# PNEUMONIA

**By**

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Lecturer of chest disease

# DEFINITION

- Syndrome caused by acute infection of the lung parenchyma characterized by clinical and radiological signs of consolidation of parts or part of one or both lungs.

# CLASSIFICATION

Anatomical:

1. Lobar (confluent)
2. Segmental (corresponding to anatomy of a segment)
3. Bronchopneumonia (lobular, patchy, non-confluent)

# CLINICAL:

1. Community acquired pneumonia (CAP) à typical or atypical.
2. Hospital acquired pneumonia (HAP) à mostly by: pneumococci, staphylococcus aureus, anaerobic organisms (all early more) or G-ve, MDR pathogens, MRSA (later) à early onset within 4 days of admission or late onset in > 5ds.
3. Ventilator acquired pneumonia (VAP).

| | Typical organisms | Atypical organisms |
|---|---|---|
| Onset | Sudden | Gradual |
| Myalgias, headache, photophobia | Rare and mild but with old age → confusion, somnolence, lost mental act. | Common, prominent and begin with URTI or Flu-like symptoms |
| Cough | Dry → Productive (rusty brown) ± blood stained | Non-productive and scanty |
| Pleuritic pain | Common | Rare |
| Fever | >39.9˚C (absent in old age) | <39˚C |
| Local signs | Dullness + bronchial | Often minimal |
| *Non classical presentation can occur with age, pre-existing LRTI, early use of antibiotics | | |
| x-ray | Focal alveolar or lobar infiltration (confluent) | Diffuse interstitial infiltration (Bpn.) |

4. Aspiration pneumonia
5. Pneumonia in immuno-compromised patients
6. Recurrent pneumonia
7. Unresolved pneumonia

- **Etiological:** (infectious and non infectious)

  1. ***Bacterial:*** (first six forms are the most common)

     - **Pneumococcal pneumonia** (typical): in ♂>♀; has 2 forms:

| Diffuse form | Segmental form |
|---|---|
| One lobe (most common)<br>More than one lobe (10-15%)<br>All the lung (<1%) | More in Children or<br>Elderly (higher M.R.) or<br>with Chronic lung disease |

- **Staphylococcal pneumonia:** more to occur in children, bilateral forming pneumatoceles (abscess surrounded by consolidation) and cavitations, mostly severe and progress to sepsis with weak response to antibiotics → *M.R.*: 25-50%
- **H. influenza pneumonia:** capsulated form is more to cause pneumonia & encapsulated form can cause bacterial or non-bacterial pneumonias.
- **G-ve enteric pneumonia:** more with aspiration → Rt > Lt.

- **Atypical pneumonia** (bronchopneumonia): see before

- **Legionella**: has 30 species and 11 serotypes (most common here are 1, 4, 6) → has no man to man infection and mostly occurs in immuno-compromised patients with Pontiac fever (flu-like) and *Bradycardia* → unilateral > bilateral (only in severe cases) → *M.R:* 5-80% (immunity?)
- **Mycoplasma:** bacteria with no cell wall, I.P = 3 wks.
- **Chlamydia:** in LL > UL, 12% bilateral, characterized by inclusion bodies detected intracellular (in MQ) and affects RES 1st, I.P = 1-2 wks.
- **Rickettsia**
- **Coxiella burnetti:** mainly affecting sheep and cattle, rarely humans in LL > UL intracellular, with rare man to man infection, I.P = 20ds-2wks.

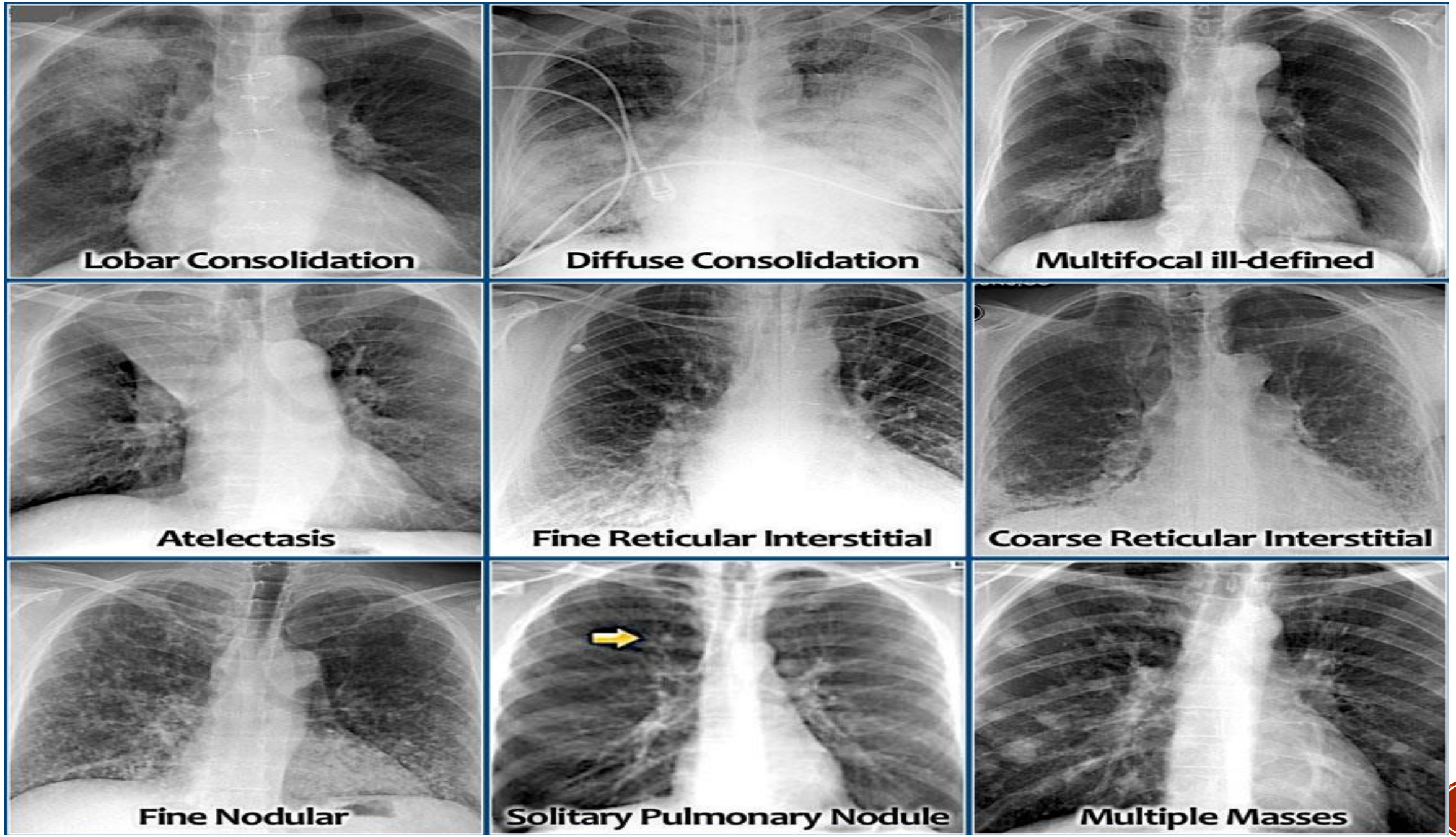
- **Klebsilella:** have 4 species → mostly unilateral pneumonia, *M.R.* 70%
- **Pseudomonas aeroginosa:** motile bacteria → bilateral pneumonia, "
- **E.Coli:** motile facultative anaerobe → mostly bilateral, *M.R.* 30%
- **Enterobacterecea**
- **Serratia**

