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*)

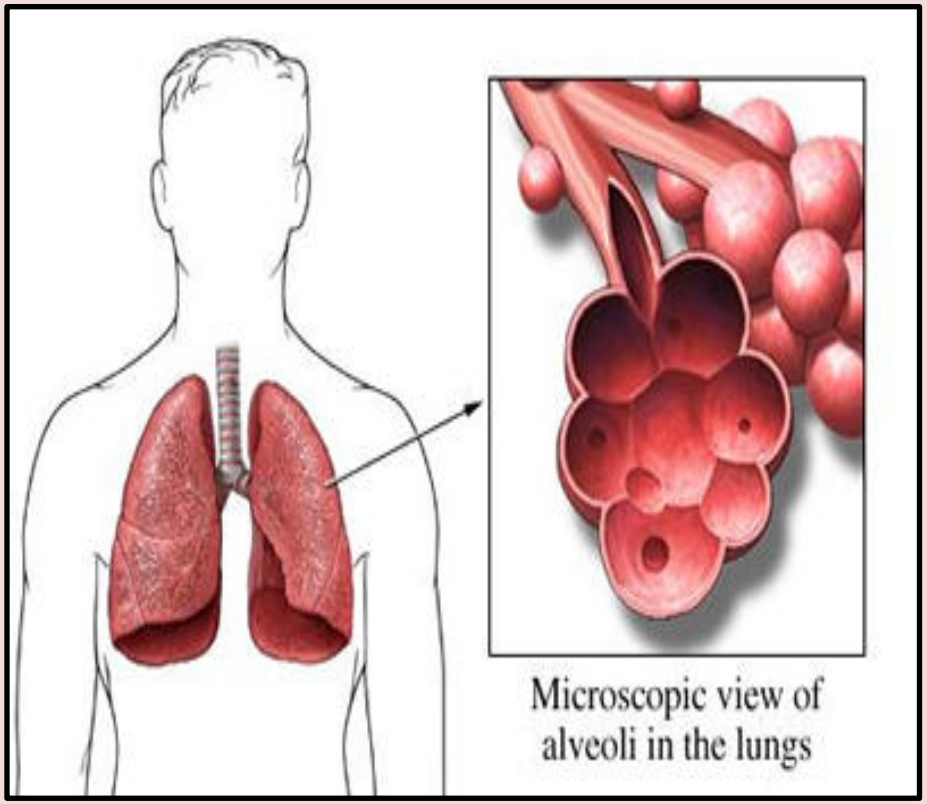
Etiological agents

Infectious:

- Bacterial
- Fungal
- Viral
- Parasitic

Non-infectious like:

