

Pneumonia

By

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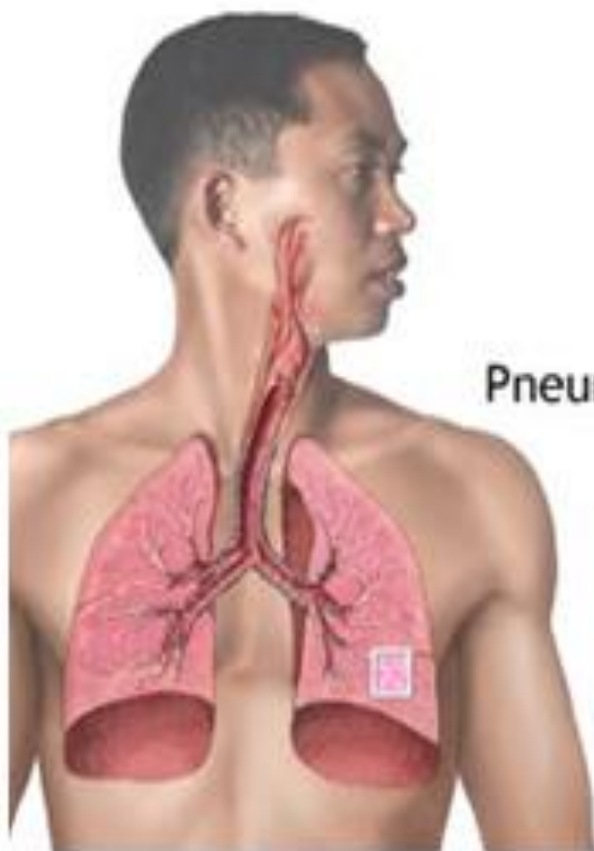
***Associate professor of
respiratory diseases***

Pneumonia

- Definition:

It is a syndrome of acute infection of the lung parenchyma, characterized by clinical and / or radiological picture of consolidation.

Commonly due to bacterial infection when the cause is non infectious, it is termed pneumonitis.

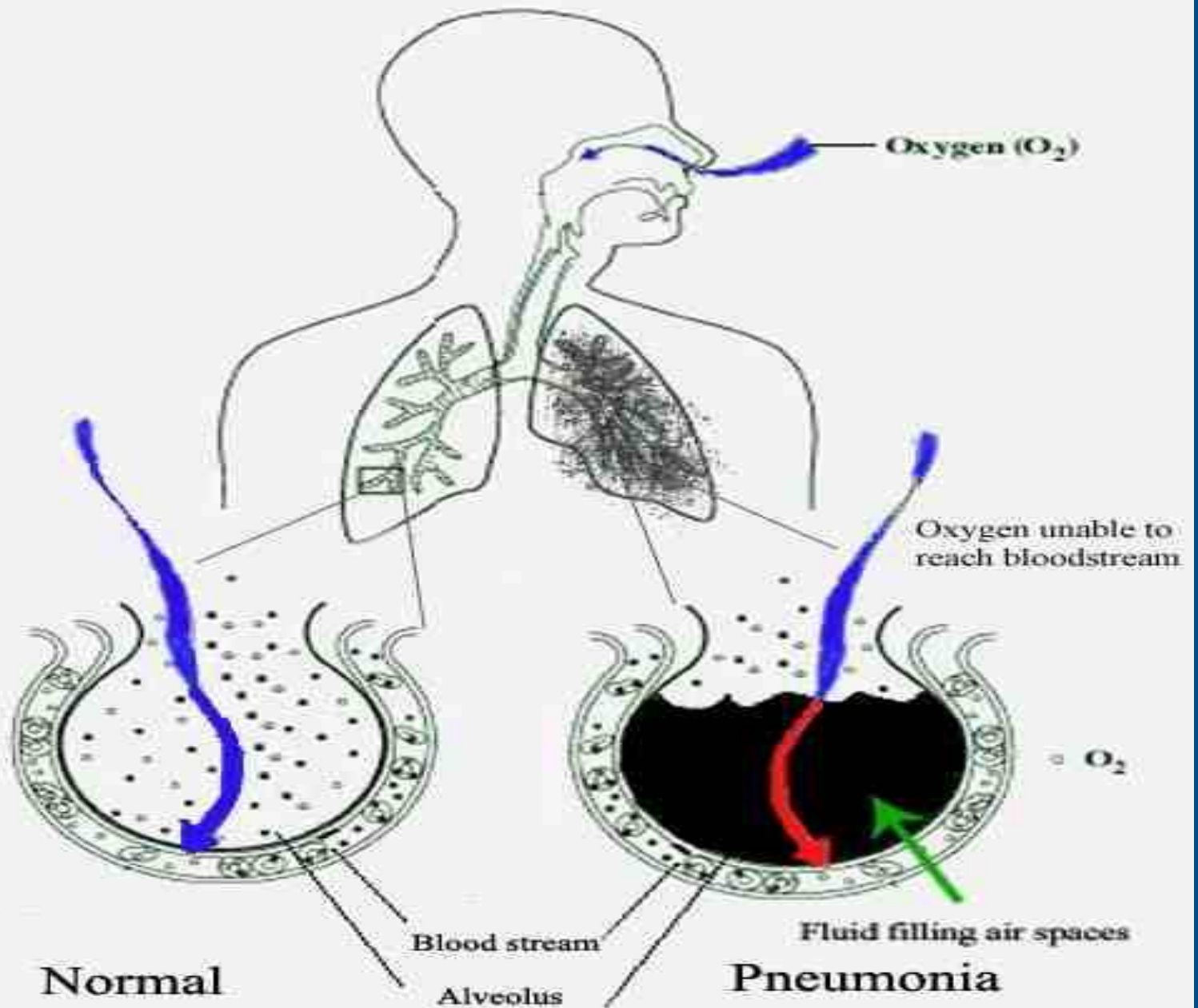


Normal
alveoli



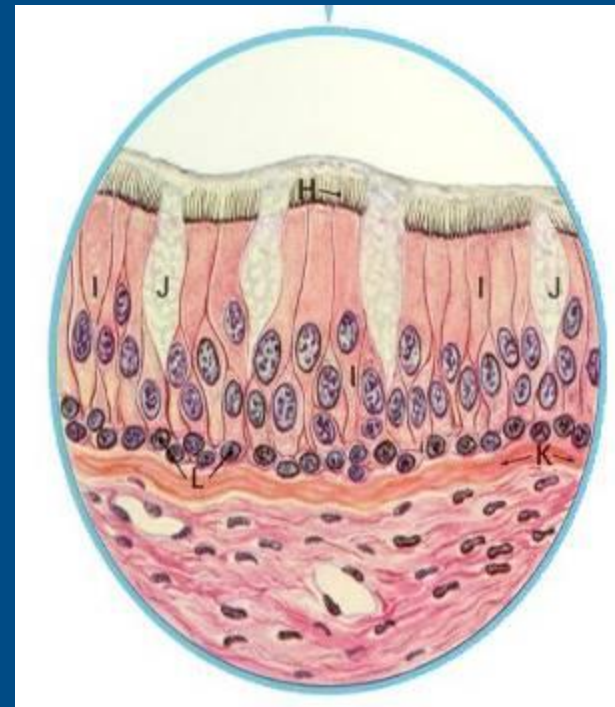
Pneumonia

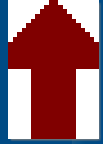




Defense Mechanisms

- 80% of cells lining central airways are ciliated, pseudostratified, columnar epithelial cells
- Each ciliated cell contains about 200 cilia that beat in coordinated waves about 1000x/minute
- So the lower respiratory tract is normally sterile





Etiology:



1- Predisposing factors:

- a- Suppression or reduction of cough reflex
- b- Impairment of mucociliary activity.
- c- Decrease of effective phagocytic activity of alveolar macrophages and neutrophils.
- d- Impairment of immunoglobulin production.

CAP – Pathogenesis



Inhalation

Aspiration

Hematogenous

A- Aspiration:

Predisposed by:

- Anaesthesia, -Surgery, - Alcoholism, - Tracheostomy

The most common oropharyngeal Commensals are:

- Anaerobe, mainly bacteroids melaninogenicus.
- Haemophilus influenza.
- Staph. Aureus
- Strept - pneumonia

B- Inhalation:

- Patient to patient by direct contact through fomites, droplet infection.
- Particle aerosols (viral and legionella).
- Contaminated nebulizer circuits or other respiratory equipments.