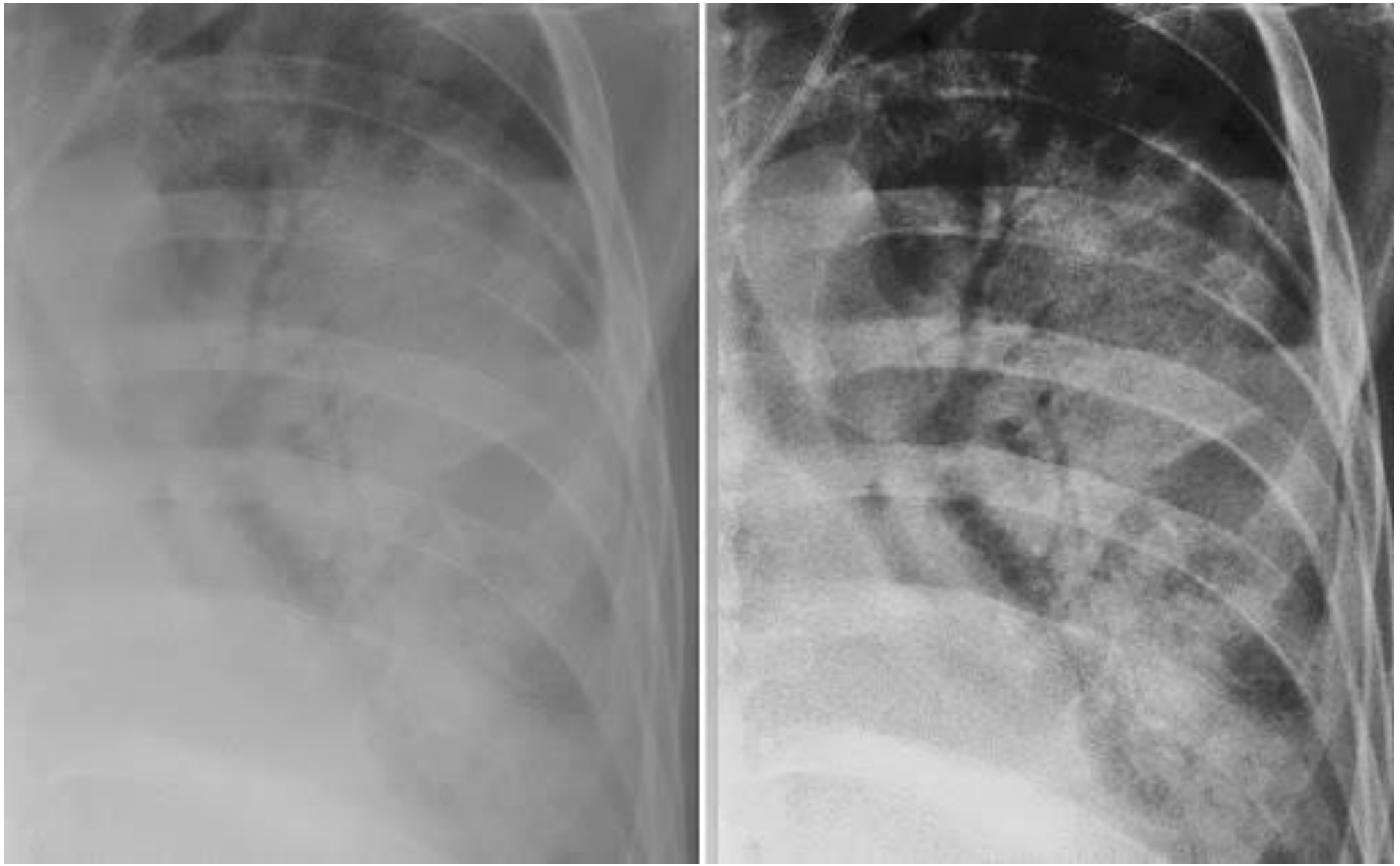
3. *Parasitic*

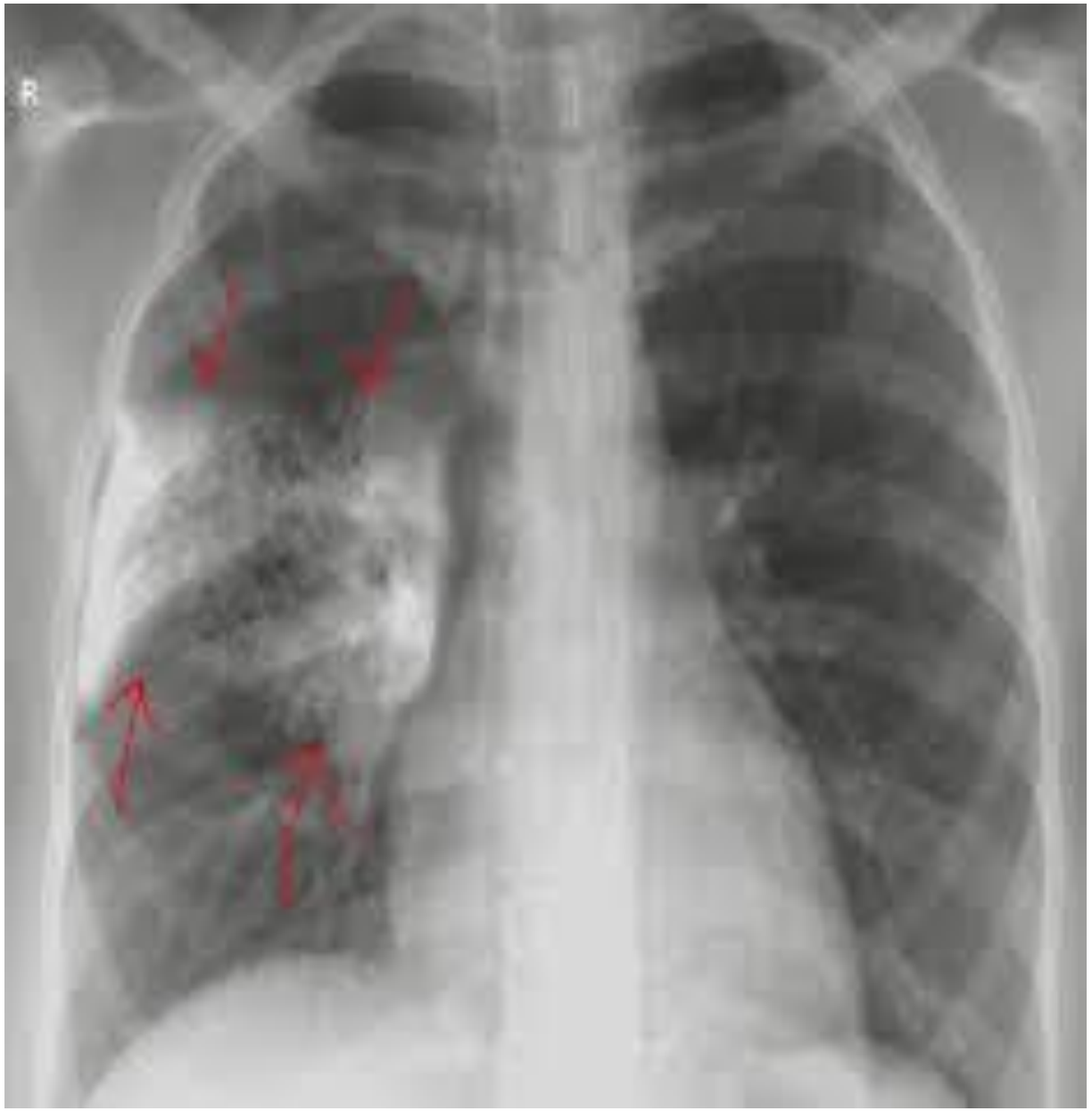
4. ***Fungal:*** pneumocystis carinii & others mainly in IC patients

5. ***Non- infectious causes:***

   - **Chemical (lipoid):** see later
   - **Physical (ionizing radiation):** see later
   - **Malignancies**


Lobar Consolidation
Diffuse Consolidation
Multifocal ill-defined
Atelectasis
Fine Reticular Interstitial
Coarse Reticular Interstitial
Fine Nodular
Solitary Pulmonary Nodule
Multiple Masses

