

Pneumonia

Community acquired pneumonia
(CAP)

Objectives

- Discuss the epidemiology and pathophysiology of pneumonia and CAP
- Explain the different classifications of pneumonia
- Recognize clinical presentations associated with CAP
- Discuss the diagnosis and treatment of CAP
- Identify common etiological agents causing CAP and discuss their laboratory work up
- Discuss virulence factors and prevention of *Streptococcus pneumoniae*

Definition

- Pneumonia is an infection that leads to inflammation of the parenchyma of the lung (the alveoli) (consolidation and exudation)
- It may present as acute, fulminant clinical disease or as a chronic disease with a more prolonged course

Epidemiology

- Overall the rate of CAP 5-6 cases per 1000 persons per year
- Mortality 23%
 - High, especially in old people
- Almost 1 million annual episodes of CAP in adults ≥ 65 yrs in the US

Risk factors

- Age < 2 yrs, > 65 yrs
- Alcoholism
- Smoking
- Asthma and COPD
- Aspiration
- Dementia
- Prior influenza
- HIV
- Immunosuppression
- Institutionalization
- Recent hotel : *Legionella*
- Travel, pets, occupational exposures- birds (*C. psittaci*)

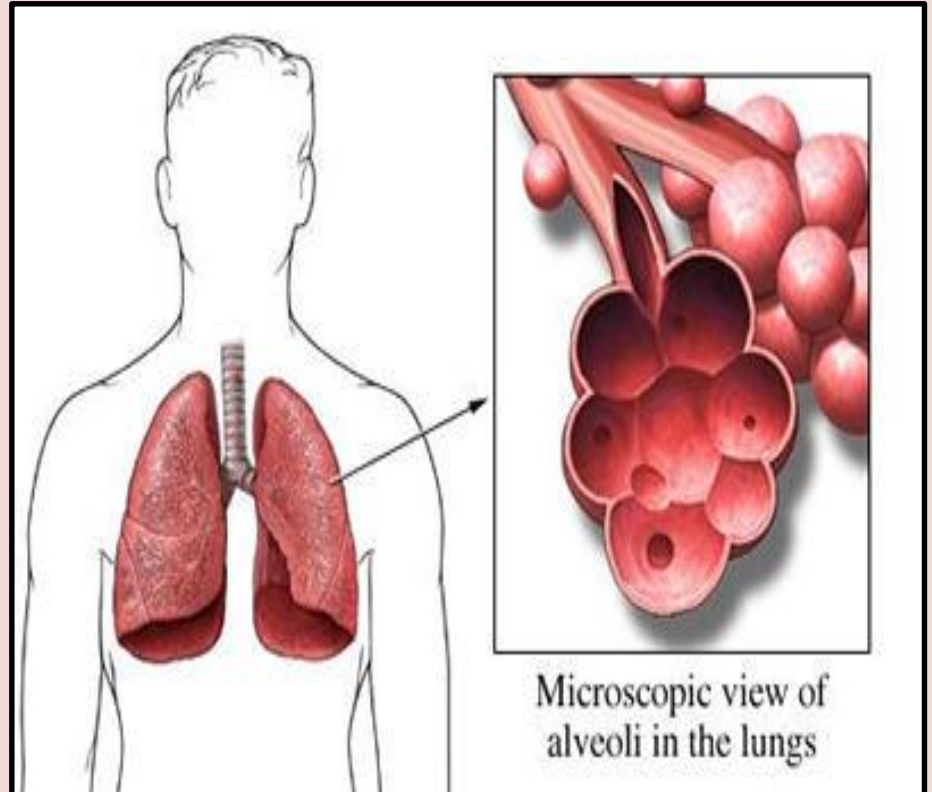
Etiological agents

Infectious:

- Bacterial
- Fungal
- Viral
- Parasitic

Non-infectious like:

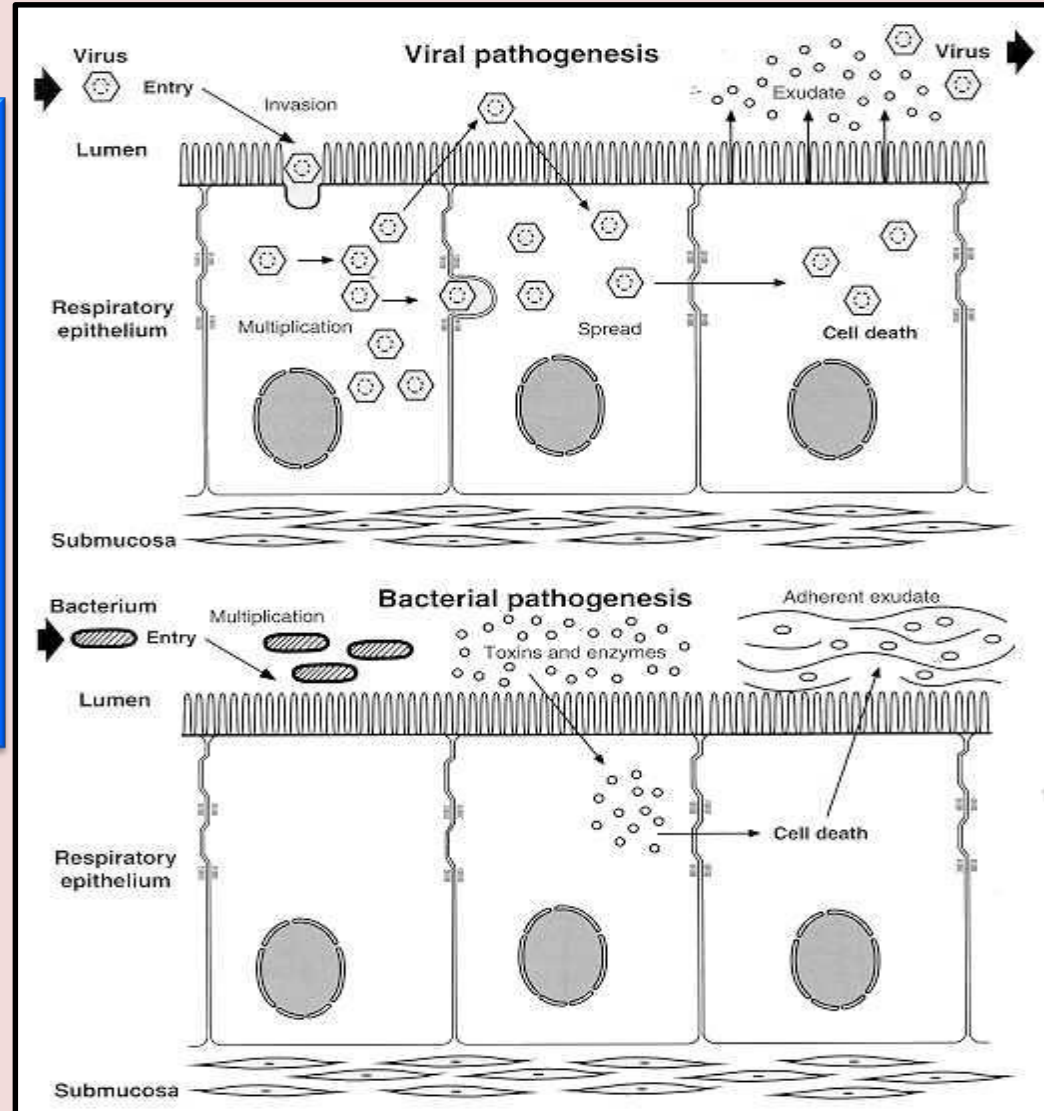
- Chemical
- Allergen related



Pathogenesis

Two factors involved
in the formation of
pneumonia

- Pathogens
- Host defenses.



Defense mechanism of respiratory tract

- Filtration and deposition of environmental pathogens in the upper airways
- Cough reflex
- Mucociliary clearance
- Alveolar macrophages
- Humoral and cellular immunity
- Oxidative metabolism of neutrophils

Pathophysiology

1. Inhalation or aspiration of pulmonary pathogenic organisms into a lung segment or lobe.
2. Results from secondary bacteraemia from a distant source, such as *Escherichia coli* urinary tract infection and/or bacteraemia (less commonly).
3. Aspiration of oropharyngeal contents (multiple pathogens).