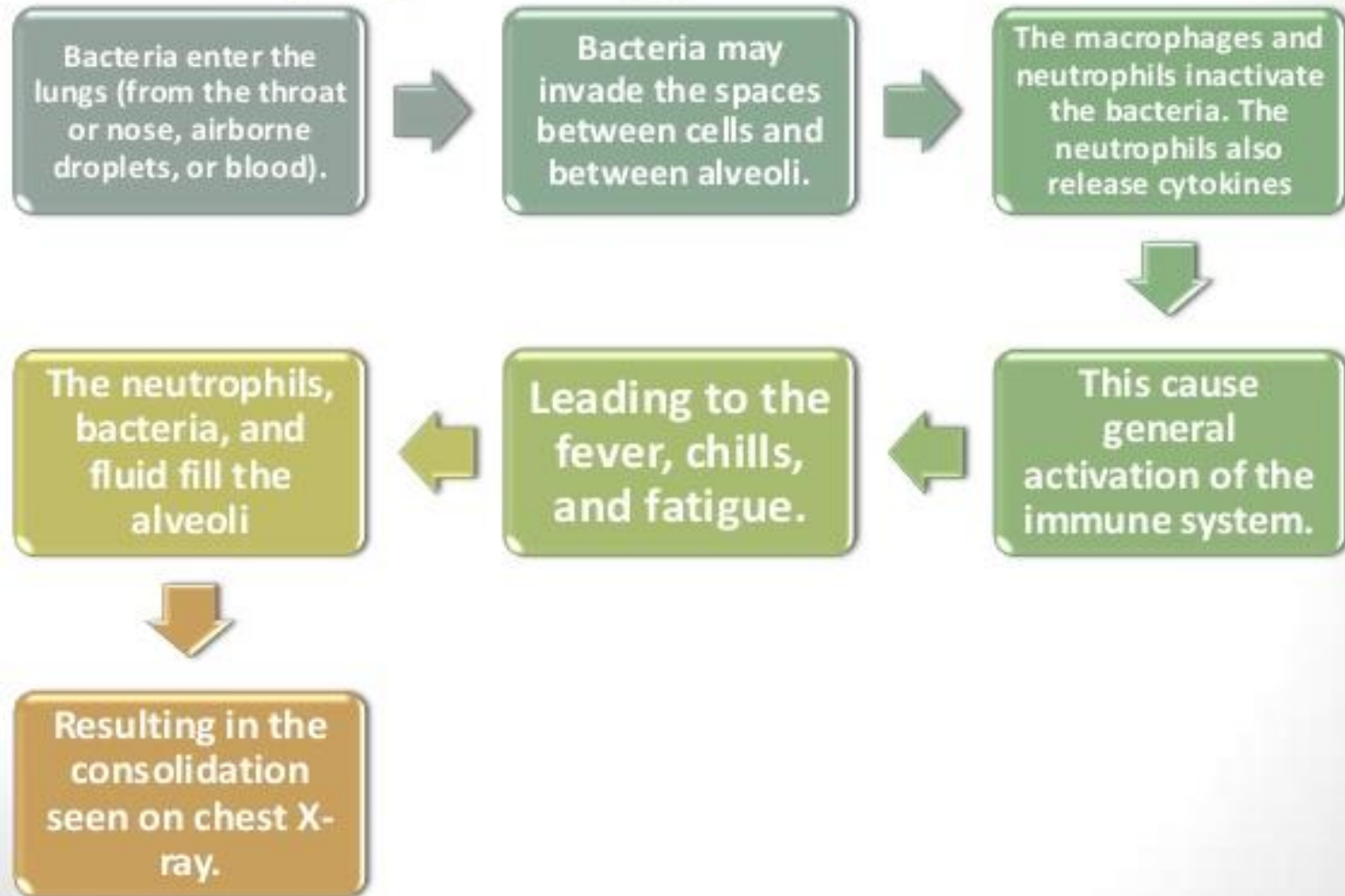
C- Colonization:

In chronically ill patients e.g.: COPD, Bronchiectasis and cystic fibrosis via acute exacerbation of infection from time to time.

D- Blood spread:

Via IV. cannulae, chronic haemodialysis and the commonest organisms are *Gm-Ve* and *staph. aureus*

Pathophysiology of pneumonia



Classification of pneumonia

1-According to causes

- **Bacterial** (the most common cause of pneumonia)
- **Viral** pneumonia
- **Fungal** pneumonia
- **Parasitic**: e.g. Malaria

Atypical micro organisms:

- Mycoplasma pneumonia (primary atypical pneumonia).
- Chlamydia (psittacosis – ornithosis).
- Coxiella burneti.
- Legionnaires (Legionella pneumophila).

Viral e.g: Adenovirus.

Fungal: e.g : Coccidioidomycosis and histoplasmosis.

- **Allergic pneumonia: e.g.,: Lofflers' syndrome and pneumonia of collagen diseases.**
- **Chemical pneumonitis e.g: Lipoid pneumonia**
- **Radiation pneumonitis**

Classification of pneumonia (cont...)

2-According to areas involved

- **Lobar pneumonia;** if one or more lobe is involved
- **Broncho-pneumonia;** the pneumonic process has originated in one or more bronchi and extends to the surrounding lung tissue.

3- According to Community or hospital acquired pneumonia.

Community acquired pneumonia.(CAP)

It is a pneumonia which is acquired in the community outside the hospitals or at hospitalization within the first 2 days in absence of any medical interference.

Hospital or Nosocomial pneumonia(HAP):

- It is a pneumonia which is acquired in the hospital after 2 days of hospitalization, the commonest organisms are Gram–ve bacilli e.g: pseudomonas aeruginosa, klebsiella and proteus.

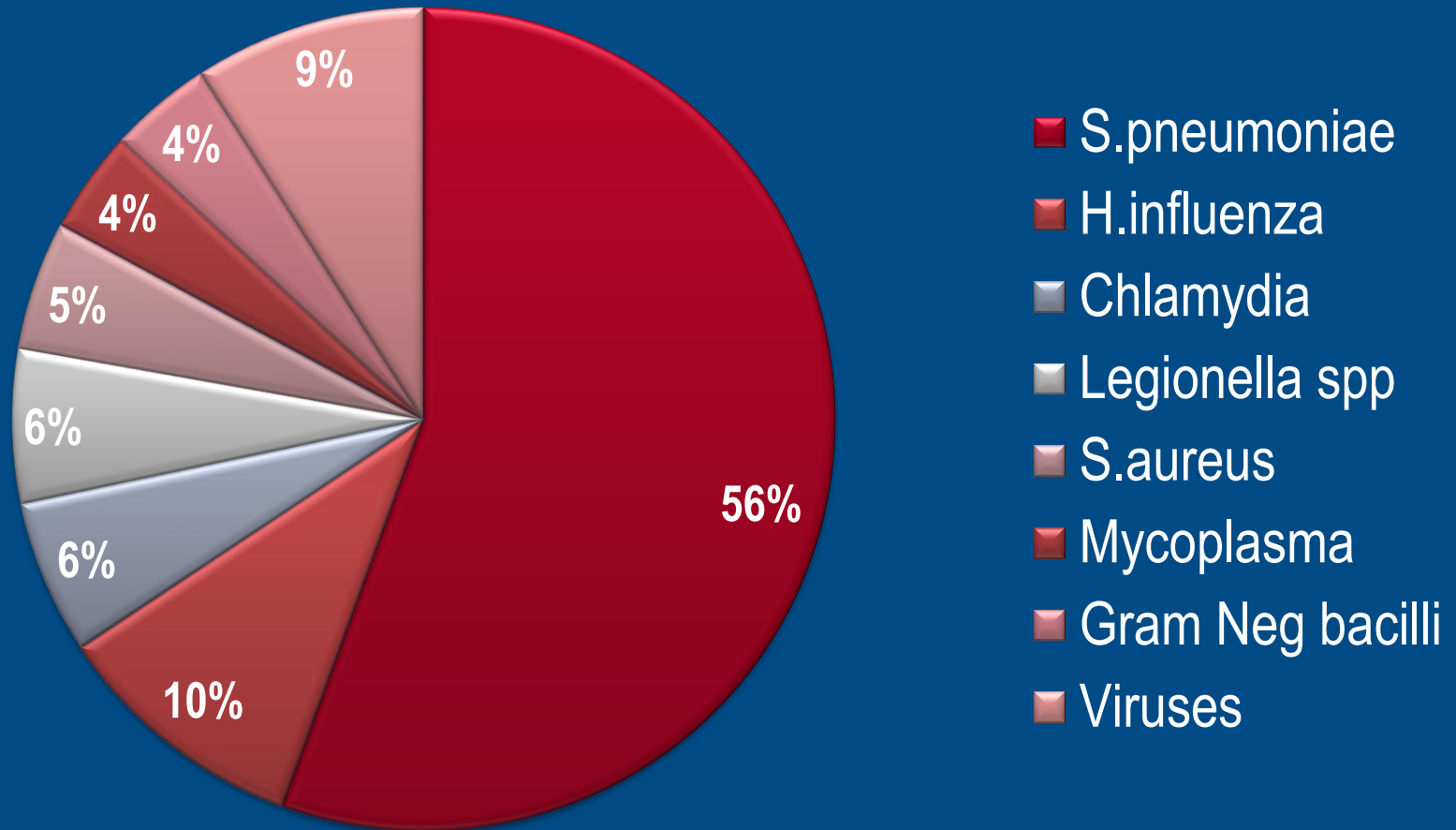
CAP – Risk Factors for Pneumonia

- Age
- Obesity; Exercise is protective
- Smoking, PVD
- Asthma, COPD
- Immuno-suppression, HIV
- Dementia

CAP – The Pathogens Involved

40-60% - No causative agent identified

2-5% - Two OR more agents identified



CAP – The Two Types of Presentations

Classical

- Sudden onset of CAP
- High fever, shaking chills
- Pleuritic chest pain, SOB
- Productive cough
- Rusty sputum, blood tinge
- Signs of consolidation
- Poor general condition
- High mortality up to 20% in patients with bacteremia
- *S.pneumoniae* causative

Atypical

- Gradual & insidious onset
- Low grade fever
- Dry cough, No blood tinge
- Extra pulmonary manifest.
- Good GC – Walking CAP
- Low mortality 1-2%; except in cases of Legionellosis
- *Mycoplasma*, *Chlamydiae*, *Legionella*, *Ricketessiae*, *Viruses* are causative

