

# 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  $\geq 65$  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*)

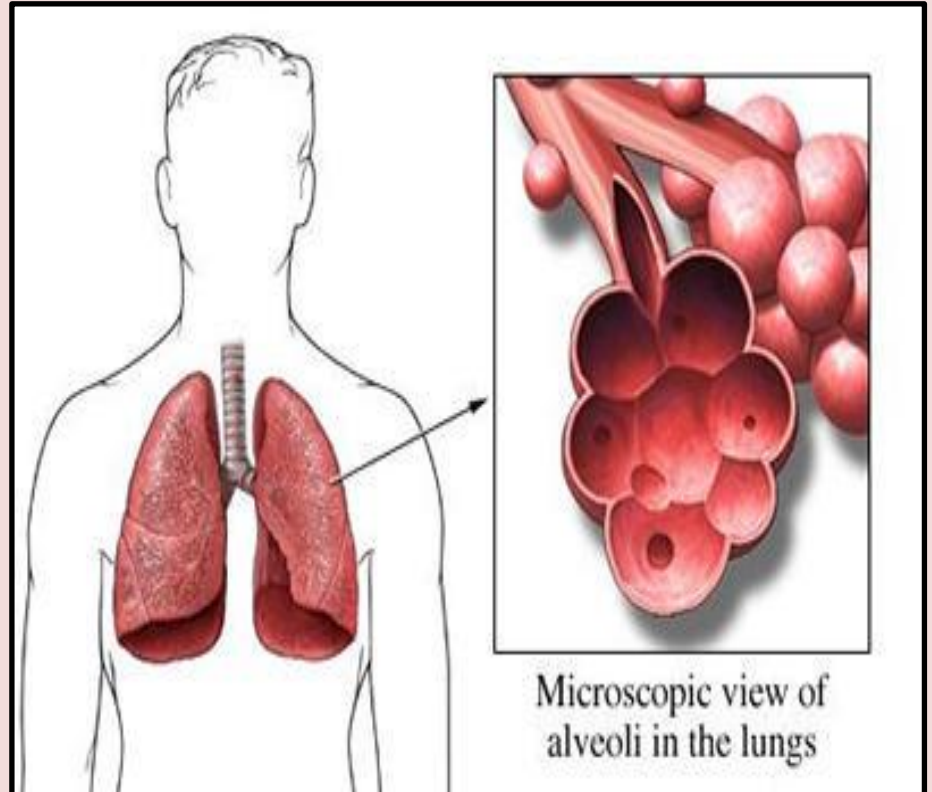
# Etiological agents

## Infectious:

- Bacterial
- Fungal
- Viral
- Parasitic

## Non-infectious like:

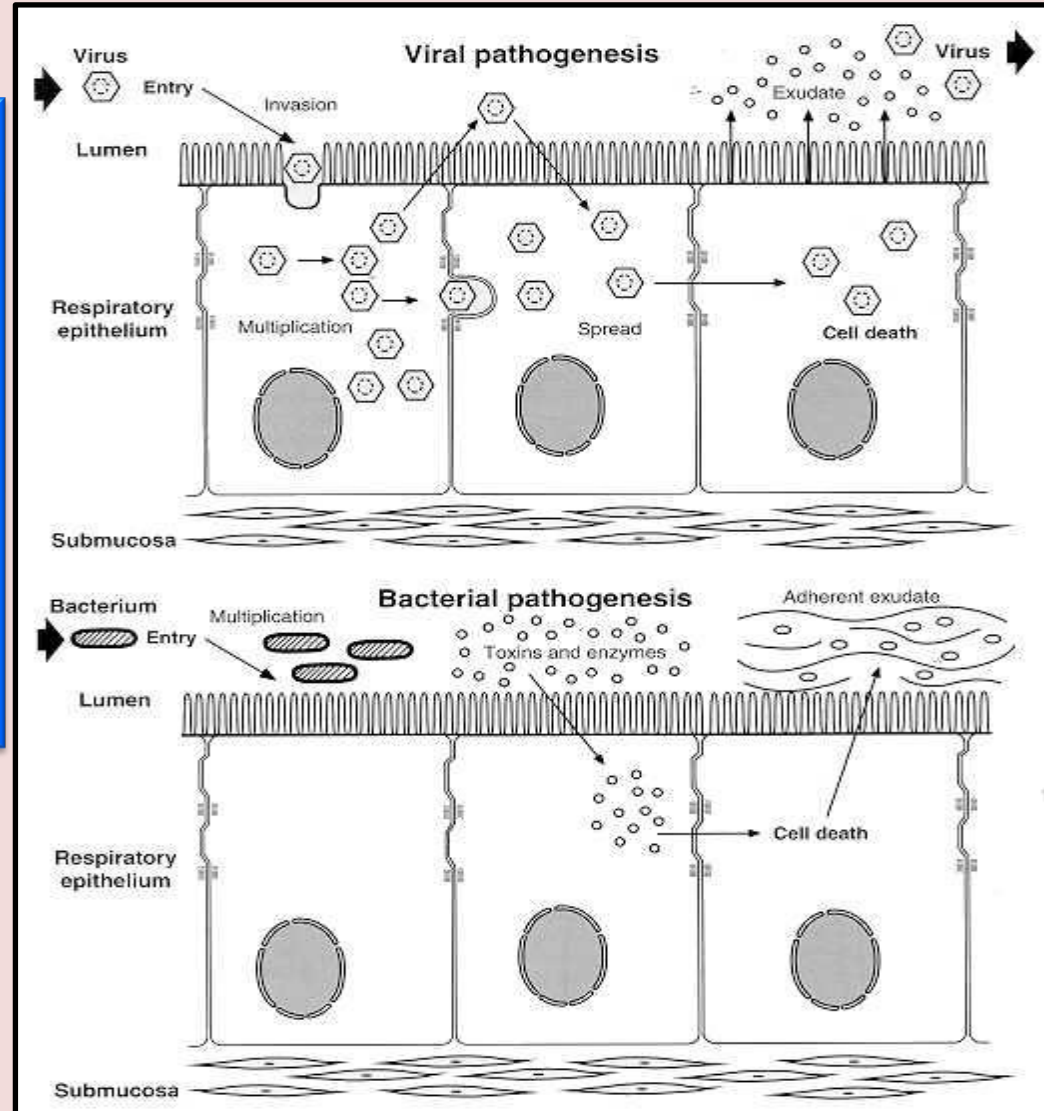
- Chemical
