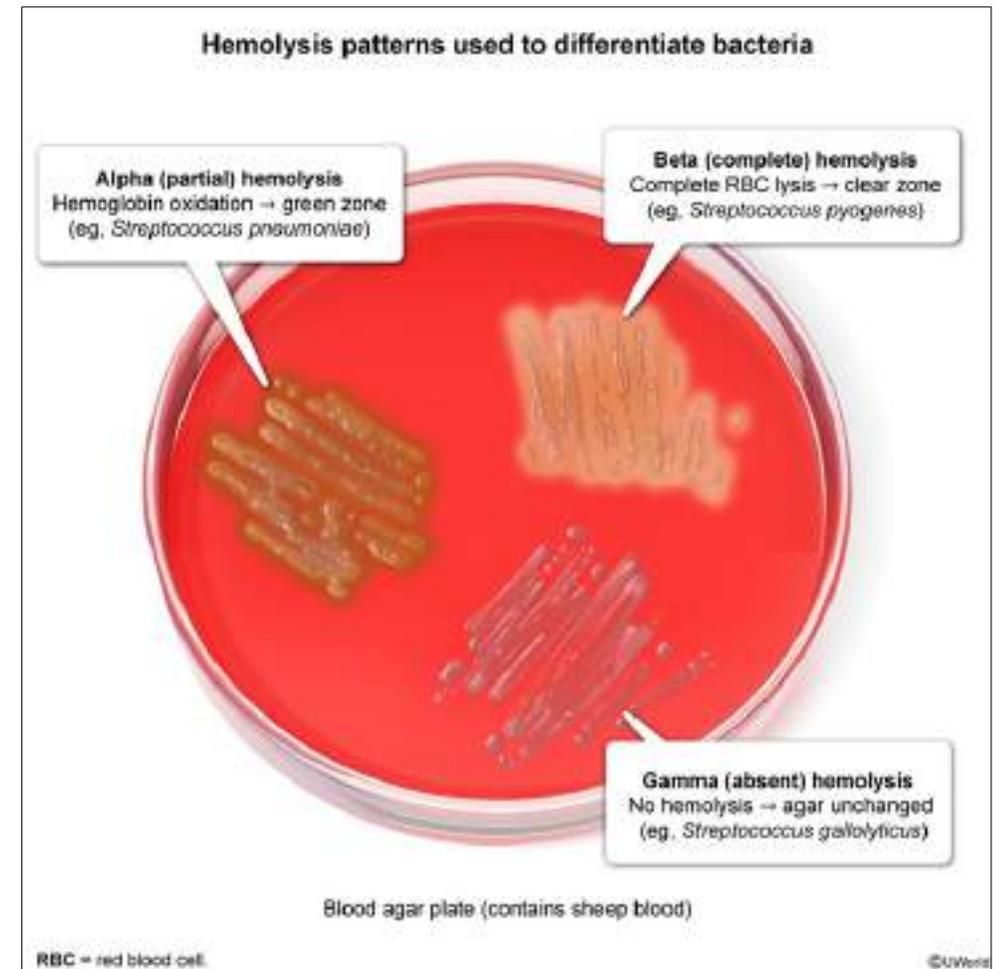
# Microbiologic laboratory identification of streptococci