Pneumonia

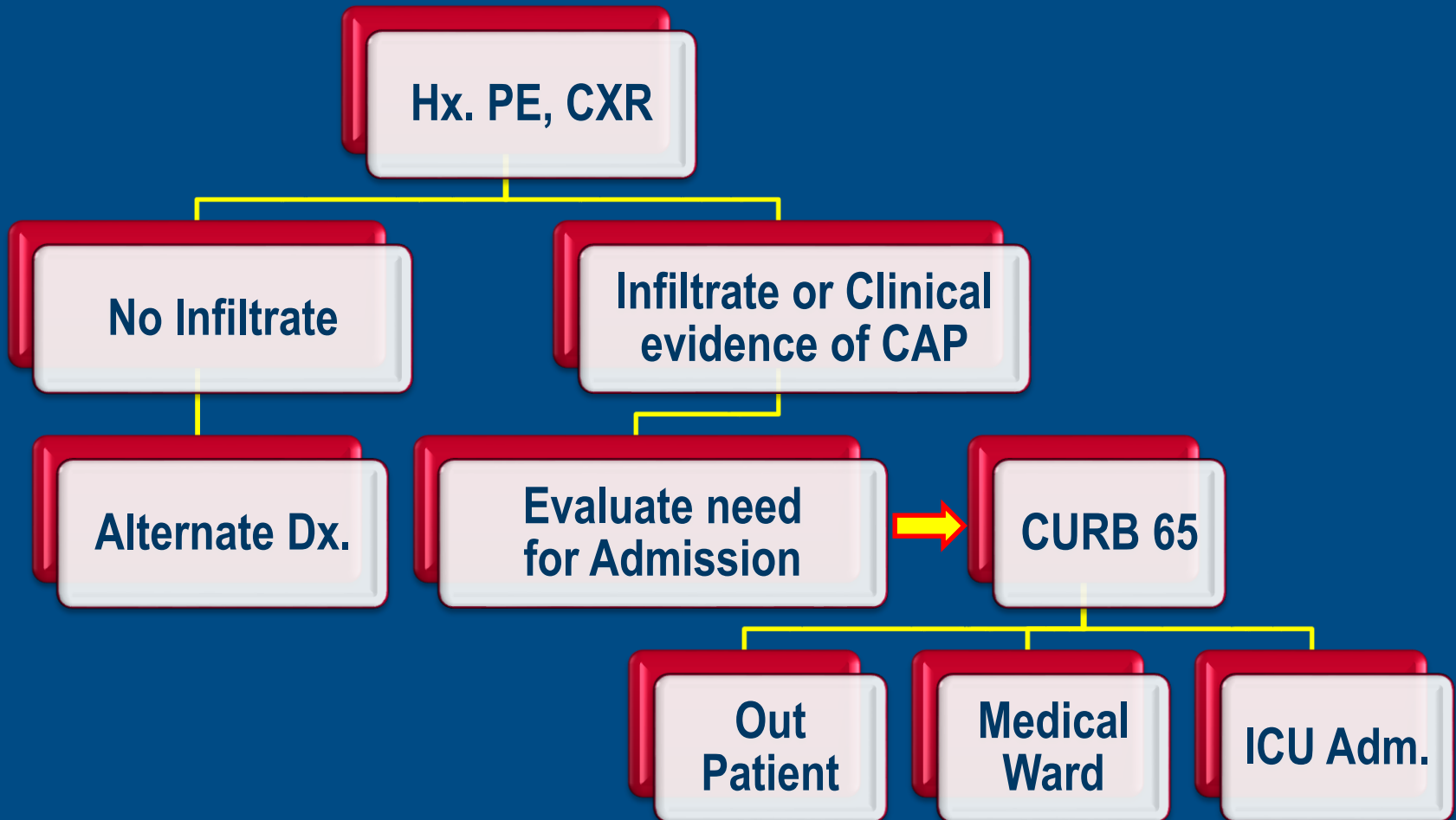
- Which of the following is **NOT** a sign of pneumonia?
- A. Dullness to percussion
- B. Tracheal deviation
- C. Bronchial breath sounds
- D. Increased tactile fremitus
- E. Late inspiratory crackles

Community Acquired Pneumonia (CAP)

Epidemiology

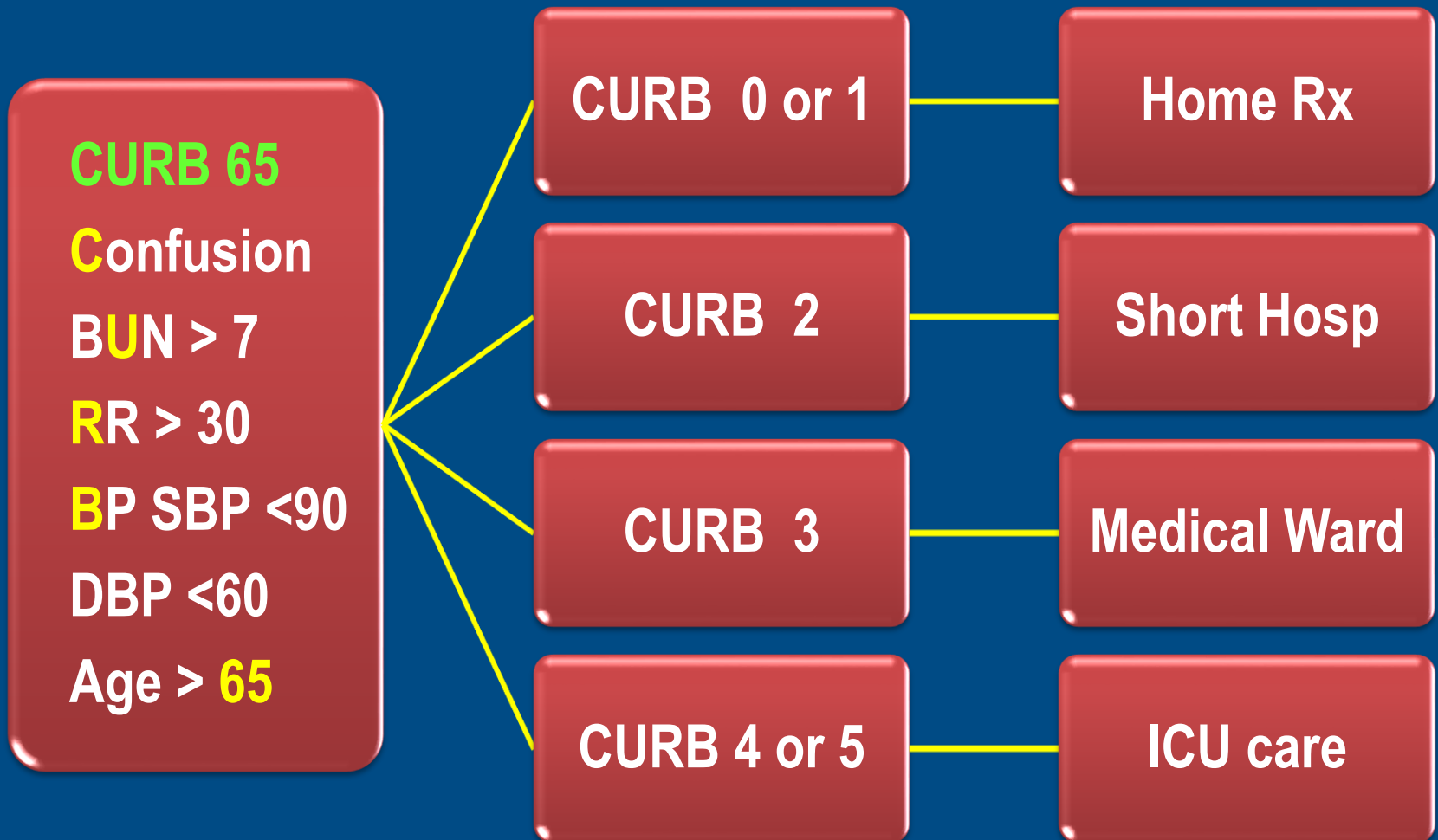
- 6th leading cause of death
- 5 million cases annually
- 20% require admission
- 14% Average mortality rate
- Mortality disproportionately high in old age

CAP – Evaluation of a Patient



CURB 65 Rule – Management of CAP

Who Should be Hospitalized?