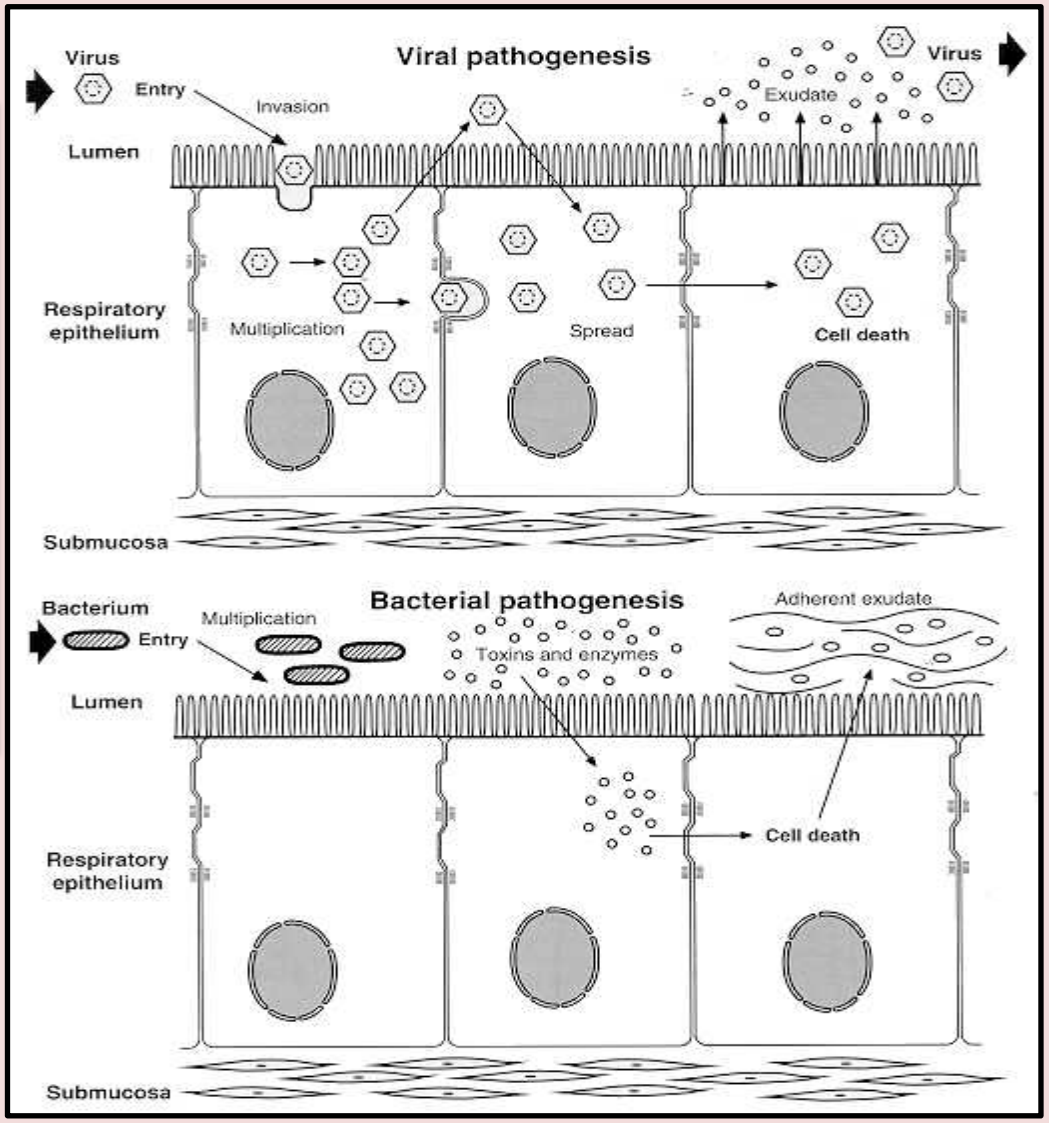
  - Chemical
  - Allergen related



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 reflux
- Mucociliary clearance
- Alveolar macrophages
- Humoral and cellular immunity
- Oxidative metabolism of neutrophils