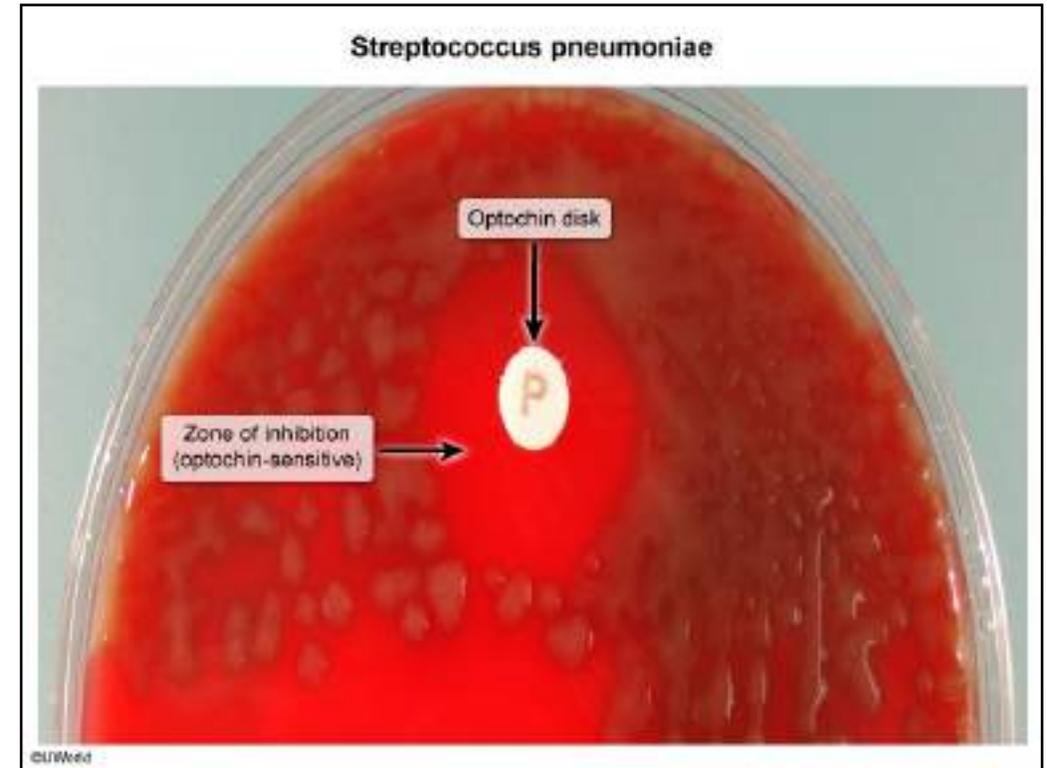


\*Formerly group D streptococci

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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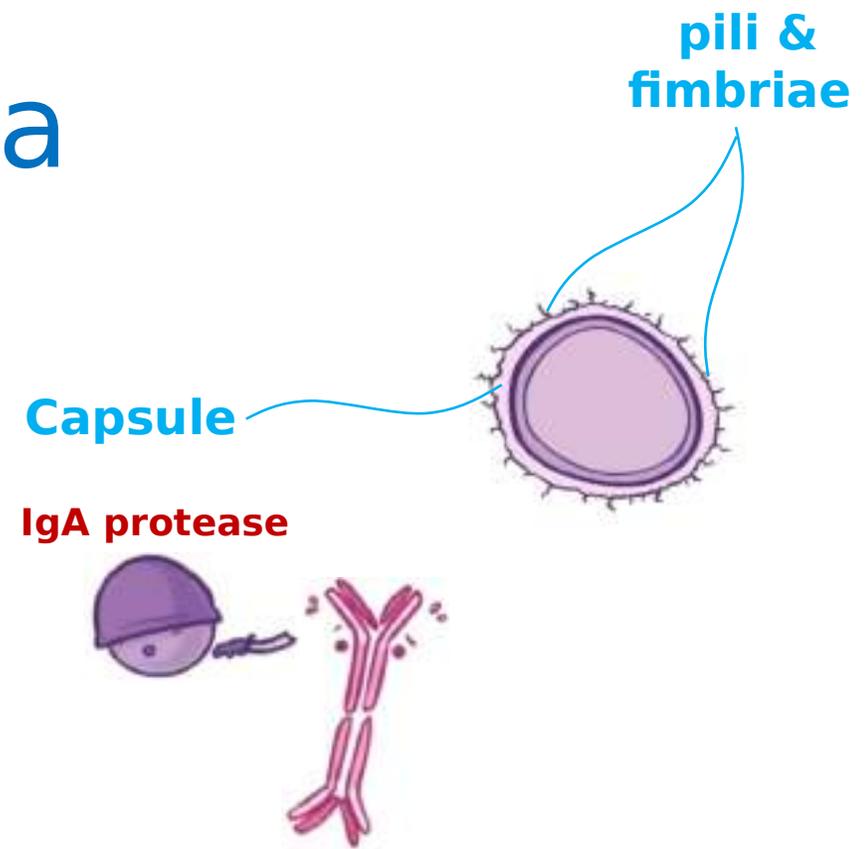




# Streptococcus pneumonia

## 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

## Virulence Factors

The major virulence factor of *S pneumoniae* is a thick **polysaccharide capsule**, which impedes phagocytosis and complement binding.

Antibodies against the capsule form during infection and are protective against future infections with that strain. **However**, over 100 capsular serotypes have been identified. Therefore, previous infection is rarely protective against future infection.

Other *S pneumoniae* virulence factors include IgA protease (inactivates secretory IgA), adhesins (necessary for adhesion to epithelial cells), and pneumolysin (a cytotoxin that causes pores in cell membranes and cell lysis).



# 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.
- Community-acquired pneumonia (all causes) has an incidence of 1.5-14 per 1000 person-years globally
  - Pneumococcal pneumonia specifically is estimated at about 1 per 1000 adults per year
  - The case-fatality rate for pneumococcal pneumonia is 5-7%

- **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.



# Streptococcus pneumonia

## Clinically

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



# Streptococcus pneumoniae

## 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 pneumoniae* 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 pneumoniae