Classification

- **Pneumonia classified according to:**

1. Pathogen

- Bacterial
 - Typical
 - Atypical
- Viral
- Fungal
- Parasite

2. Anatomy

3. Acquired environment

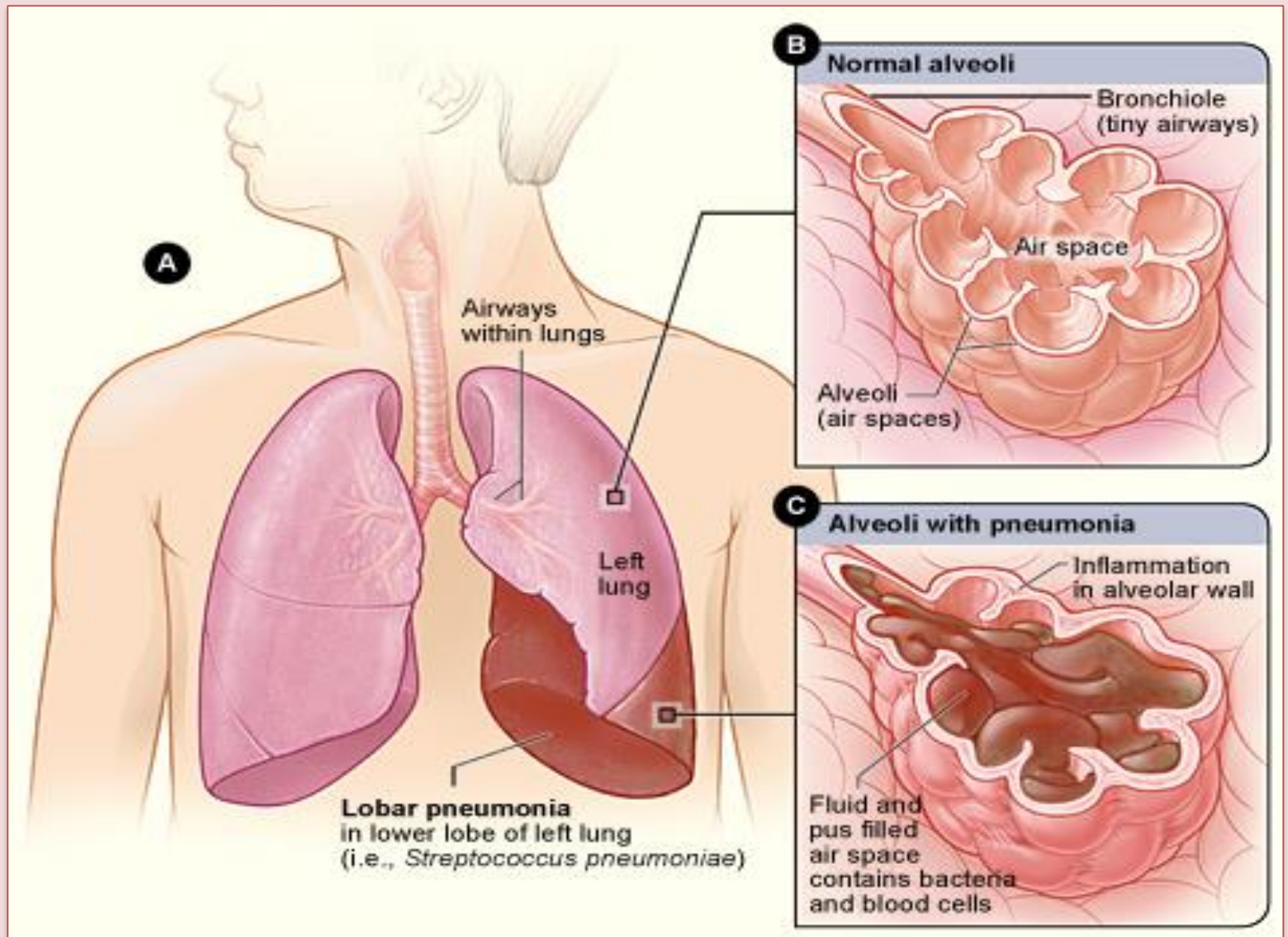
Classification by anatomy

1. Lobar: entire lobe
2. Lobular: (bronchopneumonia).
3. Interstitial



Figure 3. A chest radiograph of an HIV-infected patient with bacterial pneumonia typically shows a dense consolidation pattern.