PNEUMONIA SEVERITY INDEX FOR COMMUNITY-ACQUIRED PNEUMONIA

Risk factor	Points
Demographics	
Men	Age (years): ____
Women	Age (years) - 10: ____
Nursing home resident	+10
Comorbidities	
Neoplasm	+30
Liver disease	+20
Heart failure	+10
Stroke	+10
Renal failure	+10
Physical examination findings	
Altered mental status	+20
Respiratory rate \geq 30 breaths per minute	+20
Systolic blood pressure < 90 mm Hg	+20
Temperature < 95°F (35°C) or \geq 104°F (40°C)	+15
Pulse rate \geq 125 beats per minute	+10
Laboratory and radiographic findings	
Arterial pH < 7.35	+30
Blood urea nitrogen > 30 mg per dL	+20
Sodium < 130 mmol per L	+20
Glucose \geq 250 mg per dL	+10
Hematocrit < 30 percent	+10
Partial pressure of arterial oxygen < 60 mm Hg	+10
Pleural effusion	+10
Total points:	

Deaths/total (%)

Point total	Risk class	Adults with CAP*	Nursing home patients with CAP ¹	Recommendation†
< 51	I	3/1,472 (0.2)	None	Outpatient therapy should be considered, especially for patients in classes I and II
51 to 70	II	7/1,374 (0.5)	None	
71 to 90	III	41/1,603 (2.6)	1/21 (4.8)	
91 to 130	IV	149/1,605 (9.3)	6/50 (12.0)	Patient should be hospitalized
> 130	V	109/438 (24.9)	28/85 (32.9)	

CAP – Criteria for ICU Admission

Major criteria

- Invasive mechanical ventilation required
- Septic shock with the need of vasopressors

Minor criteria (least 3)

- Confusion/disorientation
- Blood urea nitrogen ≥ 20 mg%
- Respiratory rate ≥ 30 / min; Core temperature $< 36^{\circ}\text{C}$
- Severe hypotension; PaO₂/FiO₂ ratio ≤ 250
- Multi-lobar infiltrates
- WBC < 4000 cells; Platelets $< 100,000$

CAP – Laboratory Tests

- **CXR – PA & lateral**
- **CBC with Differential**
- **BUN and Creatinine**
- **CRP,ESR**
- **Liver enzymes**

- **Serum electrolytes**
- **Gram stain of sputum**
- **Culture of sputum**
- **Pre Rx. blood cultures**
- **Oxygen saturation**

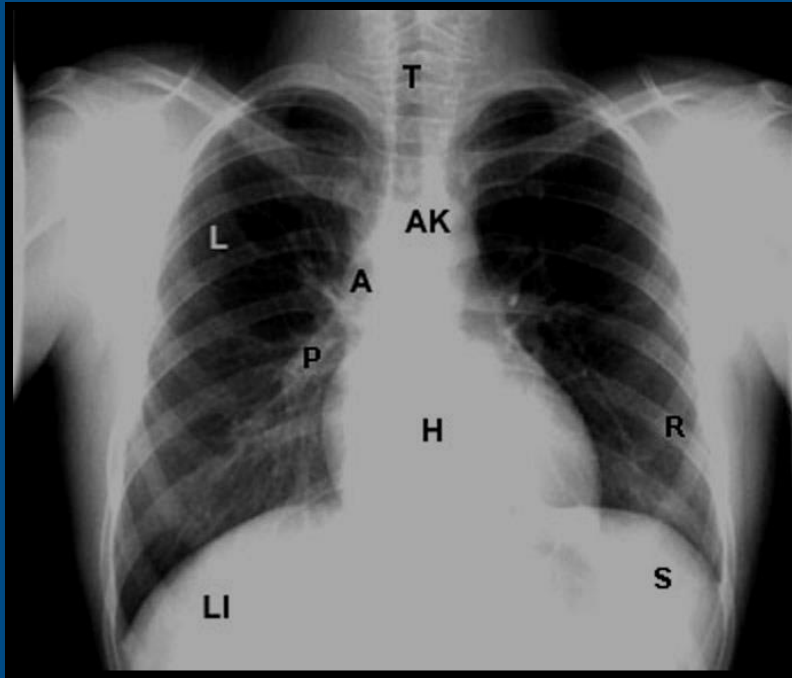
CAP – Value of Chest Radiograph

- **Usually needed to establish diagnosis**
- **It is a prognostic indicator**
- **To rule out other disorders**
- **May help in etiological diagnosis**

Infiltrate Patterns and Pathogens

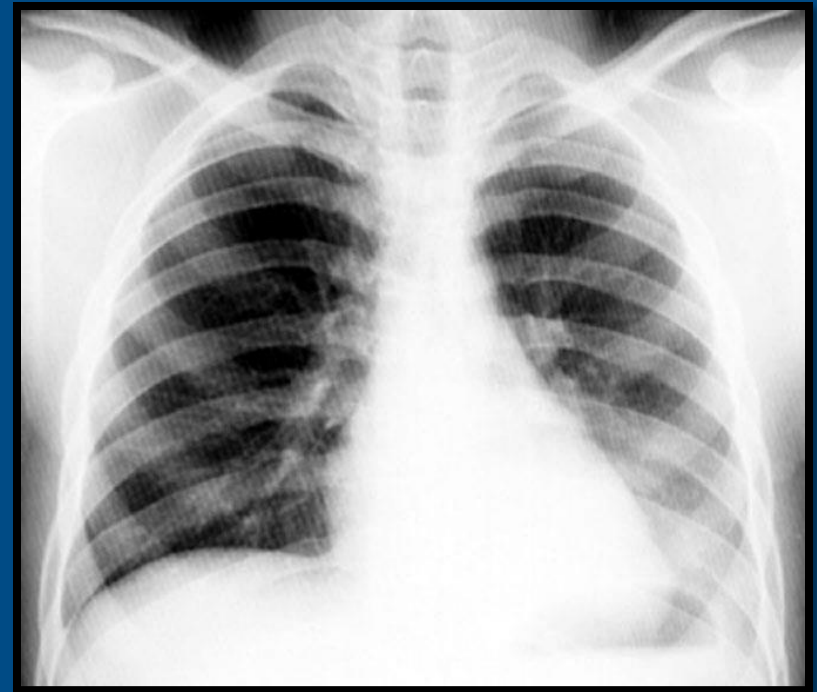
CXR Pattern	Possible Pathogens
Lobar	S.pneumo, Kleb, H. influ, Gram Neg
Patchy	Atypicals, Viral, Legionella
Interstitial	Viral, PCP, Legionella
Cavitatory	Anerobes, Kleb, TB, S.aureus, Fungi
Large effusion	Staph, Anaerobes, Klebsiella