Pathophysiology

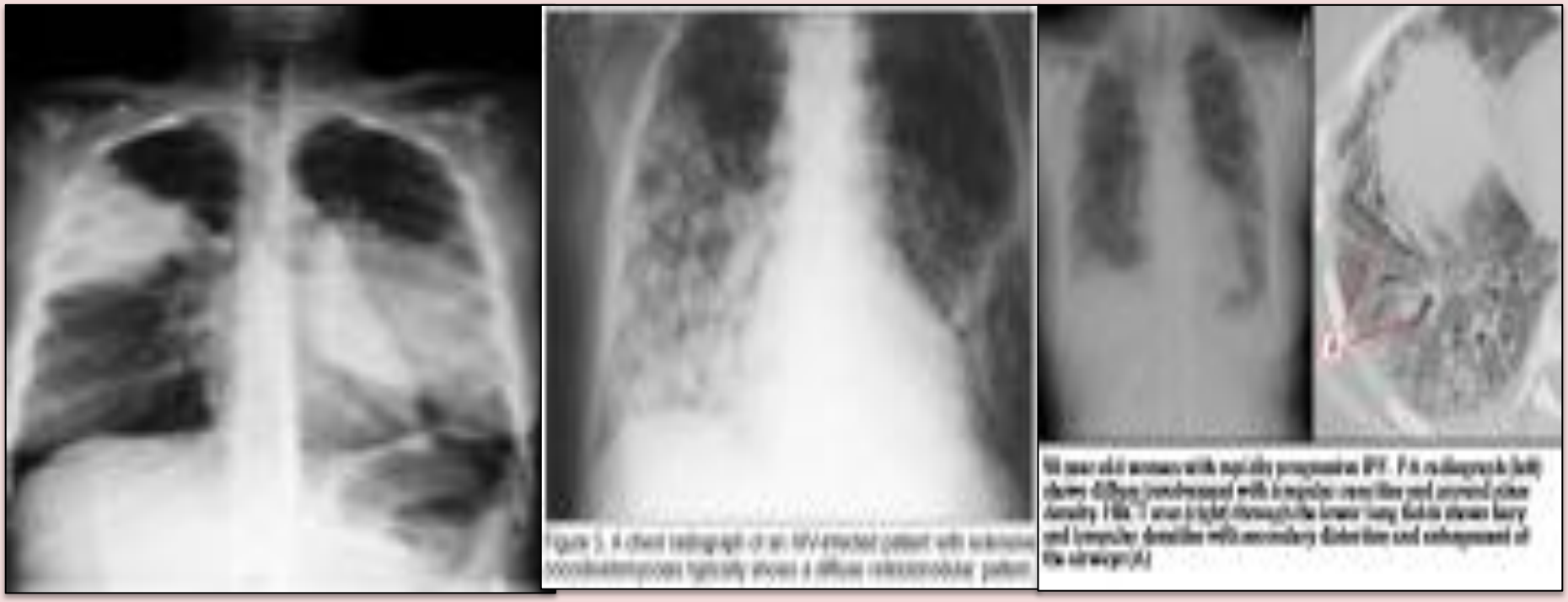
1. Inhalation or aspiration of pulmonary pathogenic organisms into a lung segment or lobe.
2. Results from secondary bacteraemia from a distant source, such as Escherichia coli urinary tract infection and/or bacteraemia (less commonly).
3. Aspiration of oropharyngeal contents (multiple pathogens).