60-year-old woman with rapidly progressive IPF. PA radiograph (left) shows diffuse involvement with irregular opacities and ground glass density. HRCT scan (right) shows the lower lung fields showing honeycombing and lymphatic dilatation with secondary dilation and enlargement of the airways (A).



Lobar pneumonia

Classification by acquired environment

- ◆ Community acquired pneumonia (CAP)
- ◆ Hospital acquired pneumonia (HAP)
- ◆ Nursing home acquired pneumonia (NHAP)

CAP- fever+ productive cough + infiltrate

- CAP : pneumonia acquired outside of hospitals or extended-care facilities

Typical

- *Strept. pneumoniae*
 - (lobar pneumonia)
- *Haemophilus influenzae*
- *Moraxella catarrhalis*
- *S. aureus*
- Gram-negative organisms

Atypical

- Atypical: not detectable on gram stain; won't grow on standard media
- *Mycoplasma pneumoniae*
- *Chlamydia pneumoniae*
- *Legionella pneumophila*

Community acquired pneumonia

- *Strep pneumonia* 48%
- Viral 23%
- Atypical orgs (MP,LG,CP) 22%
- *Haemophilus influenza* 7%
- *Moraxella catharralis* 2%
- *Staph aureus* 1.5%
- Gram -ive orgs 1.4%
- Anaerobes