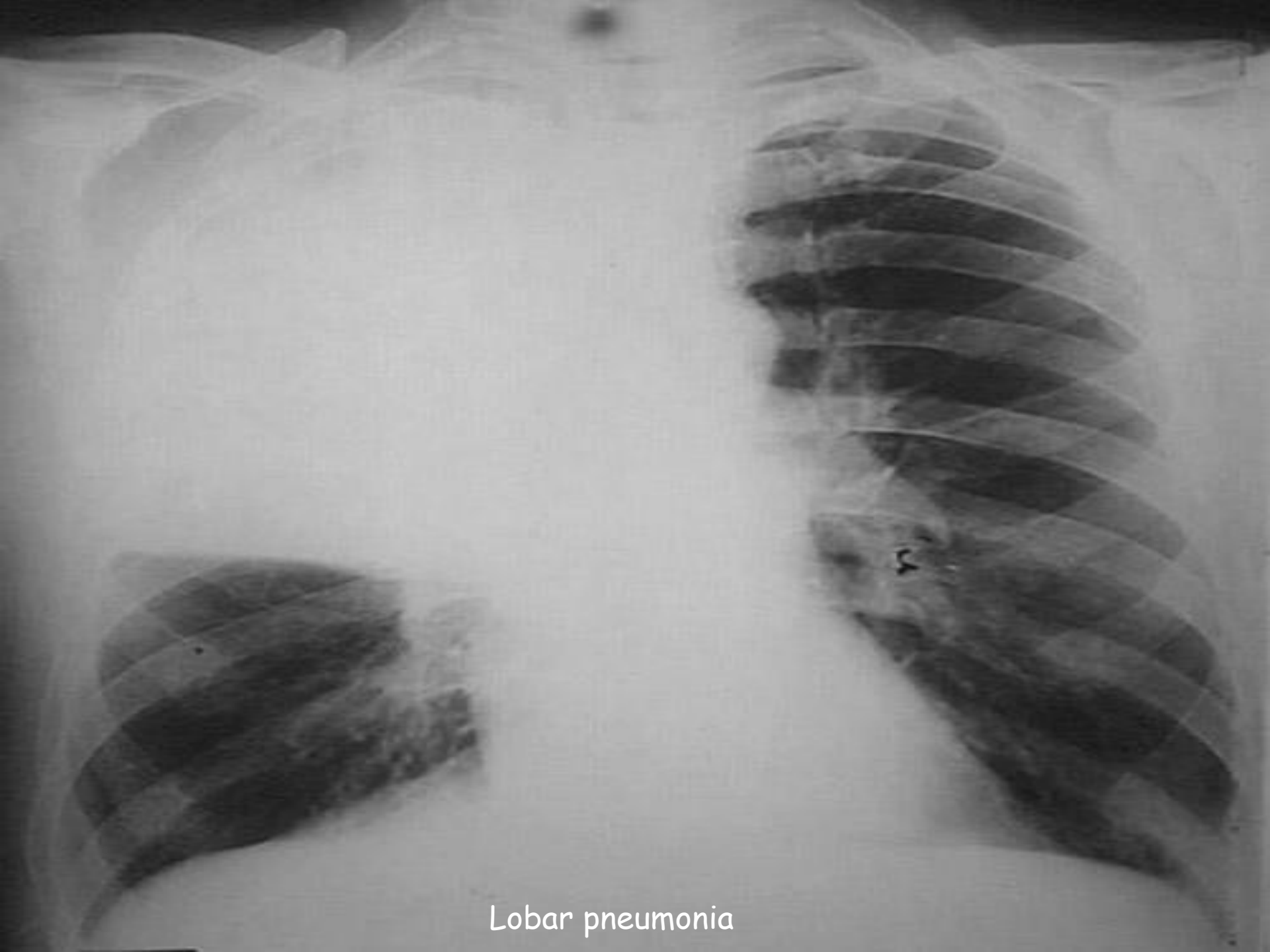
Normal CXR & Pneumonic Consolidation



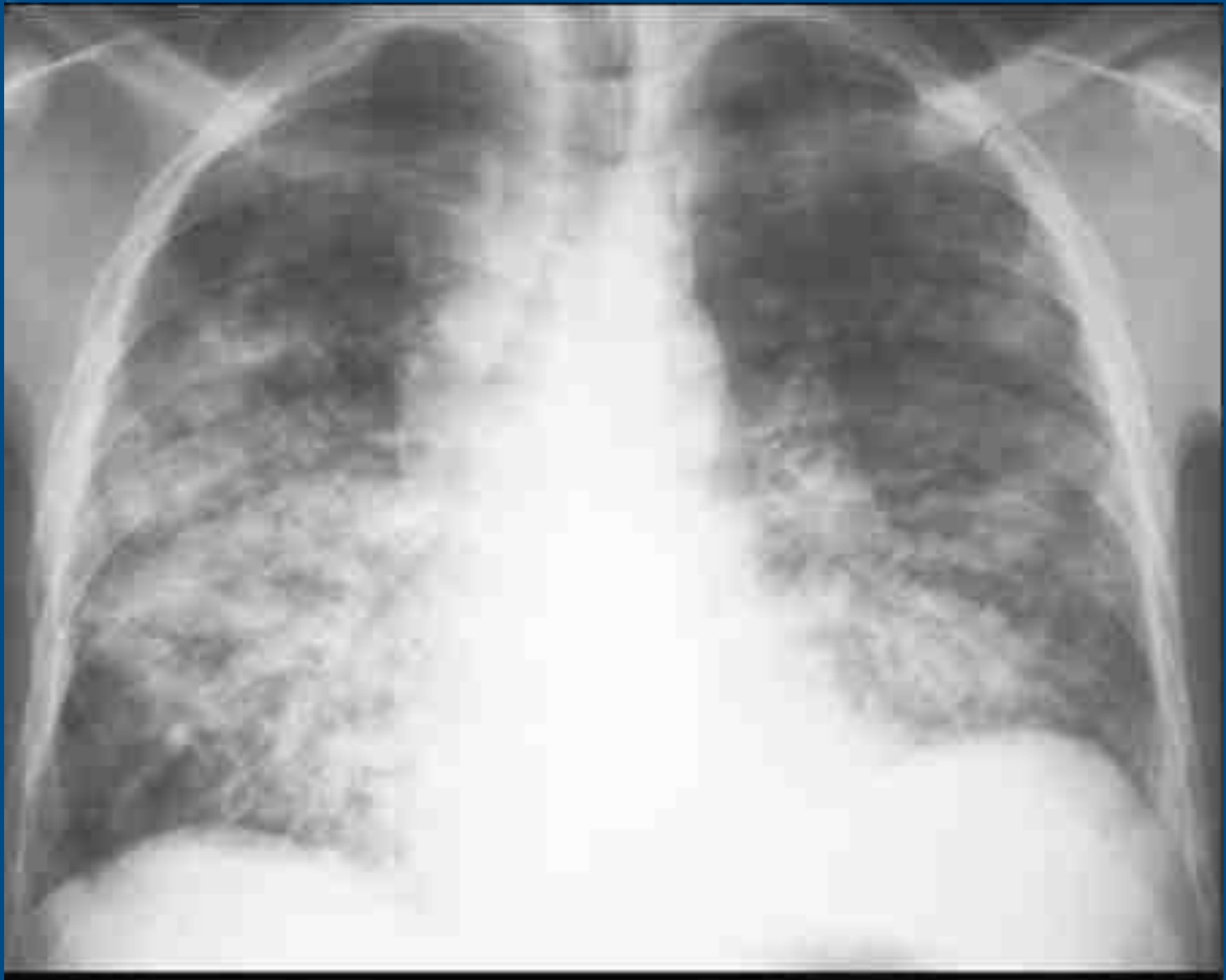
Normal CXR

LLL Mild





Lobar pneumonia

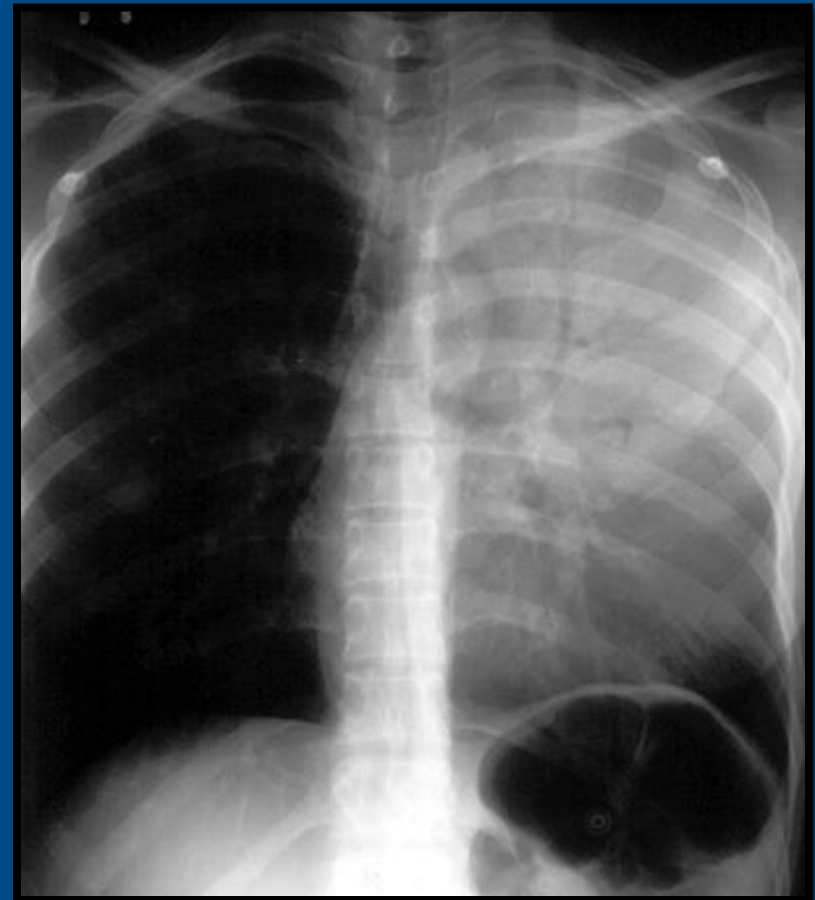


Lobar Pneumonia – *S.pneumoniae*



RUL

LUL



CXR – PA and Lateral Views

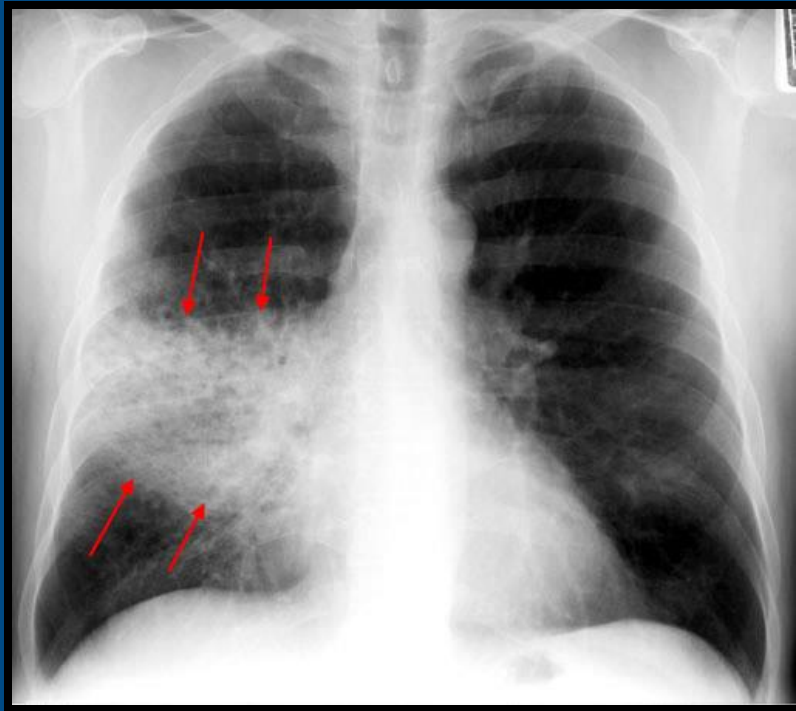


PA - RML

Lateral - RML



Lobar versus Segmental - Right Side

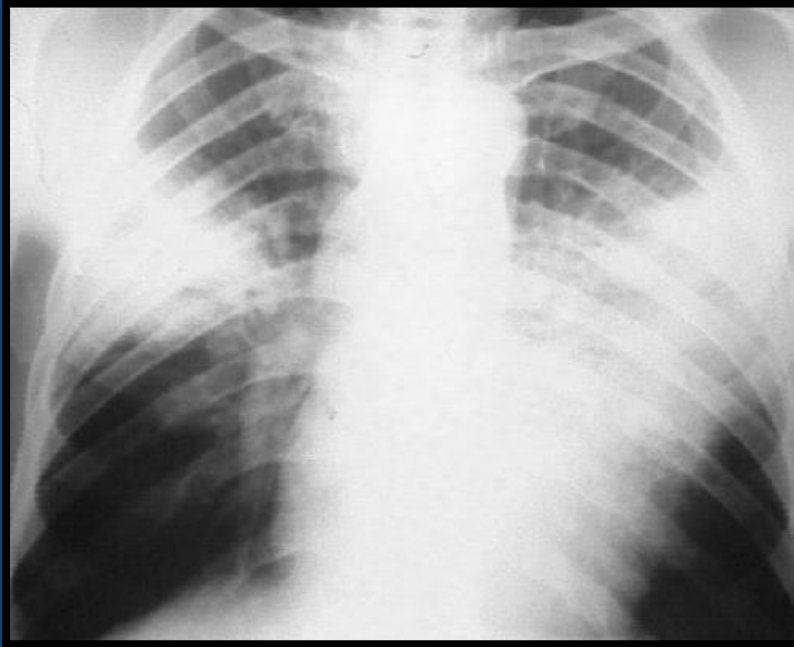


RML Early

Segmental



Lobar Pneumonia

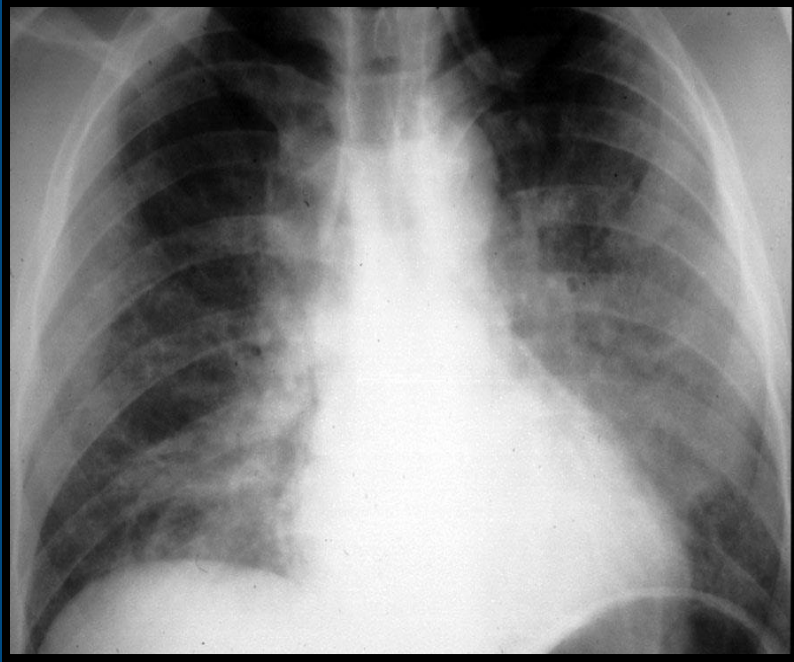


**Bilateral
Multi lobar**

LUL



Special Forms of Pneumonia

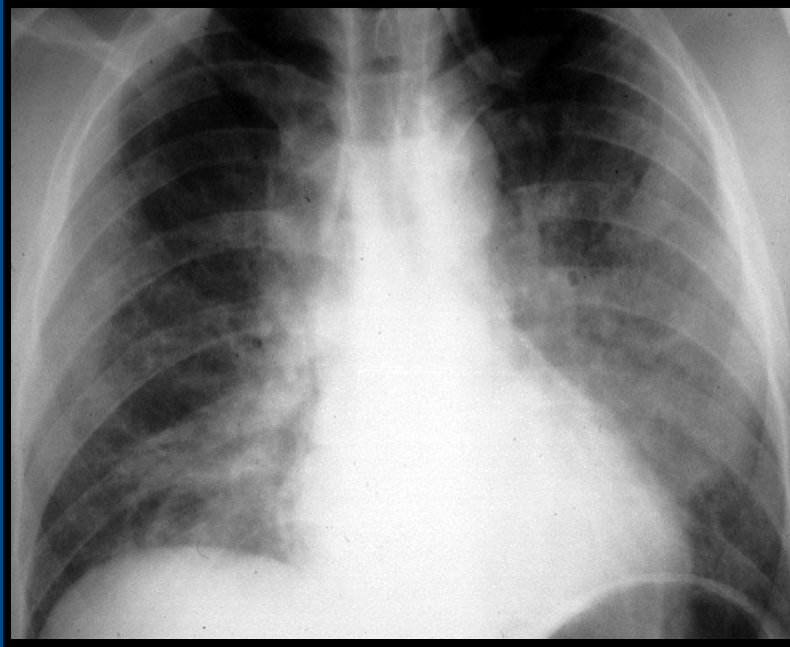


Diffuse Alveolar

Aspiration

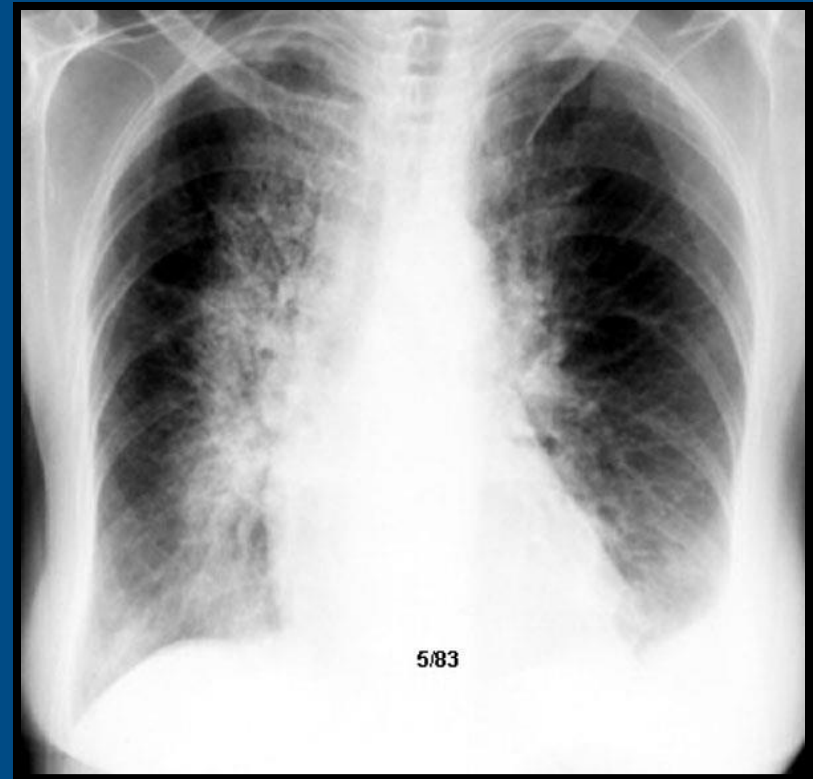


Special Forms of Pneumonia

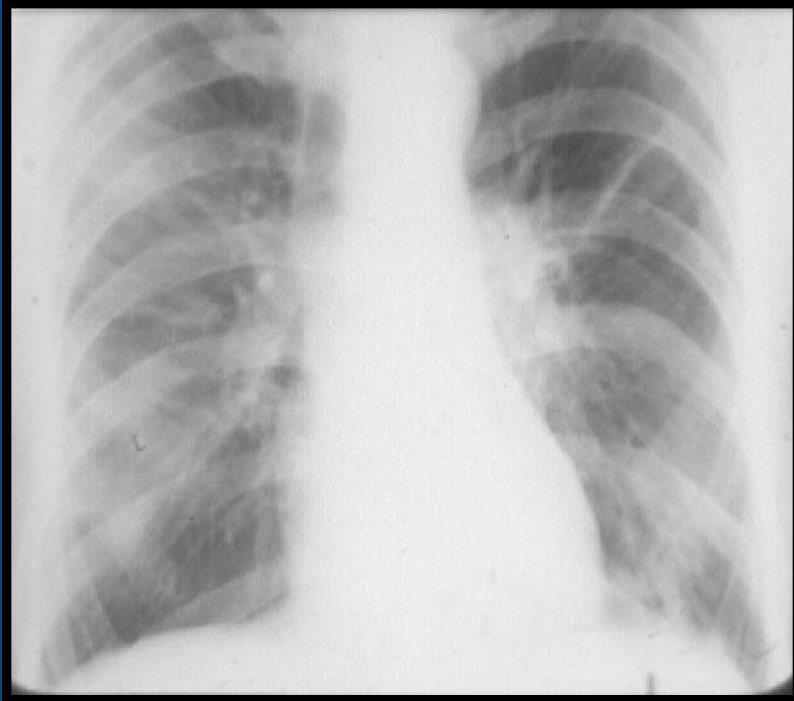


PCP/ CMV DD

Radiation



Rare Types of Pneumonia

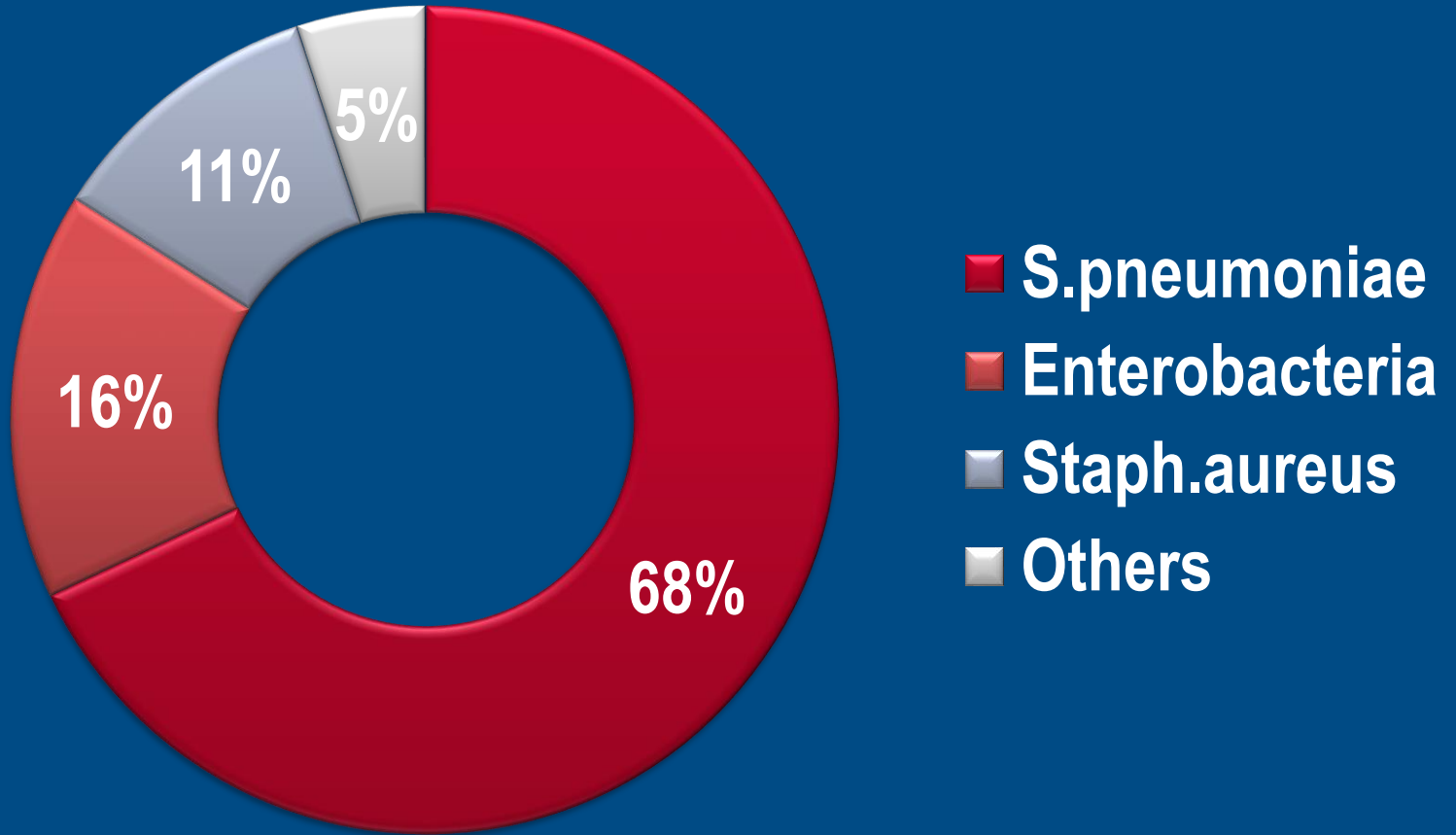


Psittacosis
Diffuse - Bil

Legionella
Pneumonia



Pathogens Retrieved from Blood Culture



Mortality of CAP – Based on Pathogen

- *P. aeruginosa* - 61.0 %
- *K. pneumoniae* - 35.7 %
- *S. aureus* - 31.8 %
- *Legionella* - 14.7 %
- *S. pneumoniae* - 12.0 %
- *C. pneumoniae* - 9.8 %
- *H. influenza* - 7.4 %



Treatment

I- Where to treat ?

II- Therapy used.

III- Duration of therapy.



Where to treat ?

Outpatient.

- Inpatient
- Hospital inpatient ward.
- Hospital ICU

CAP THERAPY

GROUP 1

OUTPATIENT-
CLINIC



Mild pneumonia,

GROUP 2

HOSPITAL



Moderate
pneumonia

GROUP 3

INTENSIVE
CARE



Severe
pneumonia



Pneumonia

Medical management

- Antibiotic, depending on sputum and blood culture
- Oxygen therapy
- Chest physiotherapy

CAP – Modifying Factors

MODIFYING FACTORS THAT INCREASE THE RISK OF INFECTION WITH SPECIFIC PATHOGENS

Penicillin-resistant and drug-resistant pneumococci

Age > 65 yr

B-Lactam therapy within the past 3 mo

Alcoholism

Immune-suppressive illness (including therapy w/ corticosteroids)

Multiple medical comorbidities

Exposure to a child in a day care center

Enteric gram-negatives

Residence in a nursing home

Underlying cardiopulmonary disease

Multiple medical comorbidities

Recent antibiotic therapy

Pseudomonas aeruginosa

Structural lung disease (bronchiectasis)

Corticosteroid therapy (10 mg of prednisone per day)

