

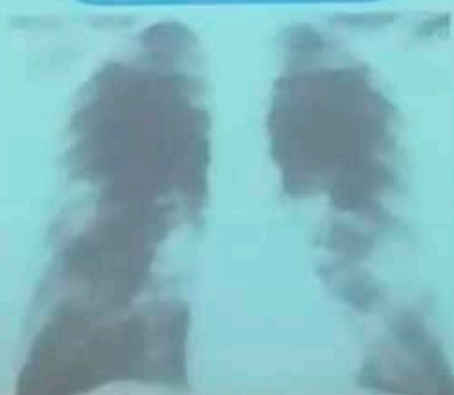
LOBAR PNEUMONIA

Non-segmental
Homogeneous
consolidation
involving one
lobe



BRONCHO PNEUMONIA

Patchy
appearance,
Peribronchial
thickening
Poorly defined
air-space
opacities.



DIFFUSE alveolar PNEUMONIA

Bilateral diffuse
infiltrates ON
CHEST
Radiograph
similar to ARDS



Settings

According to mechanisms of acquisition

According to causative agent

Settings

Community acquired

Institutional(health care/nursing/home setting)

Nosocomial (HAP/VAP)

According to mechanisms of acquisition

Aspiration associated

Ventilator associated

According to causative agent

Settings

- Community acquired
- Institutional(health care/nursing/home setting)
- Nosocomial (HAP/VAP)

According to mechanisms of acquisition

- Aspiration associated
- Ventilator associated

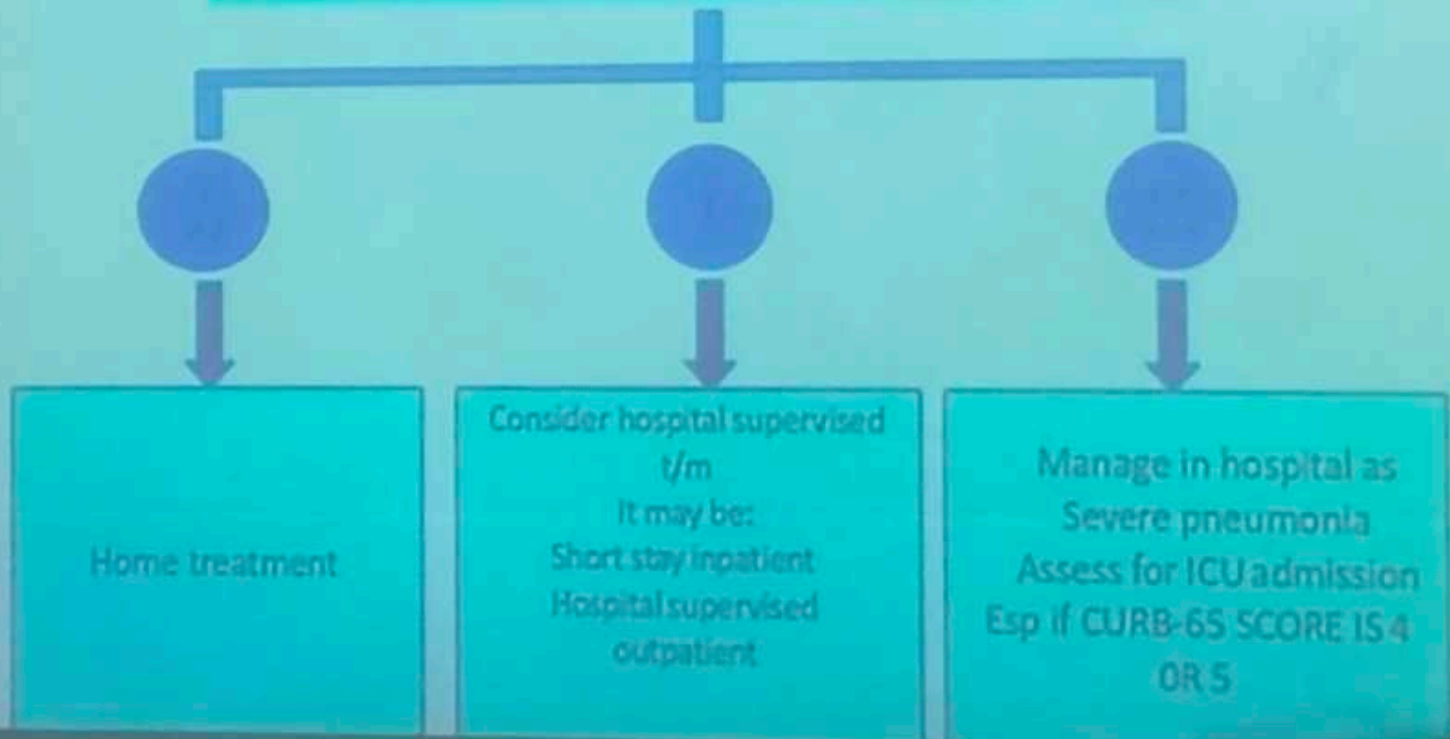
According to causative agent

- Typical pneumonia
- Atypical pneumonia

Management

RISK STRATIFICATION

Any of:
Confusion
Urea > 7mmol/l
Respiratory rate > 30/min
Blood pressure (systolic < 90mmHg or diastolic < 60mmHg)
Age > 65 years



Supportive Measures

- Analgesia and antipyretics
- Chest physiotherapy
- Intravenous fluids (and, conversely, diuretics) if indicated
- Monitoring – Pulse oximetry with or without cardiac monitoring, as indicated
- Oxygen supplementation
- Positioning of the patient to minimize aspiration risk
- Respiratory therapy, including treatment with bronchodilators and *N*-acetylcysteine
- Suctioning and bronchial hygiene
- Ventilation with low tidal volumes (6 mL/kg of ideal body weight)

Case Scenario

A 39 years old male presented in ER with high grade fever, productive cough with greenish sputum and myalgias for last 4 days followed by left sided chest pain which increases respiration .