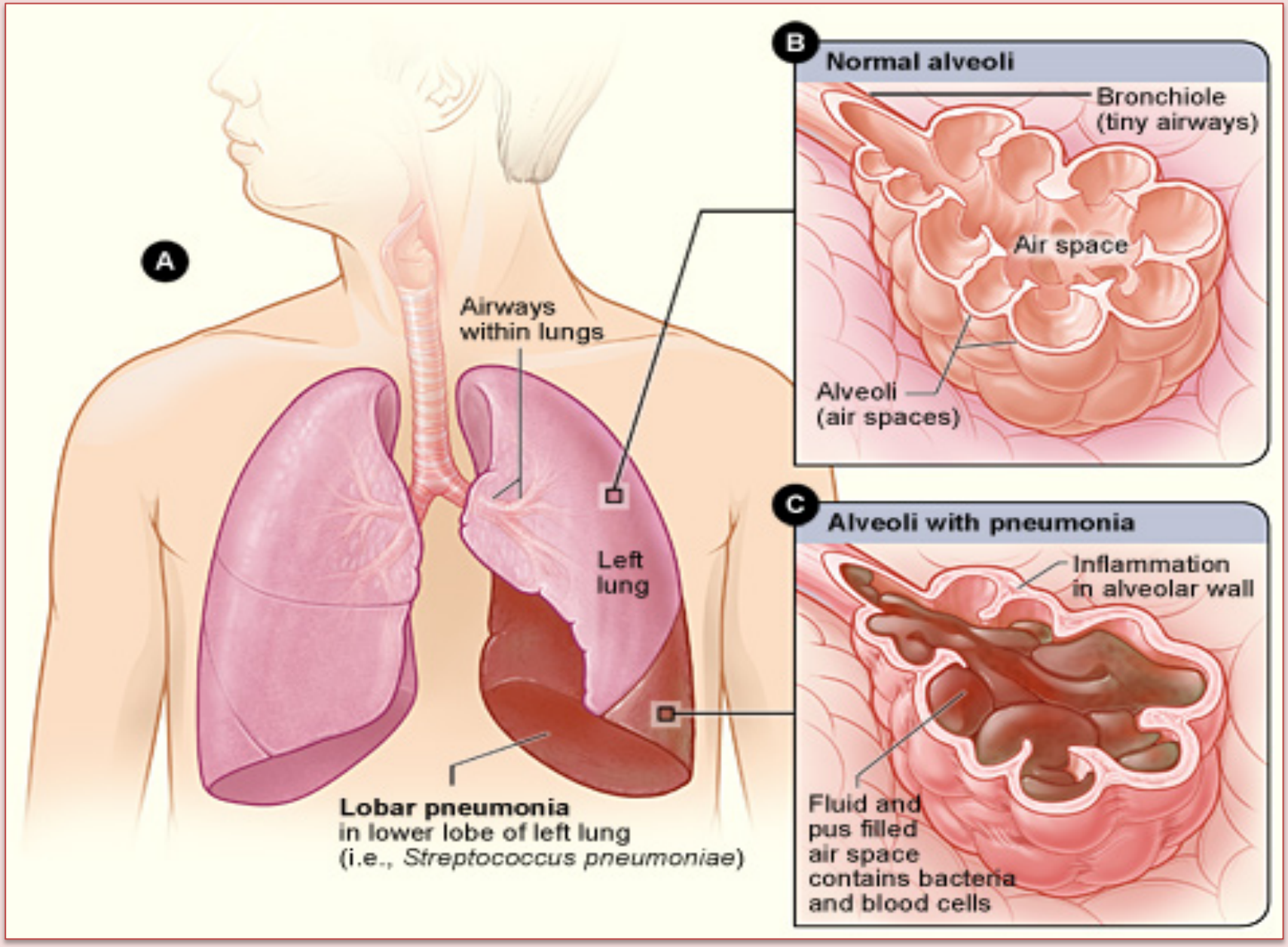
Classification

- **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





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

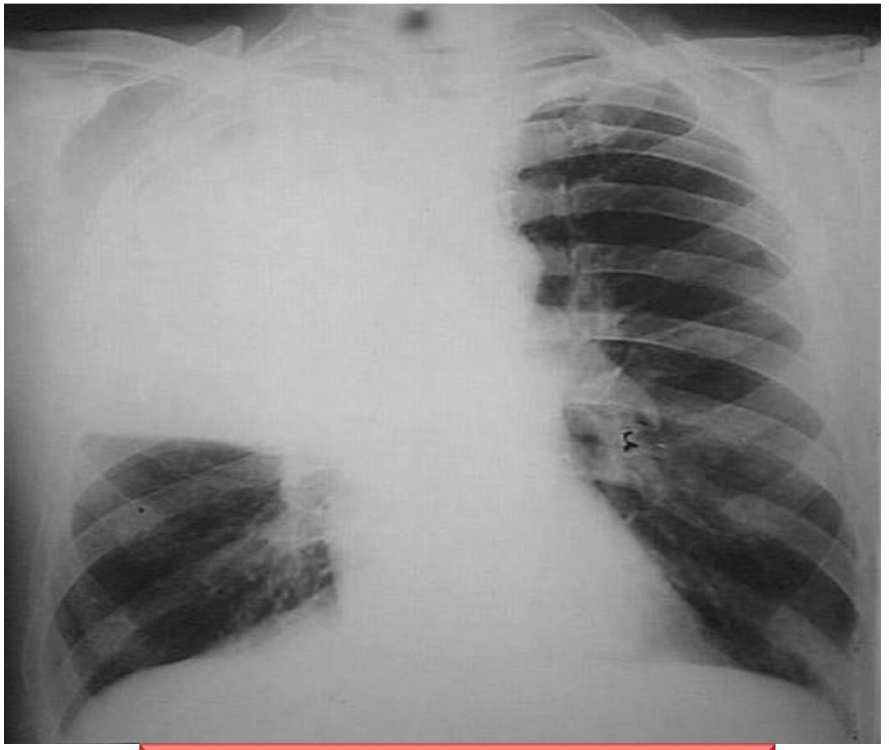
- *Strep pneumonia* 48%
- Viral 23%
- Atypical orgs (MP,LG,CP) 22%
- *Haemophilus influenza* 7%
- *Moraxella catharralis* 2%
- *Staph aureus* 1.5%
- Gram –ive orgs 1.4%
- Anaerobes