Broad-spectrum antibiotic therapy for > 7 d in the past month

Malnutrition

Table 6. Most common etiologies of community-acquired pneumonia.

Patient type	Etiology
Outpatient	<i>Streptococcus pneumoniae</i> <i>Mycoplasma pneumoniae</i> <i>Haemophilus influenzae</i> <i>Chlamydophila pneumoniae</i> Respiratory viruses ^a
Inpatient (non-ICU)	<i>S. pneumoniae</i> <i>M. pneumoniae</i> <i>C. pneumoniae</i> <i>H. influenzae</i> <i>Legionella</i> species <u>Aspiration</u> Respiratory viruses ^a
Inpatient (ICU)	<i>S. pneumoniae</i> <u><i>Staphylococcus aureus</i></u> <i>Legionella</i> species <u>Gram-negative bacilli</u> <i>H. influenzae</i>

NOTE. Based on collective data from recent studies [171]. ICU, intensive care unit.

^a Influenza A and B, adenovirus, respiratory syncytial virus, and parainfluenza.

Outpatient treatment

CURB-65 (0 or 1) who is **Previously healthy no comorbidity and no risk factors for drug-resistant**

- Amoxicillin **OR** amoxicillin + clavulanic acid **OR**
A macrolide {azithromycin (500 mg once daily), clarithromycin (500 mg twice daily), or erythromycin} (strong recommendation; level I evidence)

TABLE 2

Initial Treatment Regimens for Outpatients with Community-Acquired Pneumonia

Patient factors	Antibiotic regimen*
No risk factors for methicillin-resistant <i>Staphylococcus aureus</i> or <i>Pseudomonas aeruginosa</i> † and No comorbidities listed below	Amoxicillin, 1,000 mg every 8 hours or Doxycycline, 100 mg every 12 hours or Macrolide if local pneumococcal resistance < 25%: Azithromycin (Zithromax), 500 mg on day 1, then 250 mg per day or Clarithromycin (Biaxin), 500 mg every 12 hours or Extended-release clarithromycin (Biaxin XL), 1,000 mg per day
Comorbidities: alcoholism; asplenia; diabetes mellitus; malignancy; or chronic heart, lung, liver, or kidney disease	Combination of: Amoxicillin/clavulanate (Augmentin), 500 mg/125 mg every 8 hours, 875 mg/125 mg every 12 hours, or 2,000 mg/125 mg every 12 hours or Cefpodoxime, 200 mg every 12 hours or Cefuroxime axetil, 500 mg every 12 hours PLUS Azithromycin, 500 mg on day 1, then 250 mg per day or Clarithromycin, 500 mg every 12 hours or Doxycycline, 100 mg every 12 hours or Extended-release clarithromycin, 1,000 mg per day OR Monotherapy with a respiratory fluoroquinolone: Gemifloxacin (Factive), 320 mg per day or Levofloxacin (Levaquin), 750 mg per day or Moxifloxacin (Avelox), 400 mg per day