## 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%.

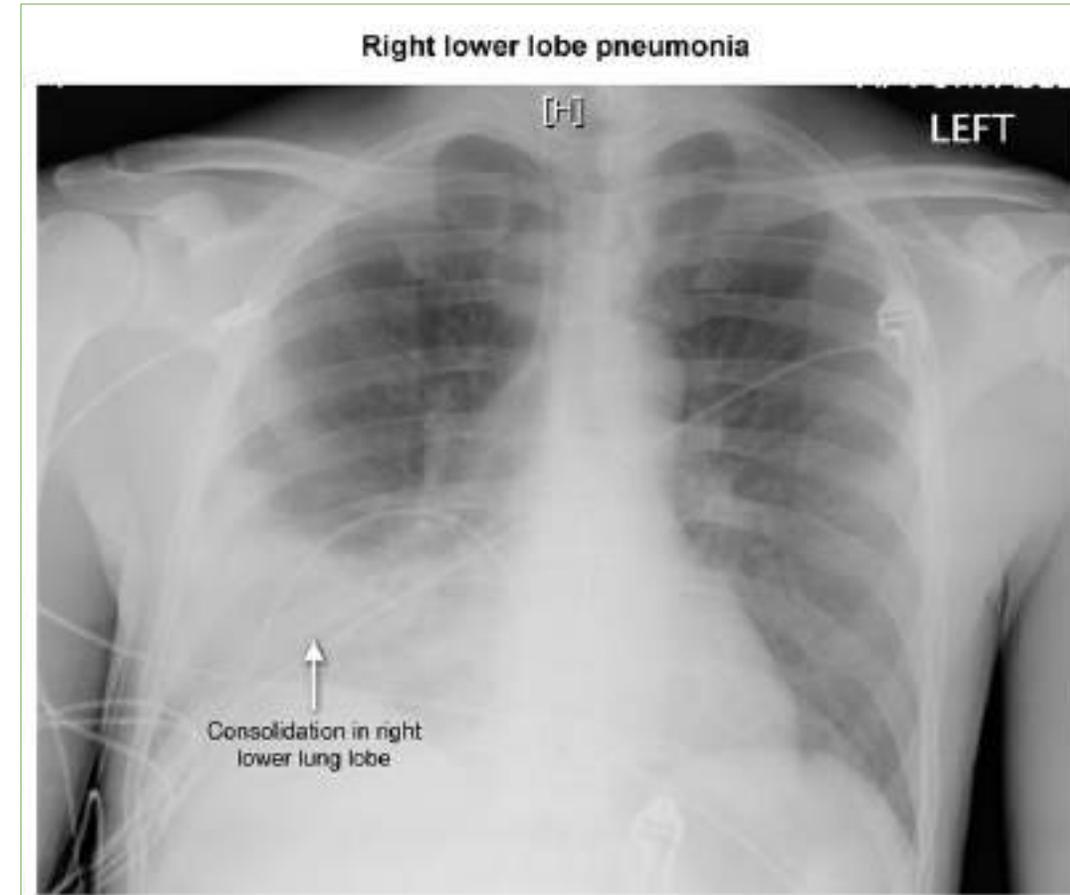


# Streptococcus pneumoniae

## 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 pneumoniae

## Clinically – Pneumonia (Treatment)

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



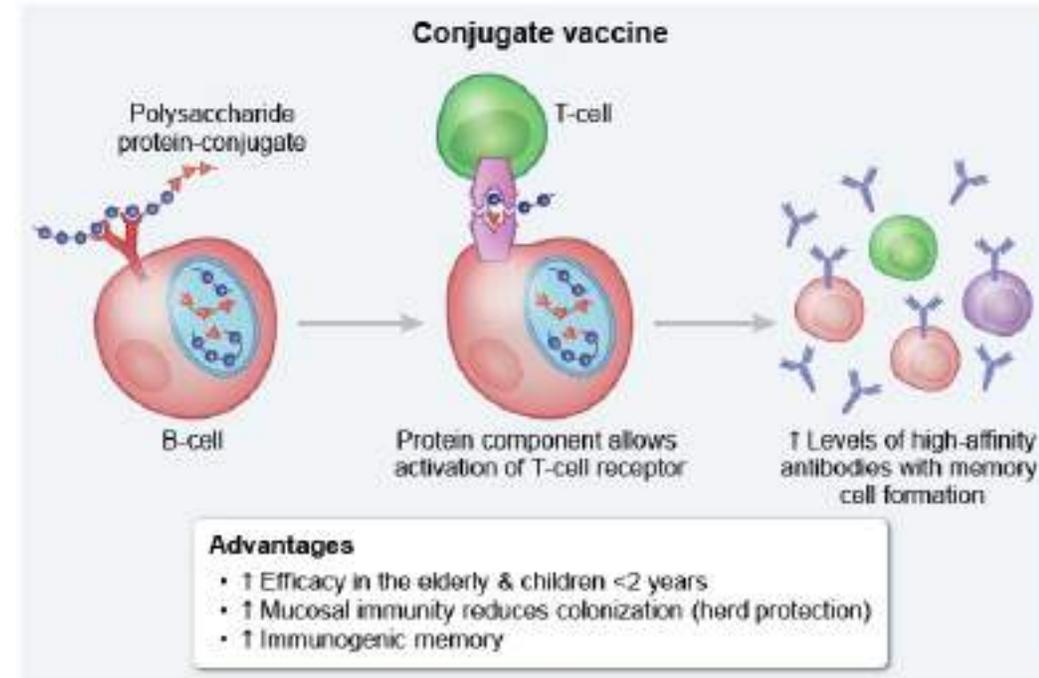
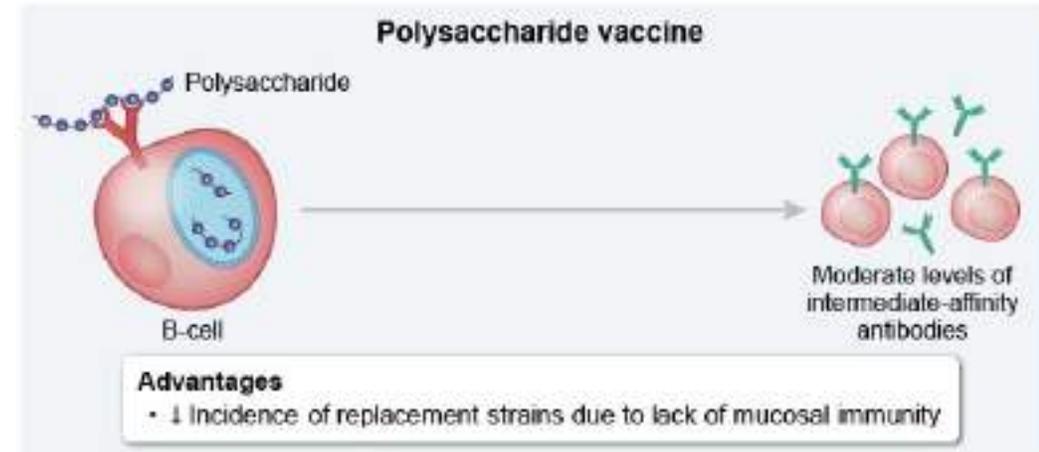
# Streptococcus pneumoniae Vaccines