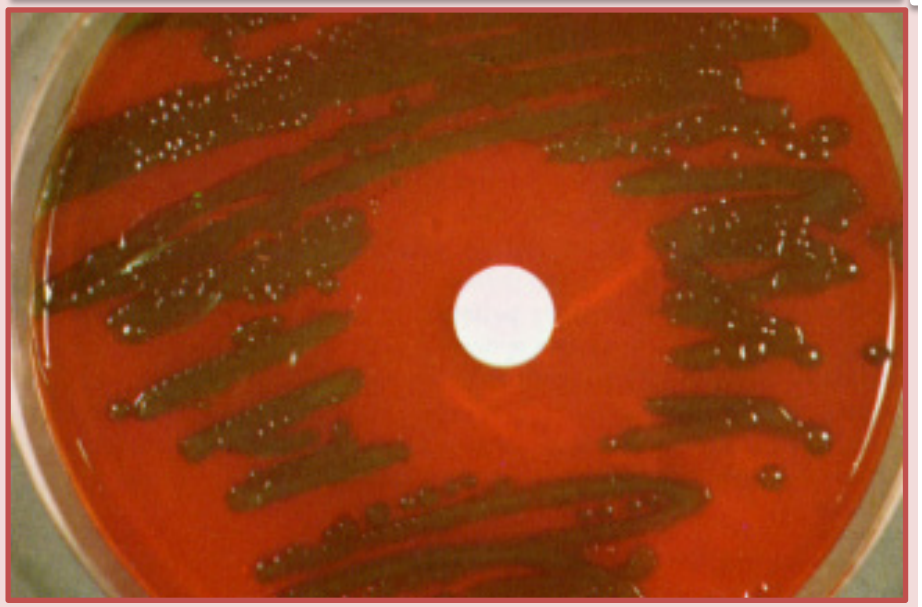
Typical pneumonia
Clinical manifestation