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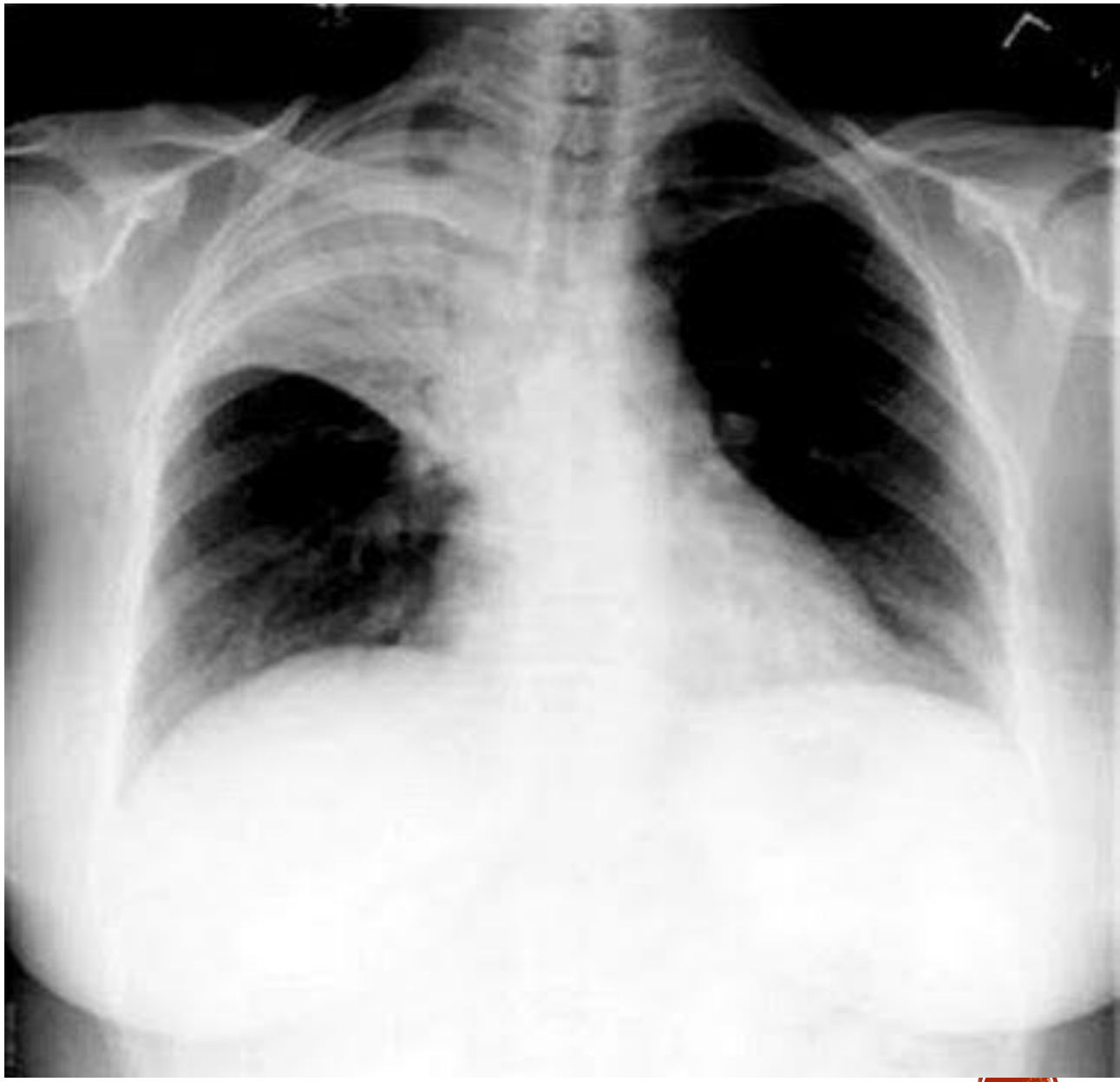