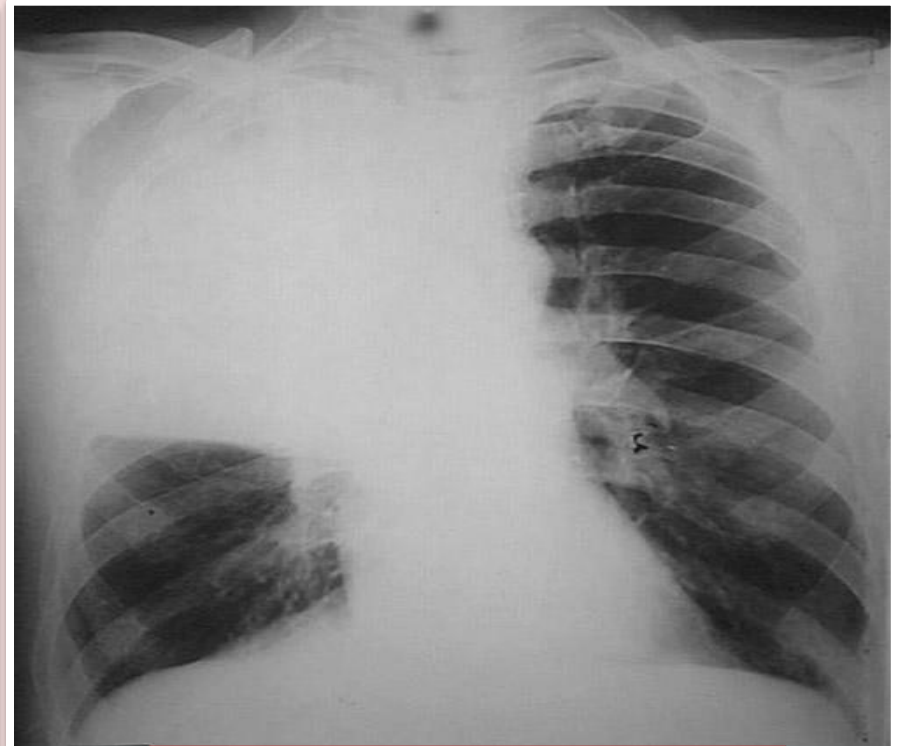
Typical pneumonia

Clinical manifestation

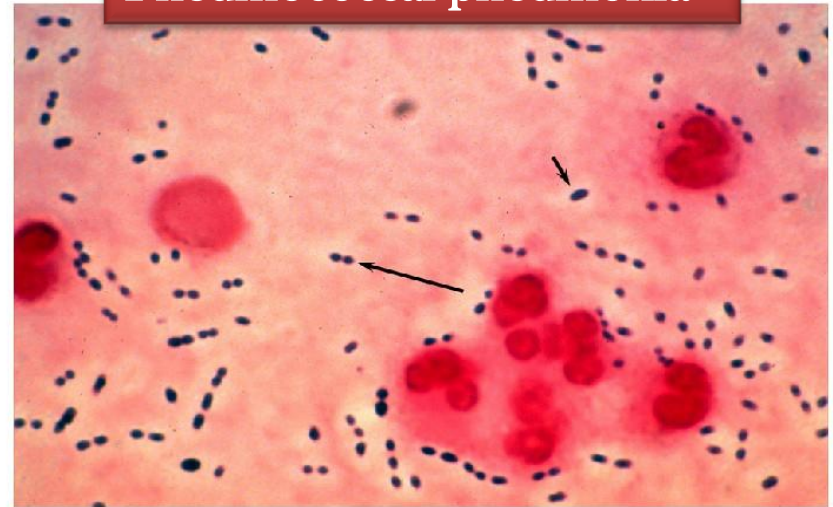
- The onset is acute
- Prior viral upper respiratory infection
- Respiratory symptoms
 - Fever
 - Shaking chills
 - Cough with sputum production (rusty-sputum)
 - Chest pain- or pleurisy
 - Shortness of breath

Diagnosis

- Clinical
 - History & physical
- X-ray examination
- Laboratory
 - CBC- leukocytosis
 - Sputum
 - Gram stain- 15%
 - Culture
 - Blood culture- 5-14%
 - Pleural effusion gram + culture



Pneumococcal pneumonia

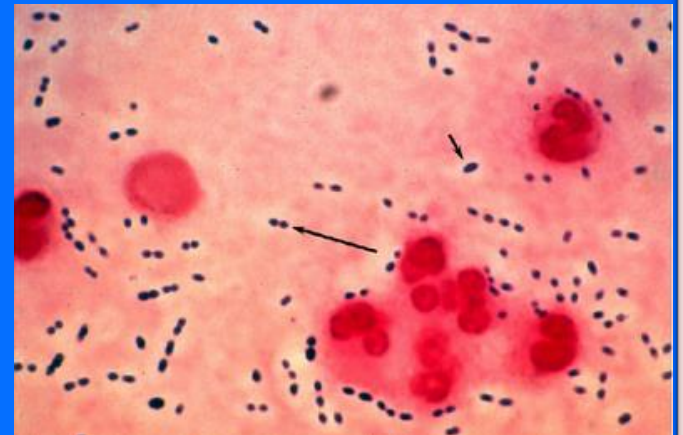
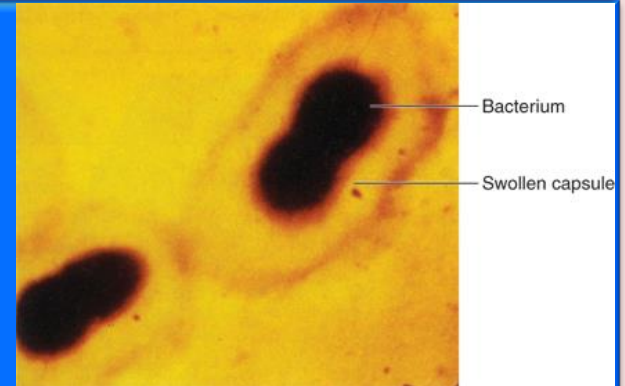


Streptococcus pneumoniae

- Gram positive diplococci
- Alpha hemolytic streptococci
- Catalase negative
- Normal flora of upper respiratory tract in 20-40% of people
- Causes:
 - Resp infections
 - pneumonia, sinusitis, otitis,
 - Non resp infections
 - bacteremia, meningitis