- **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):**

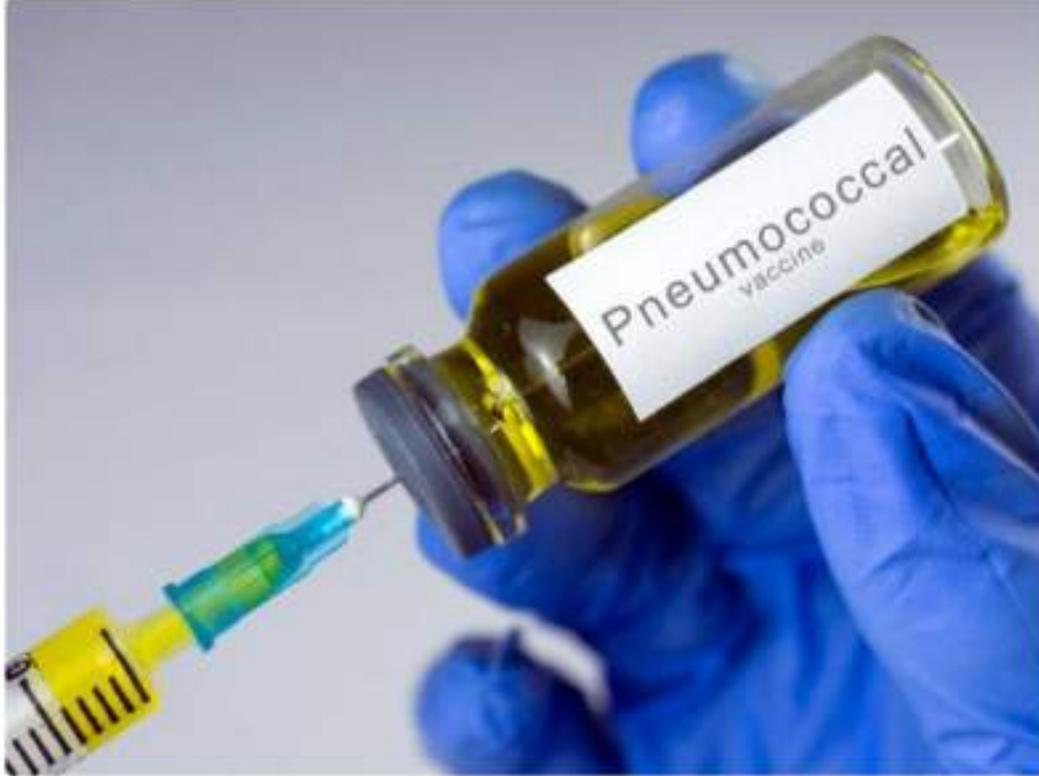
- PCV13: Protects against fewer strains (13), but creates a stronger and longer-lasting immune response due to T-cell involvement and is effective in infants.



## إدراج مطعوم المكورات الرئوية ضمن البرنامج الوطني للتطعيم



محليات | 10:46 pm - الأحد 2025-09-21



نبا الأردن - أعلنت وزارة الصحة عن إدخال مطعوم المكورات الرئوية المقترون (PCV13) إلى برنامج التطعيم الوطني، اعتباراً من 20 أيلول 2025، بحيث يشمل جميع الأطفال المولودين بدءاً من 1 كانون الثاني 2025 وما بعده.

وبحسب كتاب رسمي صادر عن الوزارة فإن المطعوم سيعطى بواقع 3 جرعات على النحو الآتي:  
الجرعة الأولى عند عمر شهرين.  
الجرعة الثانية عند عمر 4 أشهر.  
الجرعة الثالثة (المعززة) عند عمر عام.



مدير إدارة الرعاية الصحية الأولية وكالة نبا الأردن الإخبارية  
مدير مديرية صحة .....

الرقم  
التاريخ  
م / التعليم / 1330  
الواقع  
15/09/2025

- تحية طيبة وبعد ...  
تعلم وزارة الصحة عن إدخال مطعوم المكورات الرئوية المقترون (PCV13) ضمن البرنامج الوطني للتطعيم اعتباراً من 2025/9/20، بحيث يشمل جميع الأطفال المولودين بتاريخ 2025/1/1 وما بعد وعليه للتكرم بالأيعاز للمعتنين لديكم الالتزام بإعطاء المطعوم كما يلي:
1. عدد الجرعات والجدول الزمني: ثلاث جرعات تعطى على الأعمار التالية:
    - الجرعة الأولى: على صر الشهرين.
    - الجرعة الثانية: على صر 4 أشهر.
    - الجرعة الثالثة (المعززة): على صر 12 شهراً.
  2. الفئة العمرية المستهدفة: جميع الأطفال المولودين بتاريخ 2025/1/1 وما بعد.
  3. طريقة إعطاء المطعوم ومكانه والجرعة:
    - الطريقة: حقن عضلي (IM).
    - المكان: في الجانب الأمامي الوحشي للخص عند الرضع (عادةً في الفخذ الأيسر إذا أعطى المطعوم السداسي في الفخذ الأيمن).
    - الجرعة: 0.5 مل.
  4. التزام مع المطاعيم الأخرى:
    - يمكن إعطاء مطعوم PCV13 في نفس جلسة التطعيم مع مطاعيم أخرى، لكن لا يجوز خلطه مع أي مطعوم آخر في نفس الحقنة.
    - إذا تم إعطاء مطعومين في نفس الجلسة، يجب إعطائهما في موقعين مختلفين حسب النليل المرفق.
  5. التخزين والحفظ:
    - يحفظ في درجة حرارة بين ( 2 - 8 ) درجات مئوية.
    - المطعوم حساس للتجمد.
    - متابعة صلاحية المطعوم باستخدام مؤشر (VVM).