*—Duration of therapy should be ≥ 5 days for all regimens, after which the patient's vital signs, ability to eat, and mentation should be evaluated to ensure recovery.

†—Risk factors include prior respiratory isolation of methicillin-resistant *S. aureus* or *P. aeruginosa*, or hospitalization and treatment with parenteral antibiotics within the past 90 days.

Adapted with permission from Metlay JP, Waterer GW, Long AC, et al. Diagnosis and treatment of adults with community-acquired pneumonia. An official clinical practice guideline of the American Thoracic Society and Infectious Diseases Society of America. Am J Respir Crit Care

In-patient ward treatment....

1. CURB-65 (0 or 1) plus any of the followings: {Presence of comorbidities, such as chronic heart, lung, liver, or renal disease; diabetes mellitus; alcoholism; malignancies; asplenia; use of immunosuppressing drugs; use of antimicrobials within the previous 3 months.....}.

2. CURB-65 (2)

A **respiratory fluoroquinolone** (moxifloxacin, gemifloxacin, or levofloxacin [750 mg once daily]) (strong recommendation; level I evidence)

OR

- A **B-lactam plus a macrolide** (strong recommendation; level I evidence)

B-lactam antibiotics (IV doses) (High-dose amoxicillin [e.g., 1 g 3 times daily] **OR** amoxicillin-clavulanate [1.2 g (2-3) times daily]) is preferred; **alternatives** include ceftriaxone (1-2 g once daily) and cefuroxime [1.5 g (2-3) times daily];

Inpatient, ICU treatment

- A b-lactam (cefotaxime, ceftriaxone, or ampicillin-sulbactam) **plus** either azithromycin (level II evidence) or a fluoroquinolone (level I evidence) (strong recommendation) (For penicillin-allergic patients, a respiratory fluoroquinolone and aztreonam are recommended.)
- If **MRSA** is suspected, vancomycin (15 mg/kg IV every 12 hours, in seriously ill patients, a loading dose of 25 to 30 mg/kg may be given, OR linezolid)
- For **Pseudomonas infection**, use antipseudomonal b-lactam (piperacillin-tazobactam, cefepime, imipenem, or meropenem) **PLUS** either ciprofloxacin or levofloxacin (750-mg dose) or aminoglycosides.