- 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

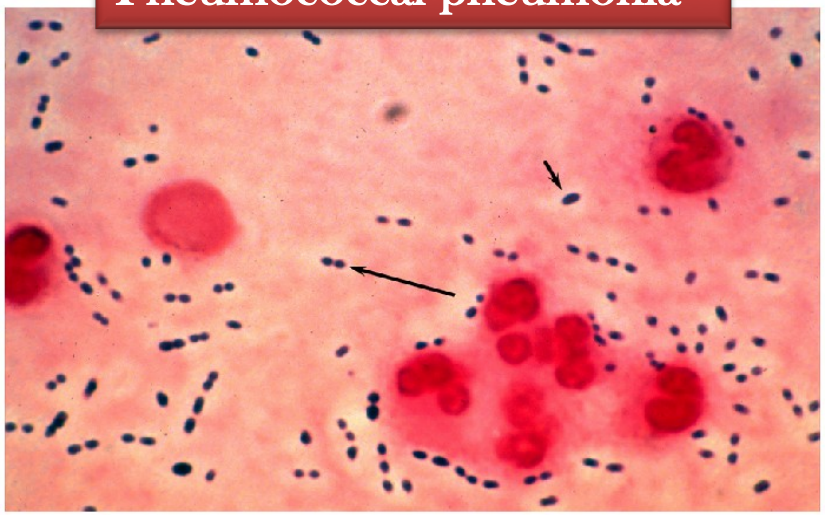
Diagnosis

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





Pneumococcal pneumonia

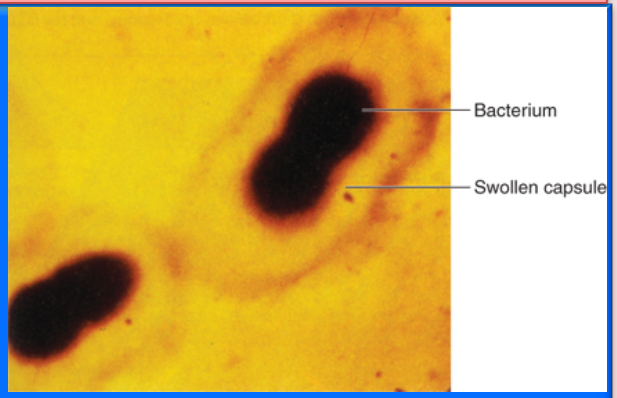


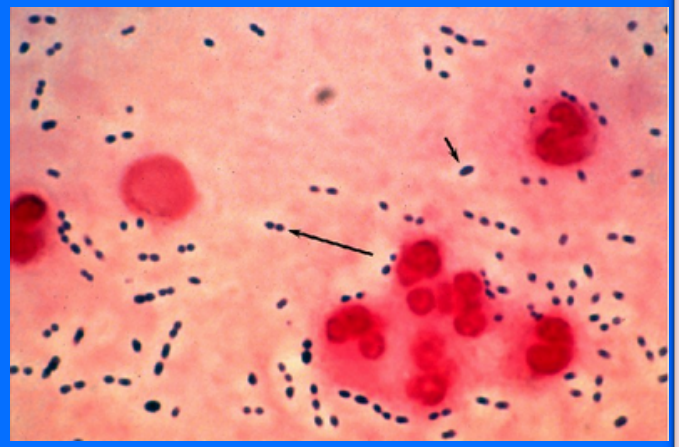
Streptococcus pneumoniae

- 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

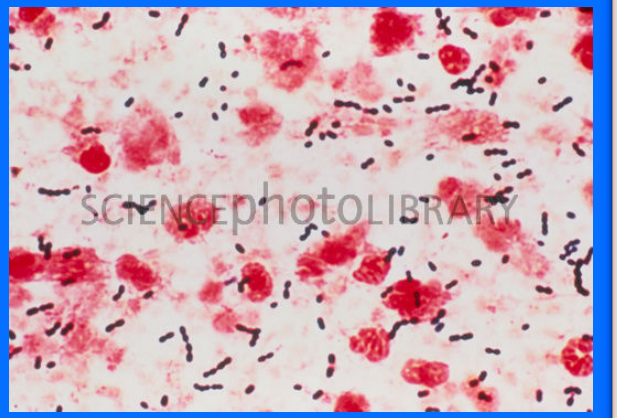
- Virulence factors:
  - Capsule
    - More than 90 capsular types
  - Pneumolysin
  - Autolysin
  - Neuraminidase
- Prevention: vaccination