# Bordetella pertussis





# Introduction

- Pertussis = whooping cough
- Highly-contagious, vaccine preventable respiratory illness
- Caused by *Bordetella pertussis*
- Highest incidence in young infants
- Can affect adolescents & adults (due to waning immunity after vaccination)

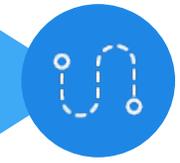




# Introduction

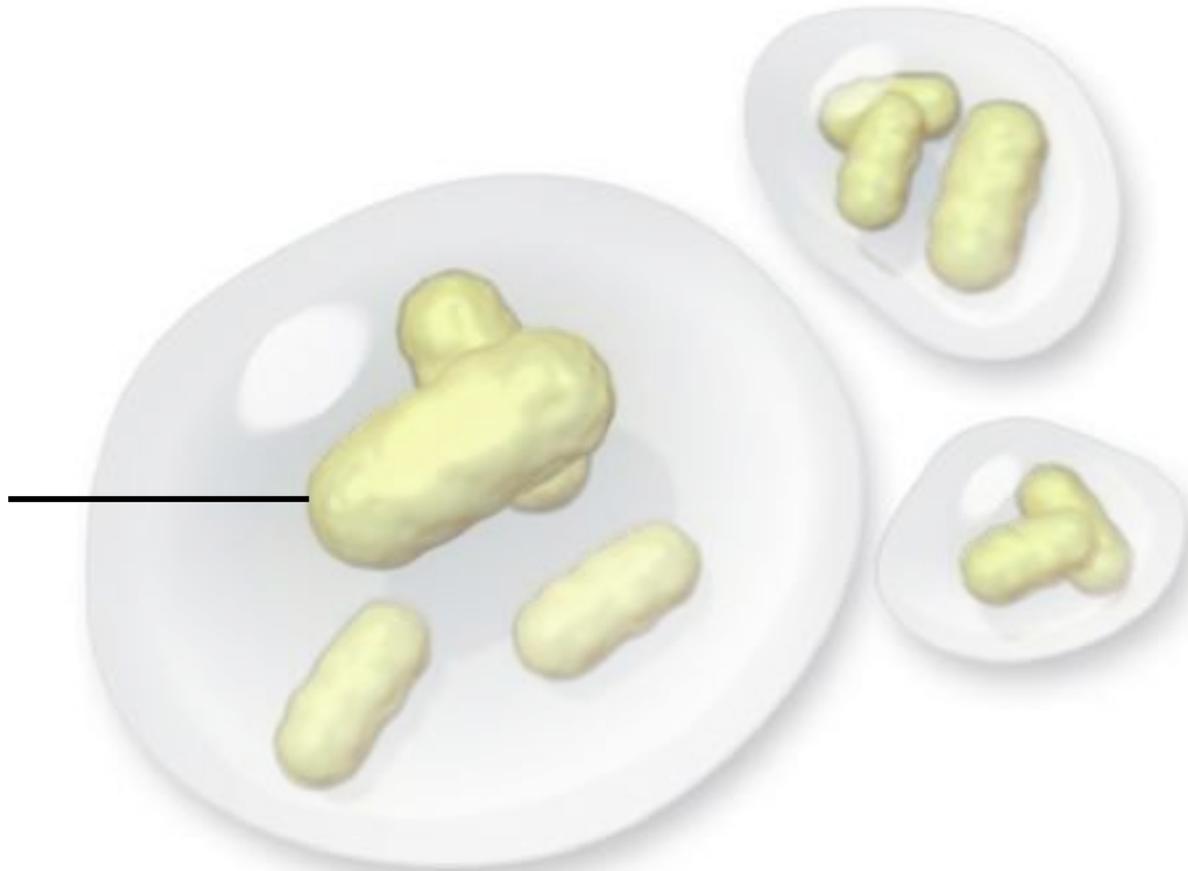
- Gram-negative coccobacillus or bacillus arranged singly, in pairs or in small groups
- They are obligate respiratory tract pathogens, therefore, they are unable to survive outside their hosts
- Aerobic and encapsulated.
- Reservoir is humans (Specific to Humans)