- Allergen related



# 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

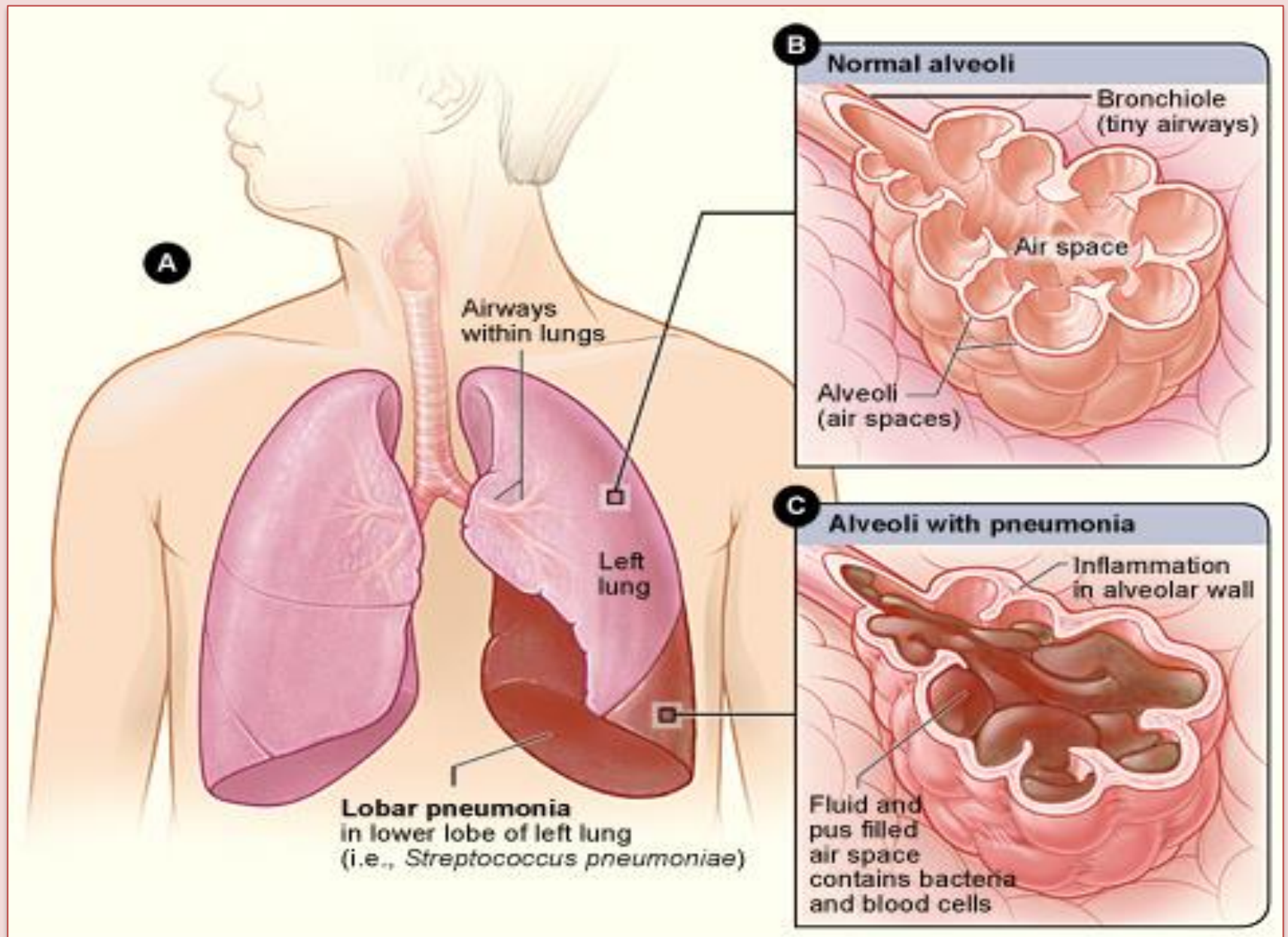
1. Lobar: entire lobe
2. Lobular: (bronchopneumonia).
3. Interstitial



Figure 3. A chest radiograph of an HIV-infected patient with bacterial bronchopneumonia typically shows a diffuse interstitial pattern.



80-year-old woman with rapidly progressive IPF. PA radiograph (left) shows diffuse (predominant with bronchovascular) and ground glass density (right) throughout the lower lung fields (arrow) and bronchovascular densities with secondary dilatation 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