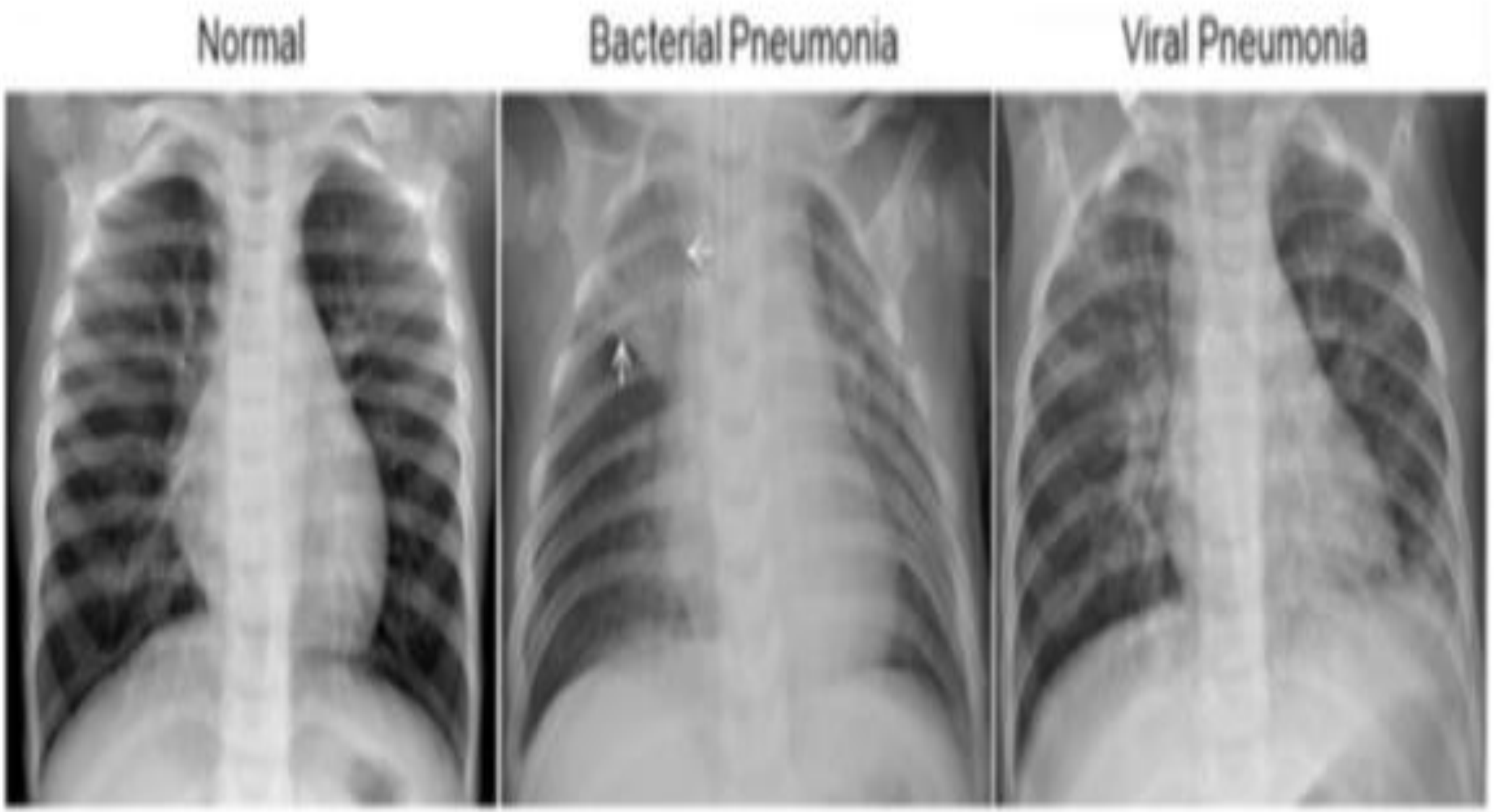
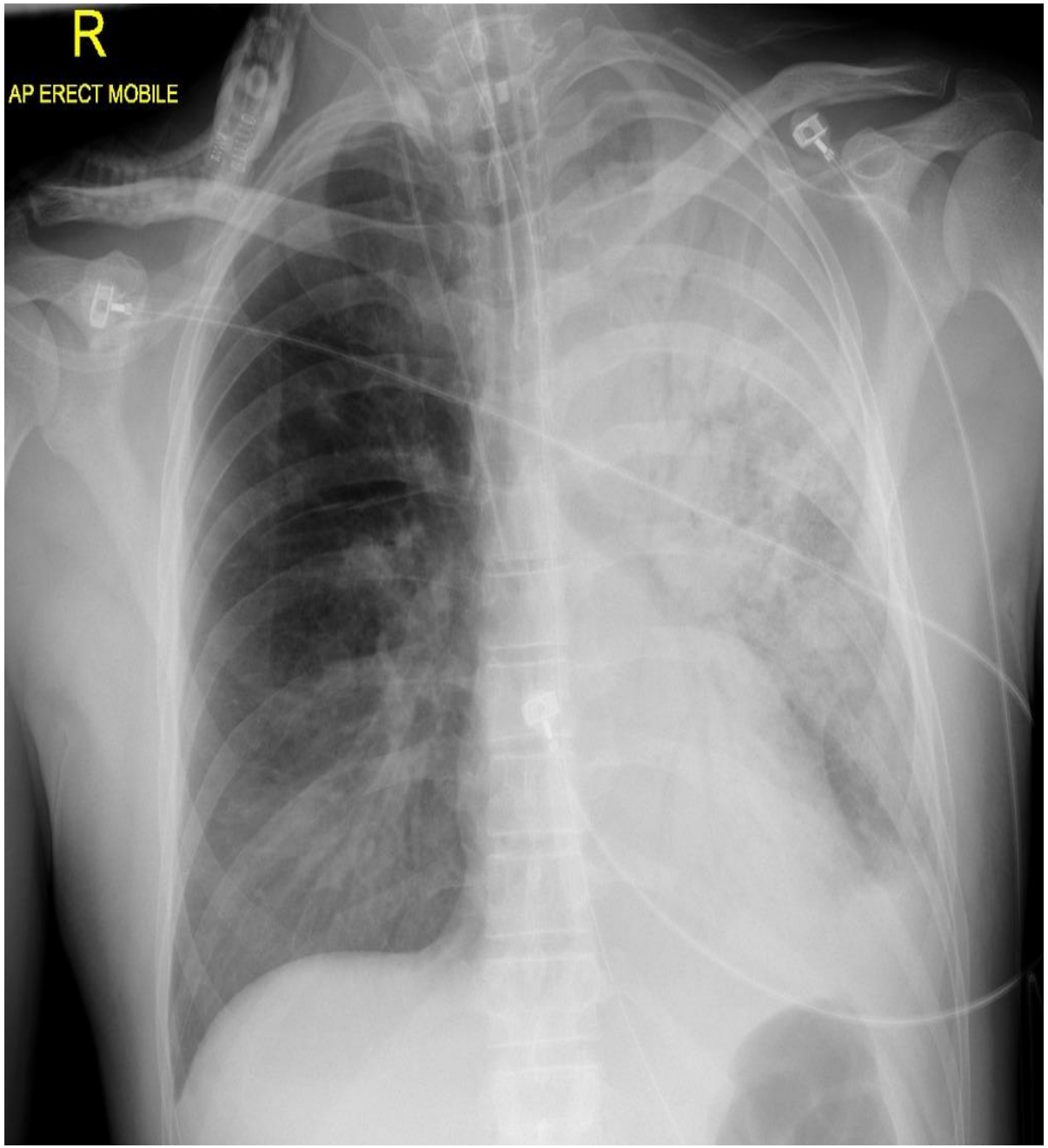