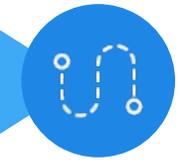




# Pathogenesis

*Bordetella  
pertussis*  
Gram-negative  
coccobacillus





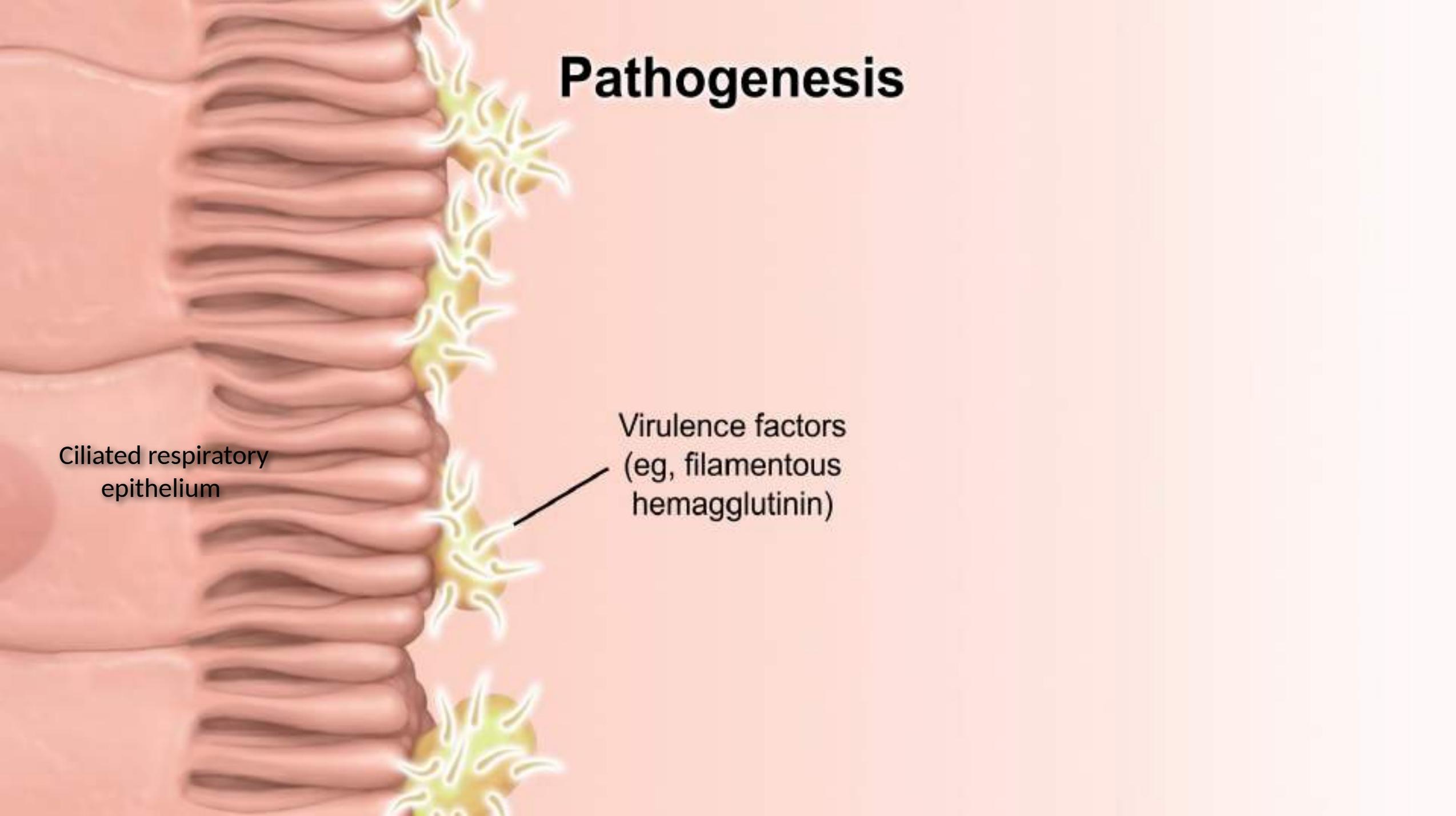
# Pathogenesis



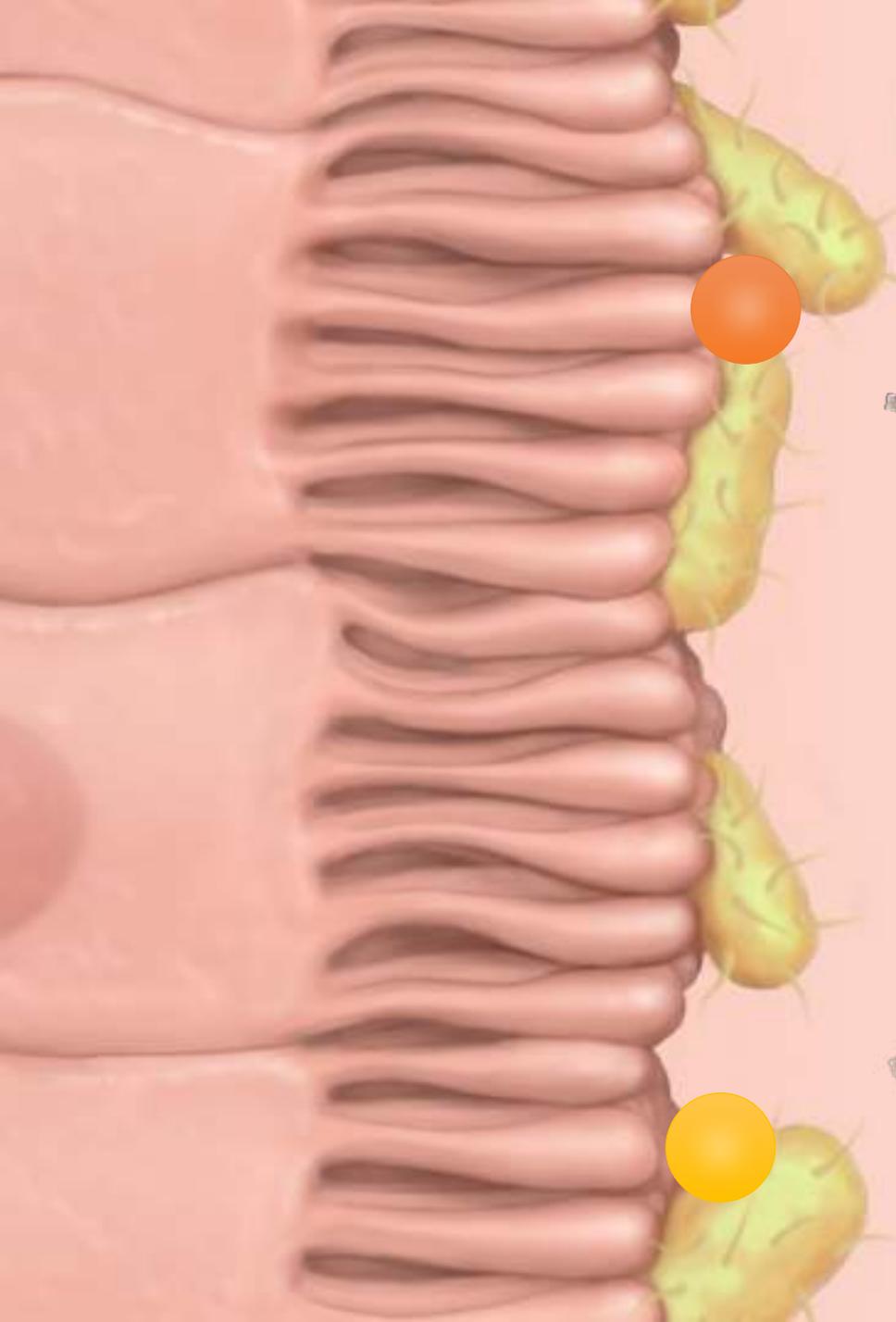