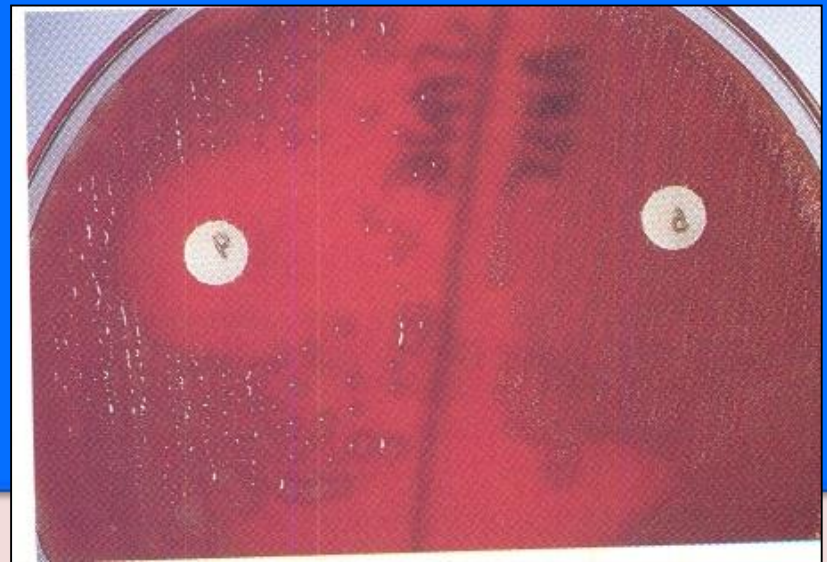
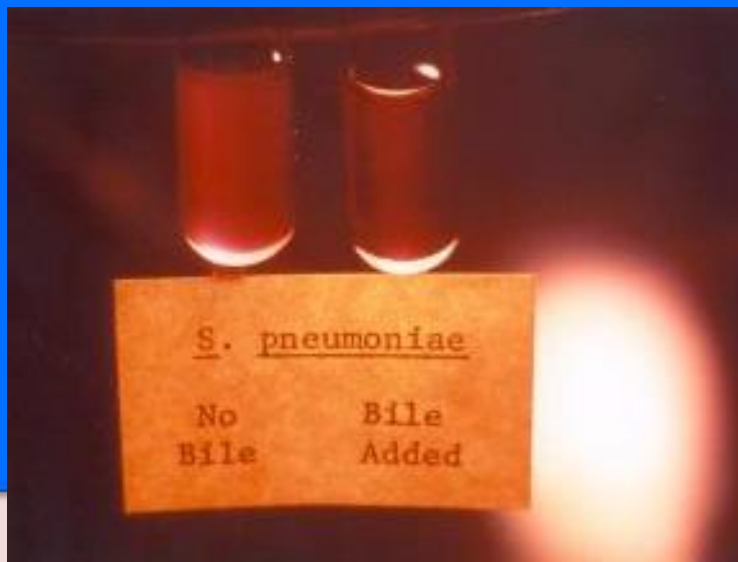
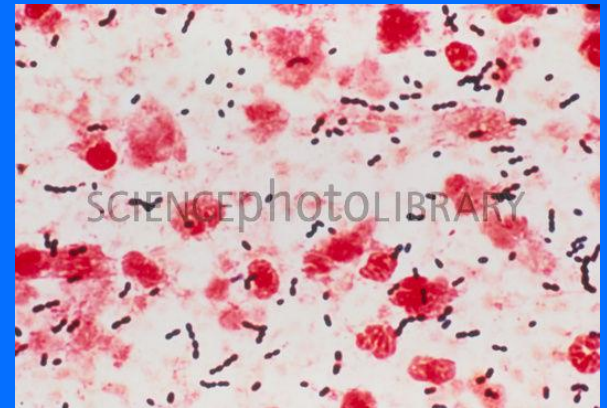
Streptococcus pneumoniae

- Virulence factors:
 - Capsule
 - More than 90 capsular types
 - Pneumolysin
 - Autolysin
 - Neuraminidase
- Prevention: vaccination



Streptococcus pneumoniae

- Sensitive to Optochin
- Lysed by bile (bile soluble)



Atypical pneumonia

- *Chlamydia pneumoniae*
 - *Mycoplasma pneumoniae*
 - *Legionella spp*
 - Psittacosis (*Chlamydia psittaci*)
 - Q fever (*Coxiella burnettii*)
- Approximately 15% of all CAP
 - Not detectable on gram stain
 - Won't grow on standard media
 - Some don't have a bacterial cell wall → Don't respond to β -lactams