Normal
Bacterial Pneumonia
Viral Pneumonia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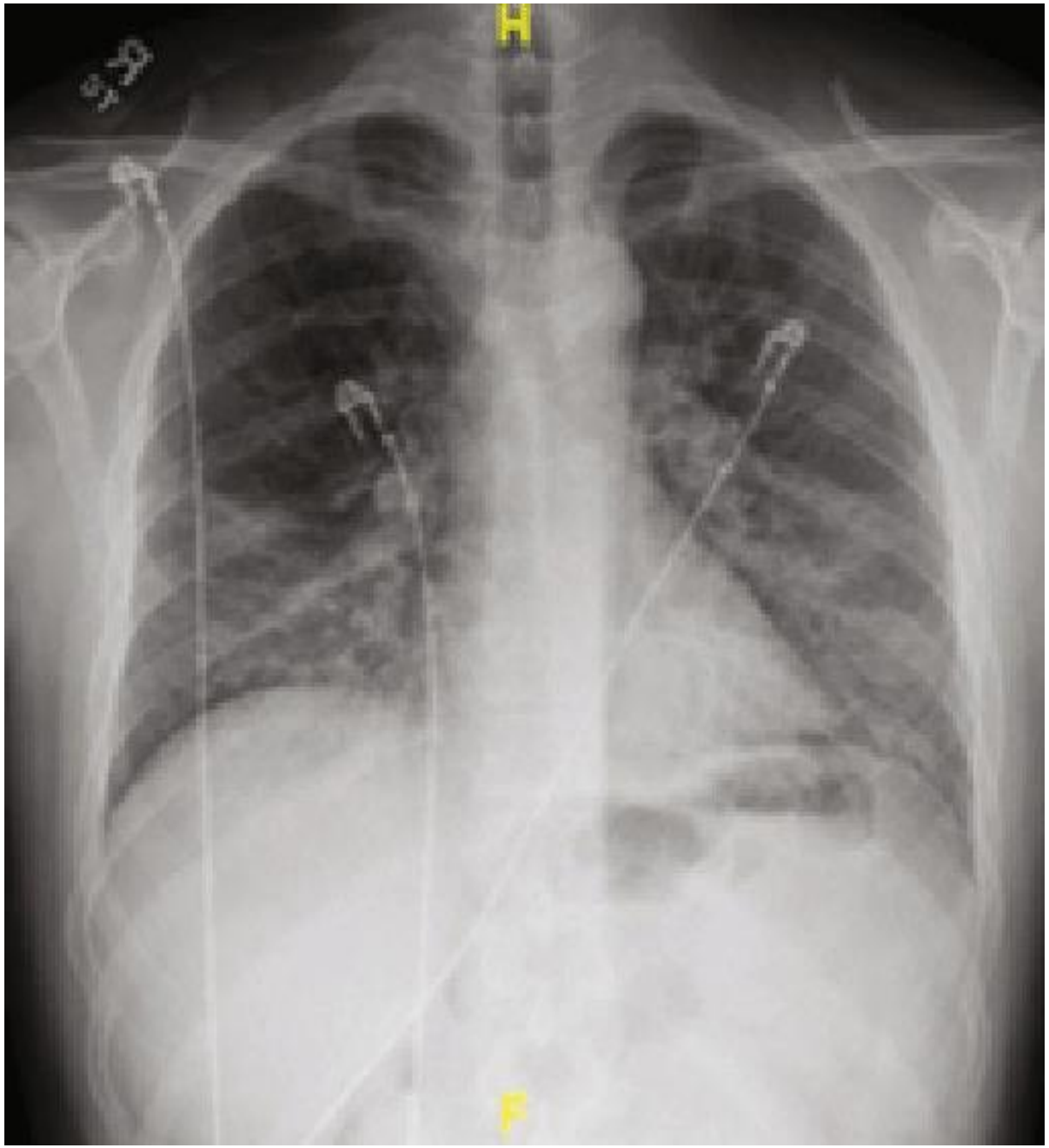
AP ERECT MOBILE