# Pathogenesis

Ciliated respiratory epithelium

Virulence factors  
(eg, filamentous hemagglutinin)



# Pathogenesis

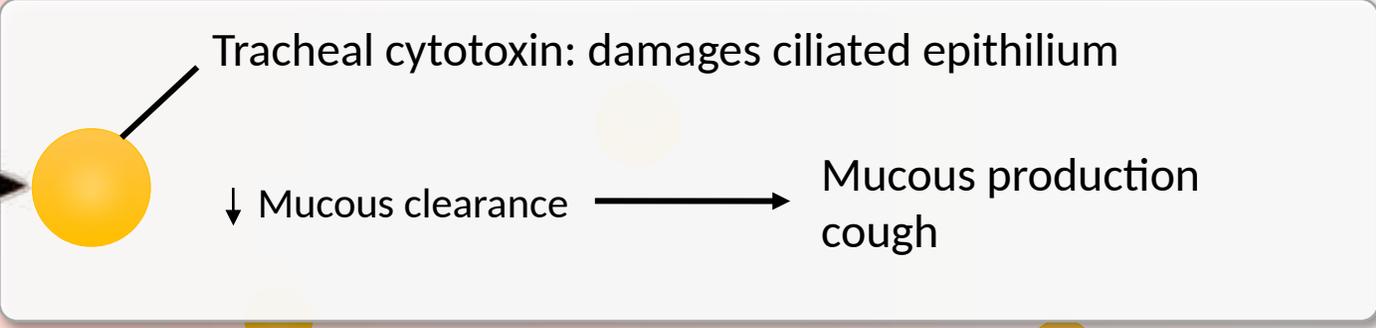
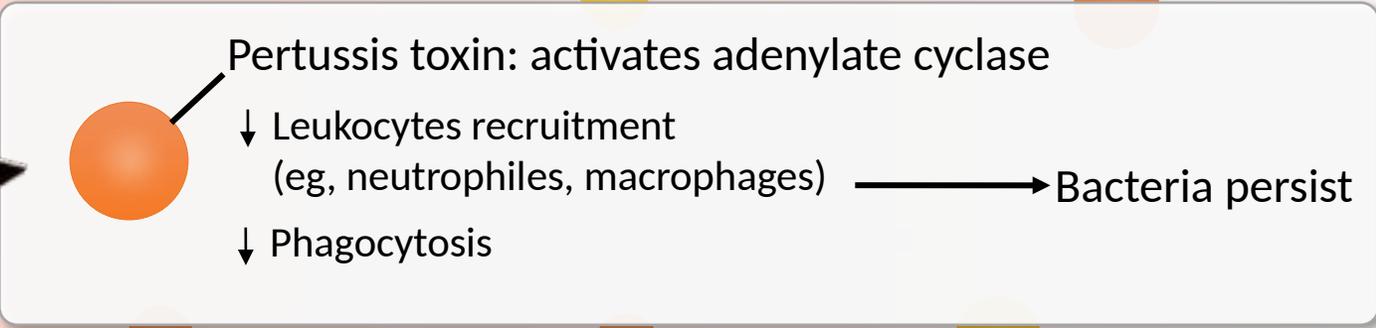
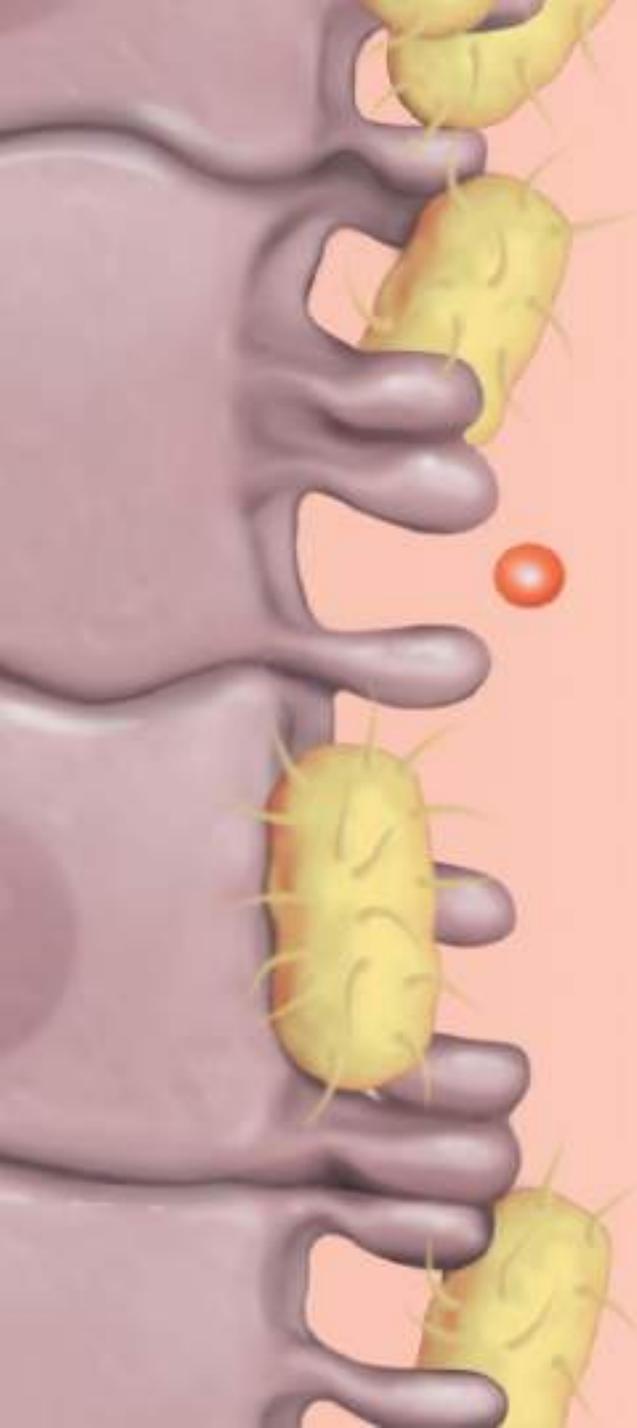