Treatment Regimens for Hospitalized Patients with Community-Acquired Pneumonia

Patient factors	Antibiotic regimen*	Patient factors	Antibiotic regimen*
Nonsevere pneumonia without risk factors for MRSA or <i>Pseudomonas aeruginosa</i> †	<p>Combination of: Ampicillin/sulbactam (Unasyn), 1.5 to 3 g IV every 6 hours or Cefotaxime (Claforan), 1 to 2 g IV every 8 hours or Ceftaroline (Teflaro), 600 mg IV every 12 hours or Ceftriaxone (Rocephin), 1 to 2 g IV every day</p> <p>PLUS Azithromycin (Zithromax), 500 mg orally or IV every day or Clarithromycin (Biaxin), 500 mg orally every 12 hours</p> <p>OR Monotherapy with a respiratory fluoroquinolone: Levofloxacin (Levaquin), 750 mg orally or IV every day or Moxifloxacin (Avelox), 400 mg orally or IV every day</p>	Severe pneumonia without risk factors for MRSA or <i>P. aeruginosa</i> †	<p>Combination of: Ampicillin/sulbactam, 1.5 to 3 g IV every 6 hours or Cefotaxime, 1 to 2 g IV every 8 hours or Ceftaroline, 600 mg IV every 12 hours or Ceftriaxone, 1 to 2 g IV every day</p> <p>PLUS Azithromycin, 500 mg orally or IV every day or Clarithromycin, 500 mg orally every 12 hours or Levofloxacin, 750 mg orally or IV every day or Moxifloxacin, 400 mg orally or IV every day</p>
Nonsevere pneumonia without risk factors for MRSA or <i>P. aeruginosa</i> † and Contraindications to macrolides and fluoroquinolones	<p>Combination of: Ampicillin/sulbactam, 1.5 to 3 g IV every 6 hours or Cefotaxime, 1 to 2 g IV every 8 hours or Ceftaroline, 600 mg IV every 12 hours or Ceftriaxone, 1 to 2 g IV every day</p> <p>PLUS Doxycycline, 100 mg orally or IV every 12 hours</p>	Severe pneumonia with locally validated risk factors for MRSA or <i>P. aeruginosa</i> †	<p>For MRSA risk factors: Linezolid (Zyvox), 600 mg orally or IV every 12 hours or Vancomycin, 15 mg per kg IV every 12 hours (adjust based on levels)</p> <p>For <i>P. aeruginosa</i> risk factors: Aztreonam (Azactam), 2 g IV every 8 hours or Cefepime, 2 g IV every 8 hours or Ceftazidime (Fortaz), 2 g IV every 8 hours or Imipenem/cilastatin (Primaxin), 500 mg IV every 6 hours or Meropenem (Merrem IV), 1 g IV every 8 hours or Piperacillin/tazobactam (Zosyn), 4.5 g IV every 6 hours</p>

IV = intravenously; MRSA = methicillin-resistant *Staphylococcus aureus*.

*—Duration of therapy should be ≥ 5 days for all regimens, after which the patient's vital signs, ability to eat, and mentation should be evaluated to ensure recovery.

†—Risk factors include prior respiratory isolation of MRSA or *P. aeruginosa*, or hospitalization and treatment with parenteral antibiotics within the past 90 days.

Information from Metlay JP, Waterer GW, Long AC, et al. Diagnosis and treatment of adults with community-acquired pneumonia. An official clinical practice guideline of the American Thoracic Society and Infectious Diseases Society of America. Am J Respir Crit Care Med. 2019;200(7):e45-e67.

Early treatment (within 48 h of the onset of symptoms) with oseltamivir or zanamivir is recommended for influenza A and B . (Strong recommendation; level I evidence.)

Use of oseltamivir and zanamivir is not recommended for patients with uncomplicated influenza with symptoms more than 48 h (level I evidence), but these drugs may be used to reduce viral shedding in **hospitalized** patients or for **influenza pneumonia**. (Moderate recommendation; level III evidence.)

Antiviral drugs against COVID-19 e.g. Favipiravir should be used in case of confirmed cases.

- Patients should demonstrate some improvement in clinical parameters **by 72 hours**, although fever may persist with lobar pneumonia.
- **Cough** from pneumococcal pneumonia may not clear for a week.
- Abnormal **chest radiograph** findings usually clear within **four weeks** but may persist **for 7- 12 weeks** in older individuals and those with underlying pulmonary disease



Switch to oral therapy

Criteria:

- Improvement of cough + Dyspnoea.
- Afebrile on two occasions 8h apart..
- ↓ Of white cell count.
- Functioning GIT. with adequate oral intake.

Duration of Therapy

There is no evidence to guide treatment length, but consensus suggests

- 5-7 days—non-severe, uncomplicated pneumonia
- 10 days—severe ,microbiologically undefined pneumonia
- 14-21 days—if Legionella, staphylococcal disease, Gram-negative suspected

Patient can be discharged home if all the following criteria:

- Curb score 0-1 , PSI score Class I
- Able to eat and drink
- Pulse ≤ 100 beats per min
- Respiratory rate ≤ 30 per min
- Normal Systolic blood pressure according to the age and BP baseline .
- Oxygen saturation ≥ 94 percent or if the resident had chronic obstructive pulmonary disease (COPD) ≥ 90 percent.
- Social support and home care .

Strategies for Prevention of CAP

- Cessation smoking

- Influenza Vaccine

It offers 90% protection and reduces mortality by 80%

- Pneumococcal Vaccine (Pneumonia shot)

It protects against 23 types of Pneumococci

70% of us have Pneumococci in our RT

It is not 100% protective but reduces mortality

Age 19-64 with co morbidity of high risk for pneumonia

Above 65 all must get it even without high risk

- Starting first dose of antibiotic within 4 h & O₂ status



Incorrect or incomplete antimicrobial treatment

- Underlying antibiotic resistance
- Inadequate dose/duration
- Non-adherence
- Malabsorption

Complication of community-acquired pneumonia

- Parapneumonic pleural effusion (exudative)
- Empyema
- Lung abscess

Underlying neoplastic lesion or other lung disease

- Obstructing lesion
- Bronchoalveolar cell carcinoma
- Bronchiectasis
- Tuberculosis

Alternative diagnosis

- Pulmonary thromboembolic disease
- Cryptogenic organizing pneumonia
- Eosinophilic pneumonia
- Pulmonary haemorrhage

CAP – Complications

- Hypotension and septic shock
- 3-5% Pleural effusion; Clear fluid + pus cells
- 1% Empyema thoracis pus in the pleural space
- Lung abscess – destruction of lung - CSLD

Single (aspiration) anaerobes, *Pseudomonas*

Multiple (metastatic) *Staphylococcus aureus*

- Septicemia – Brain abscess, Liver Abscess
- Multiple Pyemic Abscesses

CAP – So How Best to Win the War?

- Early antibiotic administration within 4-6 hours
- Empiric antibiotic Rx. as per guidelines (IDSA / ATS)
- CURB – 65 scoring and Classification of cases
- Early hospitalization if needed
- Change Abx. as per pathogen & sensitivity pattern
- Arterial oxygenation assessment in the first 24 h
- Blood culture collection in the first 24 h prior to Abx.
- Pneumococcal & Influenza vaccination; Smoking **X**

The image features a solid blue background. On the left side, there is a vertical red bar with a white border. In the center of the blue area, there is a large red oval with a thin black outline. Inside this red oval, the text "HAP & VAP" is written in a bold, white, sans-serif font.

HAP & VAP

Risk Factors for MDR Pathogens

Antimicrobial therapy in the preceding 3 months

Present hospitalization of ≥ 5 days

High frequency of antibiotic resistance in the community or in the specific hospital unit

Hospitalization for ≥ 48 h in the preceding 3 months

Home infusion therapy including antibiotics

Home wound care

Chronic dialysis within 1 month

Family member with MDR pathogen

Immunosuppressive drug and/or therapy

Initial empirical antibiotic treatment in nosocomial pneumonia and VAP of early onset in patients without risk factors for infection by MDR pathogens

Probable pathogen	Recommended antibiotic
Streptococcus pneumoniae	Ceftriaxone OR
Haemophilus influenza	Levofloxacin , moxifloxacin OR
Methicillin sensitive staph	Ampicillin/sulbactan OR
Enreric gram negative bacilli E.coli klebsiella pneumoniae enterobacter spp proteus spp serratia marcescenes	Ertapenem

Initial empirical antibiotic treatment in nosocomial pneumonia and VAP of late onset or in patients with risk factors for infection by MDR pathogens

Probable pathogen	Combined antibiotic treatment
<p>Those of previous tables plus :</p> <p><i>Pseudomonas aeruginosa</i></p> <p><i>Klebsiella pneumonia</i> (ESBL-positive)</p> <p><i>Acinetobacter</i> spp</p> <p>Other non fermenting GNB</p> <p>Methacillin resistant staph</p> <p><i>Legionella pneumophilla</i></p>	<p>Antipseudomonal cephalosporin (ceftazidime or cefepime)</p> <p>OR</p> <p>Carbapenem (imipenem , meropenem)</p> <p>OR</p> <p>Beta lactam / beta lactamase inhibitor (piperacillin-tazobactam)</p> <p>+</p> <p>Antipseudomonal fluoroquinolone (ciprofloxacin , levofloxacin)</p> <p>OR</p> <p>Aminoglycoside (amikacin)</p> <p>+,-</p> <p>Linezolid or vancomycin</p>

Thank You All