H
F

# -ROUTES OF INFECTION:

- **1. Aspiration:**

more to occur with G-ve organisms in HAP and with anaerobes or pneumococci or H. influenza in CAP leading to:

- a. Chemical injury ± pulmonary edema up to ARDS caused by the gastric acid.
- b. Asphyxia caused by large solid particles.
- c. Bronchial or segmental obstruction with atelectasis caused by small solid particles.

**2. Inhalation:** either by:

a. Patient to patient contact (direct, droplet spread or through infected fomites) à with all organisms and viruses

b. Through contaminated nebulizer or ventilator.

c. In the aerosol particles à mainly viruses, TB and legionella

d. In spores àin coxiella

3. **Colonization:** with associated chronic lung diseases (G-ve org.)

4. **Hematogenous:** in metastatic pneumonia as G-ve org. or staph.

5. **Direct spread:** from adjacent infection

6. **Feco-oral:** in adenovirus & coxiella mainly (milk)

7. **Bird contact:** with chlamydia psittaci and avian flu

# EPIDEMIOLOGY:

1. Incidence: 1-10/1000
2. Age: more in infants and elderly
3. Risk factors:

o In pseudomonas: 5% are carriers (mainly in HAP)

o In pneumococcus: 70%

o In staphylococci: 15%, ñ in addicts, D.M, hemodialysis

# PREDISPOSING FACTORS:
# VIRULENT ORG. IS ADDED TO ALL CAUSES OF PN

**Ø For CAP:**

1. Winter season > summer
2. Low socioeconomic groups
3. Cold weather (in adults)
4. RSV (in children)
5. Spleenectomy patients (ñ pneumococcal pn. ± DIC)
6. Low defense mechanisms

## Ø For HAP:

1. Patient related:

a. Low defenses:

oò Cough reflex

o Impaired muco-ciliary activity (bronchiectasis ..)

oò Phagocytic activity of alveolar MQ and PNLs

o Impaired Ig production

o Altered bacteria flora

oò Immunity

b. High risk groups:

o Ventilated patients (especially in: low conscious level, extremes of age, associated COPD or sinusitis, long stay MV, long hospital stay, re-intubation, nasal intubation, aspiration, supine position)

o Surgical patients (long stay in hospital, in thoraco-abdominal surgeries more).

o Traumatized patients (emergency intubation, head injury, ryle, pulmonary laceration or contusion).

# 2. INFECTION CONTROL RELATED:

a. Poor hand washing
b. No gloves and mask wearing
c. Bad hygiene and care for the patients
d. Inappropriate airway suctioning
e. Poor care for nebulizers, bags, ventilators

3. Doctor related: Interventions: Drugs (mainly

immunosuppresives, H2 blockers, sedatives and Abs as

they can alter normal flora), ETT, Ryle and other maneuvers without proper care and sterile conditions.

# Ø FOR ASPIRATION OR ANAEROBIC INFECTION:

1. Altered conscious level (trauma, sedation, coma…etc.)
2. Dysphagia
3. ò Glottic closure (after intubation –direct or by leakage

around cuff-, ryle or surgery)

4. ò Tone or incompetent esophageal sphincter
5. ñ Gastric pressure
6. NM disorder

# Ø FACTORS THAT Ñ THE RISK OF INFECTION WITH SPECIFIC PATHOGENS

Penicillin-resistant and drug-resistant pneumococci:

1. Age older than 65 Yrs
2. B-Lactam therapy within the past 3 Ms
3. Alcoholism
4. Immune-suppressive illness (including ttt with steroids)
5. Multiple medical co-morbidities
6. Exposure to a child in a day care center

Enteric gram-negatives:

7. Residence in a nursing home
8. Underlying cardiopulmonary disease
9. Multiple medical co-morbidities
10. Recent antibiotic therapy

Pseudomonas aeruginosa:

11. Structural lung disease (bronchiectasis)

12. Corticosteroid therapy (>10 mg of prednisone per day)

13. Broad-spectrum antibiotic therapy for > 7d in the past M.

14. Malnutrition

# PATHOLOGY:

Stages (Laennec's) are:

1. Stage of inflammatory congestion: for about 24 hours, appears as dark red lung due to hyperemia with alveoli filled with hemorrhagic exaudate.