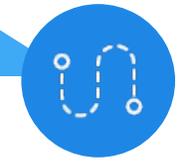
Pertussis toxin: activates adenylate cyclase  
↓ Leukocytes recruitment  
(eg, neutrophils, macrophages) → Bacteria persist  
↓ Phagocytosis



Tracheal cytotoxin: damages ciliated epithelium

# Pathogenesis





# Pathogenesis



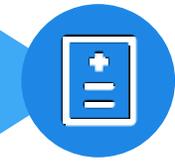
# Clinical presentation



- Non-specific symptoms (eg, mild cough, rhinorrhea)
- Most contagious stage

- Bouts of severe violent coughing
- Loud, high-pitched, inspiratory whoop (whooping cough)
- Post-tussive vomiting
- Complications: rib fracture, hernia, subconjunctival hemorrhage, syncope
- Infants: cyanosis, apnea, seizures, & respiratory failure

- Cough gradually improves
- No longer contagious



# Diagnosis

- Clinically: prolonged cough ( $\geq 2$  weeks) with an inspiratory whoop or post-tussive vomiting (paroxysmal stage)
- Confirmatory laboratory tests: culture, PCR, serology
- Increased lymphocytes (lymphocytosis)
  - Pertussis toxin: prevents lymphocytes migration out of circulation
  - Distinguishes pertussis from most other acute bacterial infections



# 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 (Macrolide antibiotic (eg, azithromycin))

### 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



# Bordetella pertussis

## Summary

Pertussis	
<b>Pathophysiology</b>	<ul style="list-style-type: none"><li>• <i>Bordetella pertussis</i> (gram-negative coccobacilli)</li><li>• Major virulence factors: pertussis toxin (AB toxin), adenylate cyclase toxin, tracheal cytotoxin</li></ul>
<b>Clinical stages</b>	<ul style="list-style-type: none"><li>• Catarrhal (1-2 weeks): mild cough, rhinitis</li><li>• Paroxysmal (2-6 weeks): severe coughing spells with inspiratory whoop, posttussive emesis; ± apnea/cyanosis (infants)</li><li>• Convalescent (weeks to months): gradual resolution</li></ul>
<b>Treatment</b>	<ul style="list-style-type: none"><li>• Macrolide antibiotic (eg, azithromycin)</li></ul>
<b>Prevention</b>	<ul style="list-style-type: none"><li>• Acellular pertussis vaccine</li></ul>





Thank You