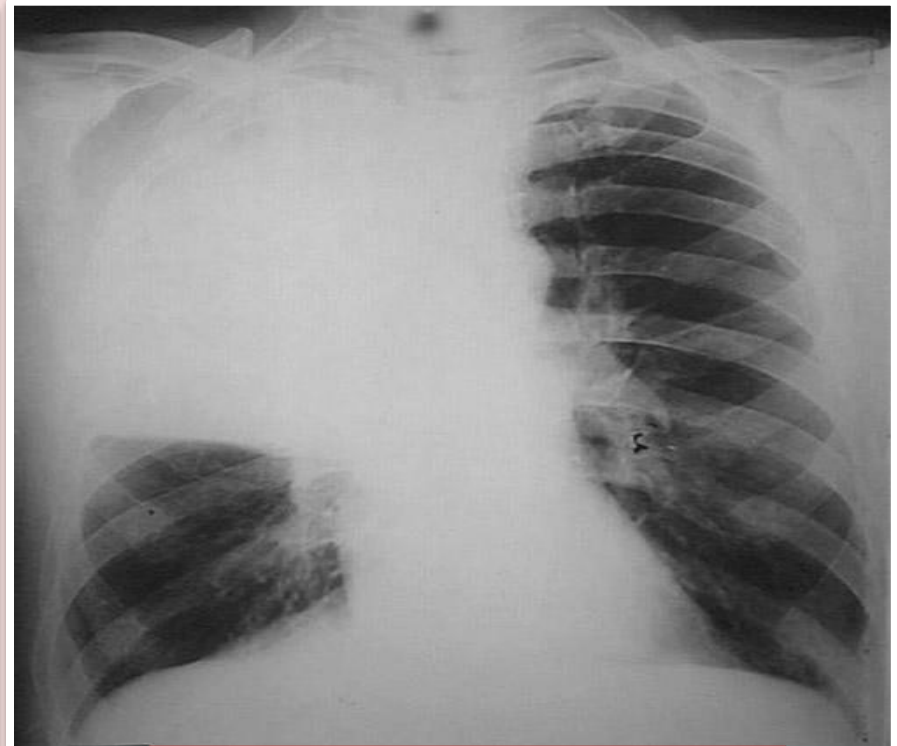
# Typical pneumonia

## Clinical manifestation

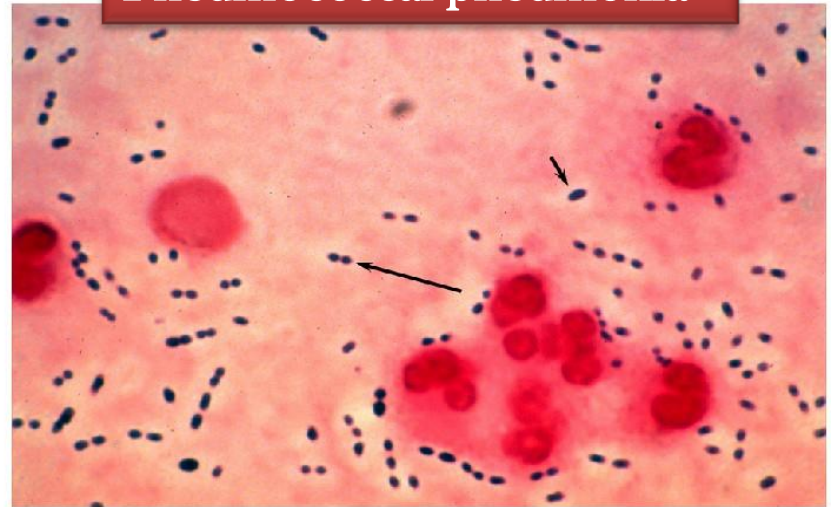
- The onset is acute
- Prior viral upper respiratory infection
- Respiratory symptoms
  - Fever
  - Shaking chills
  - Cough with sputum production (rusty-sputum)
  - Chest pain- or pleurisy
  - Shortness of breath

## 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



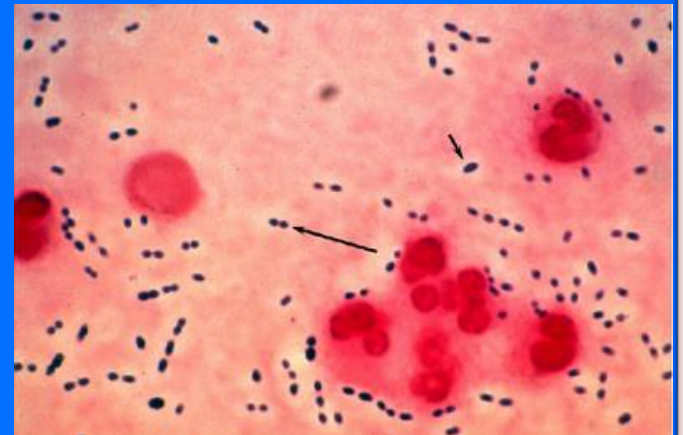
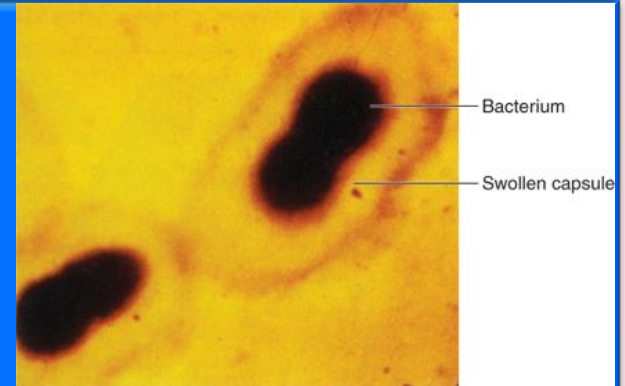