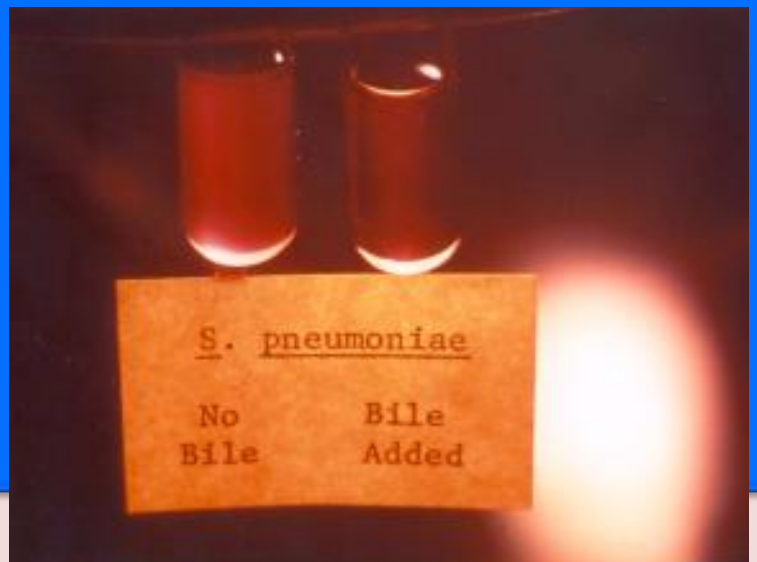


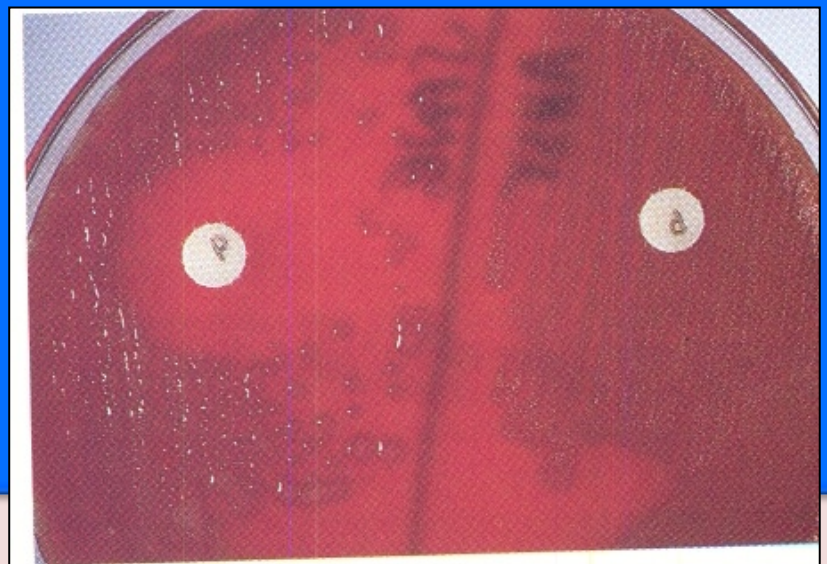


Streptococcus pneumoniae

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







Atypical pneumonia

- *Chlamydia pneumonia*
- *Mycoplasma pneumonia*
- *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

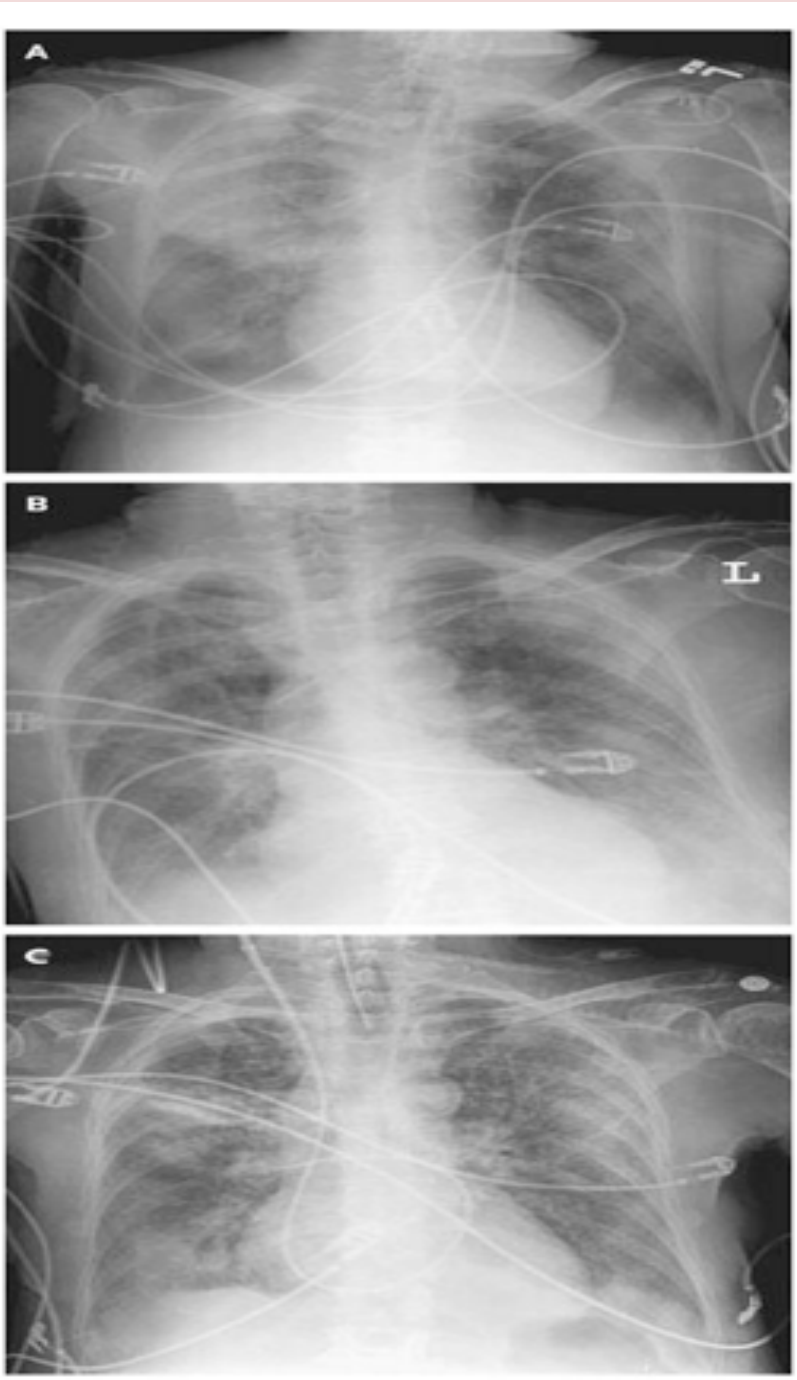
- Diagnosis:
  - X-ray
  - CBC
    - Mild elevation WBC
  - U&Es
    - Low serum Na (Legionalla)
  - LFTs
    - ↑ ALT
    - ↑ Alk Phos
  - Sputum Culture on special media (BCYE) for *Legionella*
  - Urine antigen for *Legionella*
  - Serology for detecting antibodies
  - DNA detection