Atypical pneumonia

Symptoms

- Insidious onset
- Mild to severe
- Headache
- Malaise
- Fever
- Dry cough
- Arthralgia / myalgia

Signs

- Minimal
- Low grade fever
- Few crackles
- Rhonchi

Diagnosis & Treatment

- **Diagnosis:**

- X-ray
- CBC
 - Mild elevation WBC
- U&Es
 - Low serum Na (Legionella)
- LFTs
 - ↑ ALT
 - ↑ Alk Phos
- Sputum Culture on special media (BCYE) for *Legionella*
- Urine antigen for *Legionella*
- Serology for detecting antibodies
- DNA detection

- **Treatment:**

- Macrolide
- Quinolones
- Tetracycline
 - ❖ B lactams have no activity
- Treat for 10-14 days

Mycoplasma pneumoniae

- Eaton's agent (1944)
 - No cell wall
 - Common
 - Rare in children and in > 65
 - People younger than 40.
 - Crowded places like schools, homeless shelters, prisons.
 - Can cause URT symptoms
 - Usually mild and responds well to antibiotics.
 - Can be very serious
- May be associated with extra pulmonary findings:
 - skin rash, hemolysis, myocarditis, pancreatitis, encephalitis
 - Diagnosis:
 - Serology
 - NAAT
 - Culture can be done but requires special media and slow grower (weeks)



Mycoplasma
pneumonia
Cx-ray

Chlamydia pneumoniae

- Obligate intracellular organism
- 50% of adults sero-positive
- Mild disease
- Sub clinical infections common
- 5-10% of community acquired pneumonia
- Diagnosis:
 - Serology
 - NAAT

Psittacosis



- *Chlamydia psittaci*
- Exposure to birds
- Bird owners, pet shop employees, vets
- Parrots, pigeons and poultry
- Birds often asymptomatic

Q fever (*Coxiella burnetii*)

- Exposure to farm animals mainly sheep
 - Spread by inhalation of infected animal birth products
- Pneumonia is acute form of infection
- Diagnosis: serology



Legionella pneumophila

- Legionnaire's disease
 - Serious outbreaks linked to exposure to cooling towers
 - Can be very severe and lead to ICU admission.
- Can cause
 - Hyponatraemia common
 - (<130mMol)
 - Bradycardia
 - WBC < 15,000
 - Abnormal LFTs
 - Raised CPK
 - Acute Renal failure

Legionella pneumophila

- **Diagnosis:**

- Specimen: sputum
- Culture on specialized media (BCYE)
- DFA (low sensitivity)
- NAAT
- Urine antigen testing

- **Pontiac fever:**

- Non pneumonic
- Influenza like illness
- Self limiting
- Related to exposure to environmental aerosols containing Legionella (potentially reaction to bacterial endotoxins)



Legionnaires in ICU

Antibiotic Treatment of CAP

- Factors to consider in selection of antibiotic:
 - Co morbidities
 - Previous antibiotic exposure in last 3 months
 - Severity
 - Out patient management vs requiring inpatient admission vs requiring ICU

		Macrolides	Doxycycline	Levofloxacin	B-lactam And Macrolide	B-lactam And Levo
Outpatient, healthy patient with no exposure to antibiotics in the last 3 months	- <i>S. pneumoniae</i> -Atypical pathogens -Viral					
Outpatient, patient with comorbidity or exposure to antibiotics in the last 3 months	<i>As above + Anaerobes S. aureus</i>					
Inpatient : Not ICU	Same as above + coliforms					
Inpatient : ICU	Same as above + <i>Pseudomonas</i>					

References

- Ryan, Kenneth J.. Sherris Medical Microbiology, Seventh Edition. McGraw-Hill Education.
 - Lower respiratory tract infections, part of the chapter on Infectious Diseases: Syndromes and Etiologies
 - Streptococci, chapter 25
 - Legionella and Coxiella, chapter 34
 - Mycoplasma, chapter 38
 - Chlamydia, chapter 39