# *Streptococcus pneumoniae*

- 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

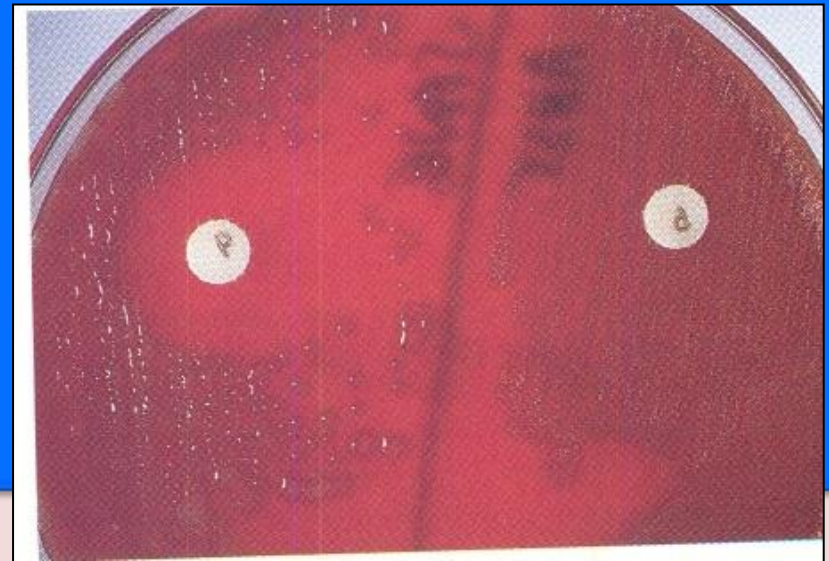
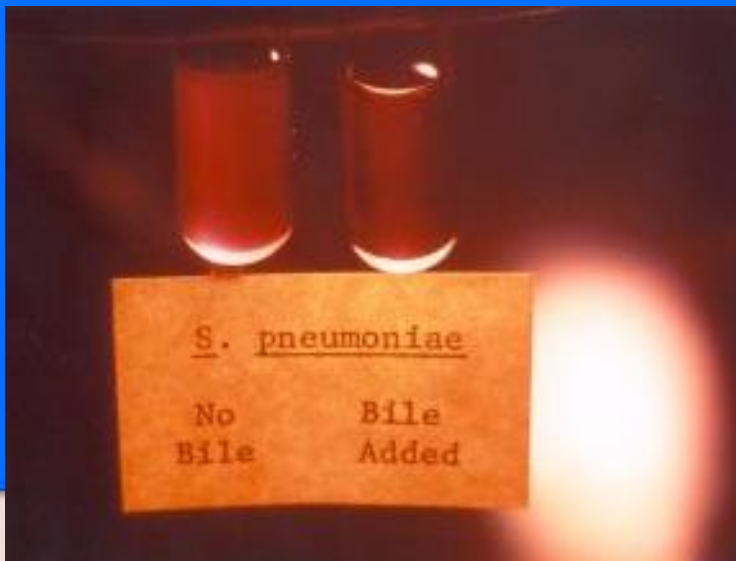
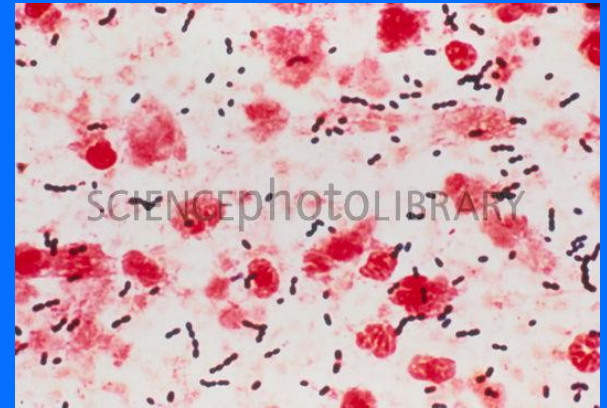
# *Streptococcus pneumoniae*

- 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  $\beta$ -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
<b>Outpatient, healthy patient with no exposure to antibiotics in the last 3 months</b>	- <i>S. pneumoniae</i> -Atypical pathogens -Viral					
<b>Outpatient, patient with comorbidity or exposure to antibiotics in the last 3 months</b>	<i>As above + Anaerobes</i> <i>S. aureus</i>					
<b>Inpatient : Not ICU</b>	Same as above + coliforms					
<b>Inpatient : ICU</b>	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