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

Mycoplasma pneumonia

- 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 pneumonia

- 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 burnetti*)

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

Legionella pneumophila

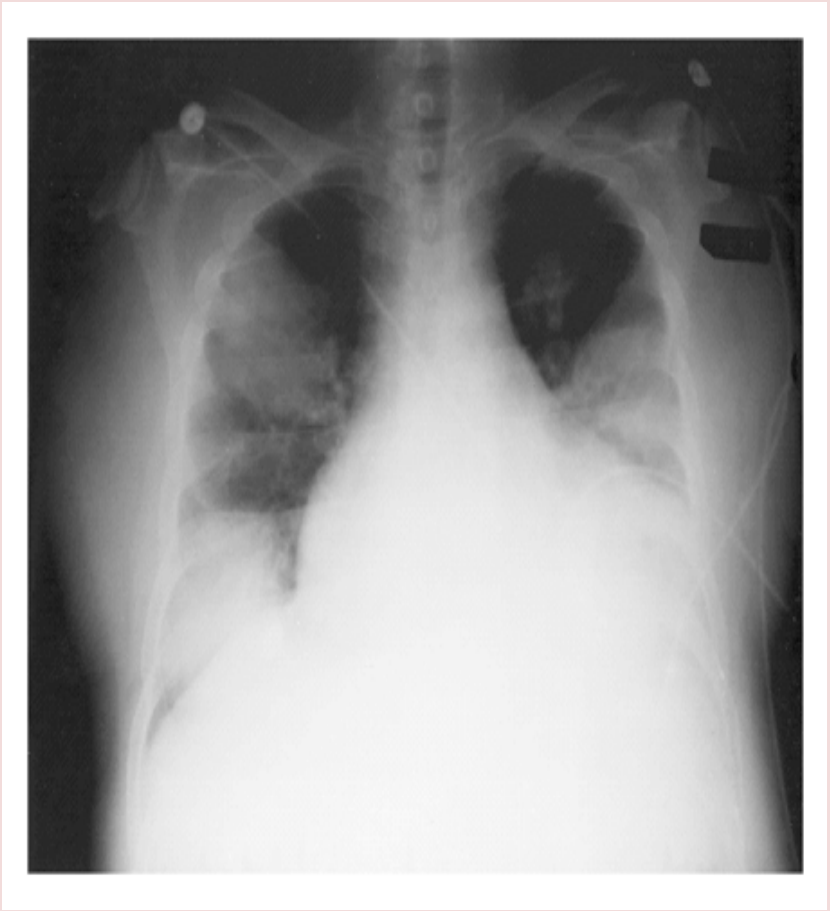
- Legionnaire's disease
- Serious outbreaks linked to exposure to cooling towers
- Can be very severe and lead to ICU admission.

- 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	-*S. pneumoniae* -Atypical pathogens -Viral					
Outpatient, patient with comorbidity or exposure to antibiotics in the last 3 months	*As above +* *Anaerobes* *S. aureus*					
Inpatient : Not ICU	Same as above + coliforms					
Inpatient : ICU	Same as above + *Pseudomonas*					

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