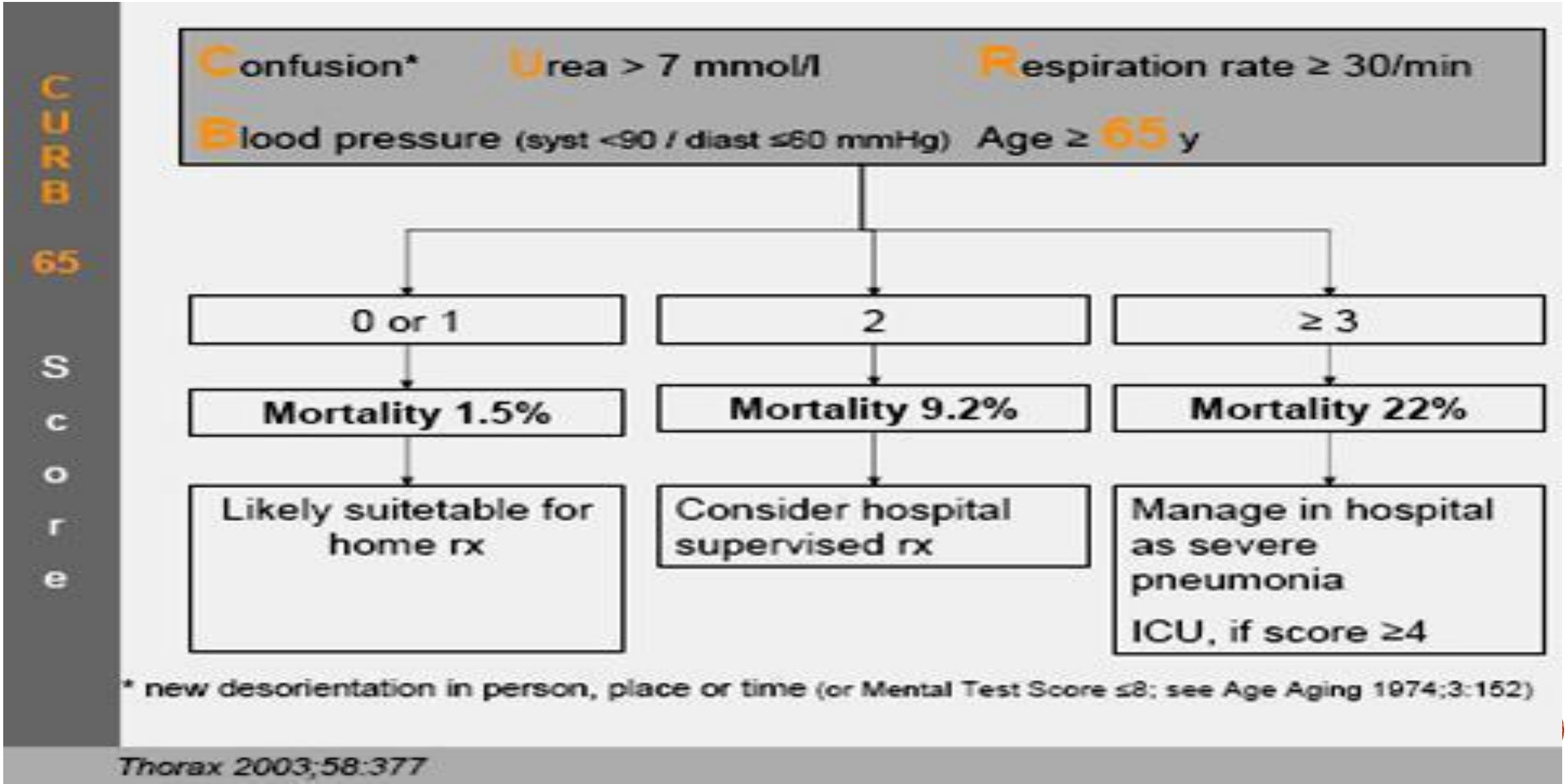
- 2. Stage of red hepatization: fibrinous exaudate coagulates forming a liver like picture (fibrin extends between alveoli with alveoli filled with PNLs, RBCs

3. Stage of grey hepatization: the same as 2 but with fewer RBCs and increased amount of neutrophils.

4. Stage of resolution: complete resolution by crisis occurs in 7- 10ds without antibiotic intake in lobar pneumonia but incomplete resolution by lysis occurs in bronchopneumonia (can take up to 8 wks in chlamydia).

# CLINICAL ASSESSMENT OF PNEUMONIA

# CURB-፷፭:


CURB 65 Score
Confusion* Urea > 7 mmol/l Respiration rate ≥ 30/min
Blood pressure (syst <90 / diast ≤60 mmHg) Age ≥ 65 y
0 or 1
2
≥ 3
Mortality 1.5%
Mortality 9.2%
Mortality 22%
Likely suitetable for home rx
Consider hospital supervised rx
Manage in hospital as severe pneumonia
ICU, if score ≥4
* new desorientation in person, place or time (or Mental Test Score ≤8; see Age Aging 1974;3:152)
Thorax 2003;58:377

# DIFFERENTIAL DIAGNOSIS:

- Pulmonary infarction.
- Atypical pulmonary edema.
- Subphrenic abscess or pancreatitis.
- Pulmonary eosinophilia.
- Bronchoalveolar cell carcinoma.
- Primary and secondary lung tumors.

# INVESTIGATIONS:

A. Laboratory investigations:

1. CBC:

· WBCs:

o Leucocytosis à bacterial & 2/3 of mycoplasmal cases

o Lymphocytosis àviral & atypical pneumonias

o Leucopenia à overwhelming sepsis in IS pts, viral pn.

o Eosinophilia à parasitic, allergic, fungal

o Normal àelderly & coxiella

· RBCs: anemia can occur in bacteremia.

· Platelets: decrease in DIC and avian flu sometimes

# D. RADIOLOGICAL INVESTIGATIONS:

1. Homogeneous hazy shadowing: density according to the intensity of exudation à either patchy (non confluent) or confluent.

2. Miliary/Interstitial: viruses, mycoplasma, TB, fungi.

3. Cavitations: in necrotizing pneumonia (staph, klebsiella, pseudomonas, TB, anaerobes, fungi, viruses).

4. Pneumatoceles: in staph pneumonia.

5. Bowing fissure: in klebsiella due to increased lobar edema.

6. Coin shape lesion: in coxiella.

7. Pseudo tumor: in coxiella.

8. Linear atelectasis: in coxiella.

9. Calcifications: in TB, fungal & chicken pox pneumonias.

10. LN++: TB, viruses, atypical cases.

11. Follow up: improvement is detected 2-4 weeks after clinical improvement à if persistent it's a kind of unresolved pneumonia and may need bronchoscopy.

12. Detect complications.

13. Normal: sometimes in chlamydia as bronchitis > pneumonia.

# TREATMENT:

# A. PREVENTION: PREVENT RISK FACTORS MAINLY OF CAP:

**CAP: Prevention in immunocompetent pts**

| recommendation | indication |
|---|---|
| Influenza vaccination<br>1x/y | ▪ >65y<br>▪ living in long-term facilities<br>▪ health-care workers<br>▪ chronic disease (heart, kidney, lung, liver,diabetes)<br>▪ pregnancy 2°/3° trimenon |
| Pneumococcal vaccination<br>23-valent vaccine; repeat after 5-10y | ▪ >65y<br>▪ living in long-term facilities<br>▪ dementia; epilepsia<br>▪ chronic disease (heart, kidney, lung, liver,diabetes)<br>▪ functional/anatomical asplenia<br>▪ liquorrhoea |
| smoking cessation | |

***For healthy outpatient adults without comorbidities***

**Aamoxicillin** 1 g three times daily (strong recommendation, moderate quality of evidence), or

**Doxycycline 100** mg twice daily (conditional recommendation, low quality of evidence), or

**Mmacrolide** (azithromycin 500 mg on first day then 250 mg daily or clarithromycin 500 mg twice daily or clarithromycin extended release 1,000 mg daily) only in areas with pneumococcal resistance to macrolides ,25%.

***For outpatient adults with comorbidities such as chronic heart, lung, liver, or renal disease; diabetes mellitus; alcoholism; malignancy; or asplenia*** (in no particular order of preference)

***Combination therapy:***

***Amoxicillin/clavulanate, or a cephalosporin*** (cefpodoxime 200 mg twice daily or cefuroxime 500 mg twice daily);

AND

***Macrolide*** (azithromycin 500 mg on first day then 250 mg daily, clarithromycin [500 mg twice daily or extended release 1,000 mg once daily]), or doxycycline 100 mg twice daily (conditional

OR

***Monotherapy:***

B respiratory fluoroquinolone (levofloxacin 750 mg daily, moxifloxacin 400 mg daily, or gemifloxacin 320 mg daily).

***In inpatient adults with non-severe CAP without risk factors for MRSA or P. aeruginosa*** (in no order of preference)

1- Combination therapy with a b-lactam (ampicillin1sulbactam 1.5–3 g every 6 h, cefotaxime 1–2 g every 8 h, ceftriaxone 1–2 g daily, or ceftaroline 600 mg every 12 h) and a macrolide (azithromycin 500 mg daily or clarithromycin 500 mg twice daily) (strong recommendation, high quality of evidence),

or

2- Monotherapy with a respiratory fluoroquinolone (levofloxacin 750 mg daily, moxifloxacin 400 mg daily) (strong recommendation, high quality of evidence).

# GROUP IV: ICU-ADMITTED PATIENTS: ^,†

| Organisms | Therapy_, ‡ |
| --- | --- |
| **a. No Risks for *Pseudomonas aeruginosa:*** | |
| **-Streptococcus pneumoniae**(including DRSP)<br>**-Legionella** spp.<br><br>**-Hemophilus influenza**<br><br>**-Enteric gram-negative bacilli**<br>**-Staphylococcus aureus**<br><br>**-Mycoplasma pneumoniae**<br><br>**-Miscellaneous**<br>Chlamydia pneumoniae,<br>Mycobacterium tuberculosis,<br>endemic fungi | **Intravenous B-Lactam**<br><br>(cefotaxime,ceftriaxone)§<br>*plus either*<br>**Intravenous macrolide** *OR*<br>**Intravenous fluoroquinolone** |

**b. Risks for *Pseudomonas aeruginosa*:**

All of the above pathogens **plus**
**-P. aeruginosa**

Selected intravenous **antipseudomonal B-lactam** (cefepime, imipenem, meropenem, piperacillin/tazobactam)#
*plus*
**Intravenous antipseudomonal quinolone** (ciprofloxacin)
*OR*
Selected intravenous **antipseudomonal B-lactam**
*Plus*
**Intravenous aminoglycoside**
*plus either*
**Intravenous macrolide** *or*
**Intravenous nonpseudomonal fluoroquinolone**

# *DURATION OF THERAPY:

Total duration of treatment of CAP, may be 10-14 days or 5 days after disappearance of fever (2 weeks in legionella or Staph pneumonia).

***Criteria for Switch Therapy:**

- No clinical indications for continuing IV therapy.
- No abnormal GI absorption.
- Patient afebrile.
- Cough& respiratory distress improved.
- WBC returning to normal

# *RESPONSE TO TREATMENT:

Adequate clinical response:

– Clinical improvement within 48-72 h (ATS, ERS)

– Subjective response within 1-3 days (IDSA).

– Fever usually persists for longer than other signs and symptoms

# CLINICAL RESOLUTION CAN BE DELAYED BY:

- Old age
- Comorbidity
- Severe infection
- Other host factors.

# TREATMENT FAILURE:
# NO RESPONSE IN 2WKS CLINICALLY & 4 WKS RADIOLOGICALLY

Patient fails to respond or deteriorates following initial therapy

| ***Incorrect diagnosis*** | | ***Correct diagnosis*** | |
|---|---|---|---|
| Other conditions | Host | Drug | Pathogen |
| Congestive heart failure<br>Embolus<br>Neoplasm<br>Sarcoid<br>Drug reaction<br>Hemorrhage | Local factors (e.g., obstruction, foreign body)<br>Inadequate host response<br>Complication (e.g., pulmonary superinfection, empyema) | Error in drug selection<br>Error in dose or route<br>Compliance<br>Adverse drug reaction | Drug-resistant organism<br>Other pathogen |

# THANK YOU