On Examination: He is alert and oriented in time and place . He is febrile, has tachycardia BP of 120/80, Respiratory rate of 24/min and SPO₂ of 94% at room air .

Chest X RAY: left lower lobe consolidation and urea of 5mmol

Empiric antibiotics for CAP

Outpatient management

1. For previously healthy patients who have not taken antibiotics within the past 3 months:
 - a. A macrolide (clarithromycin, 500 mg orally twice a day, or azithromycin, 500 mg orally as a first dose and then 250 mg orally daily for 4 days, or 500 mg orally daily for 3 days), or
 - b. Doxycycline, 100 mg orally twice a day.
2. For patients with comorbid medical conditions, use of immunosuppressive drugs; or use of antibiotics within the previous 3 months

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b. Doxycycline, 100 mg orally twice a day.

2. For patients with comorbid medical conditions, use of immunosuppressive drugs; or use of antibiotics within the previous 3 months

a. A respiratory fluoroquinolone plus a beta-lactam (amoxicillin, 1 g orally three times a day; amoxicillin-clavulanate, 2 g orally twice a day are preferred to cefpodoxime, 200 mg orally twice a day; cefuroxime, 500 mg orally twice a day).

Case Scenario

A 59 years old male presented in ER with high grade fever, productive cough with greenish sputum and myalgias for last 4 days followed by left sided chest pain which increases respiration .

On Examination: He is alert and oriented in time and place . He is febrile, has tachycardia BP of 120/80, Respiratory rate of 34/min and SPO2 of 94% at room air .

Chest X RAY: left lower lobe consolidation and urea of 5mmol

Inpatient management not requiring intensive care

1. A respiratory fluoroquinolone For intravenous therapy, moxifloxacin, 400 mg daily; levofloxacin, 750 mg daily; ciprofloxacin, 400 mg every 8–12 hours
2. A macrolide plus a beta-lactam. For intravenous therapy, ampicillin, 1–2 g every 4–6 hours; cefotaxime, 1–2 g every 4–12 hours; ceftriaxone, 1–2 g every 12–24 hours.

Case Scenario

A 59 years old male presented in ER with high grade fever, productive cough with greenish sputum and myalgias for last 4 days followed by left sided chest pain which increases respiration .

On Examination: He is alert and oriented in time and place . He is febrile, has tachycardia BP of 80/50, Respiratory rate of 34/min and SPO₂ of 94% at room air .

Chest X RAY: left lower lobe consolidation and urea of 9 mmol

Inpatients in ICU

1. Azithromycin or a respiratory fluoroquinolone plus an antipneumococcal beta-lactam (cefotaxime, ceftriaxone, or ampicillin-sulbactam, 1.5–3 g every 6 hours).
2. For patients allergic to beta-lactam antibiotics, a fluoroquinolone plus aztreonam (1–2 g every 6–12 hours).
3. For patients at risk for Pseudomonas infection:

Inpatients in ICU

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2. For patients allergic to beta-lactam antibiotics, a fluoroquinolone plus aztreonam (1–2 g every 6–12 hours).
3. For patients at risk for Pseudomonas infection:
 - a. An antipneumococcal, antipseudomonal beta-lactam (piperacillin-tazobactam, imipenem, meropenem) plus moxifloxacin or levofloxacin
 - b. The above beta-lactam plus an aminoglycoside (gentamicin, tobramycin, amikacin) or azithromycin or a respiratory fluoroquinolone.

- Give 1st dose Antibiotics in ER (no specified time frame)
- Switch from IV to oral when pts are hemodynamically stable and clinically improving
- Discharge from hospital:
 - As soon as clinically stable, no active medical problems
- Duration of therapy is usually 7-10 days:
 - Treat for a minimum of 5 days
 - Before stopping therapy: afebrile for 48-72 hours, hemodynamically stable, RR <24, O2 sat >90%, normal mental status
 - Treat longer if initial therapy wasn't active against identified pathogen; or if complications (lung abscess, empyema...)

Treatment of specific organism

- H.influenzae: 2nd or 3rd gen cephalosporin
- Mycoplasma: macrolide, doxycycline or quinolones
- Legionella: macrolide, doxycycline or quinolones
- Coxiella brunetti: doxycycline
- Klebsiella: inj gentamycin 80mg i/v 8hrly/inj ceftazidime
- Staph.aureus: oxacillin, nafcillin/vancomycin/linezolid (if resistant)
- Coccidioidomycosis: mild dz> fluconazole/itraconazole
Severe dz> amphotericin
- Pneumocystis pneumonia: trimethoprim/sulfamethoxazole

Complications

- Parapneumonic effusion
- Empyema
- Lobar collapse (retention of sputum)
- Thromboembolic disease
- Pneumothorax (staph aureus particul)
- Lung abscess
- ARDS
- renal failure
- multiorgan failure
- Ectopic abscess formation (staph)
- Hepatitis, pericarditis, myocarditis, meningoencephalitis)
- Pyrexia (hypersensitivity)
- Parapneumonic effusion

Scenario

A 64-year-old male presented with severe abdominal pain, fever, and dehydration for approximately the last 24 hours

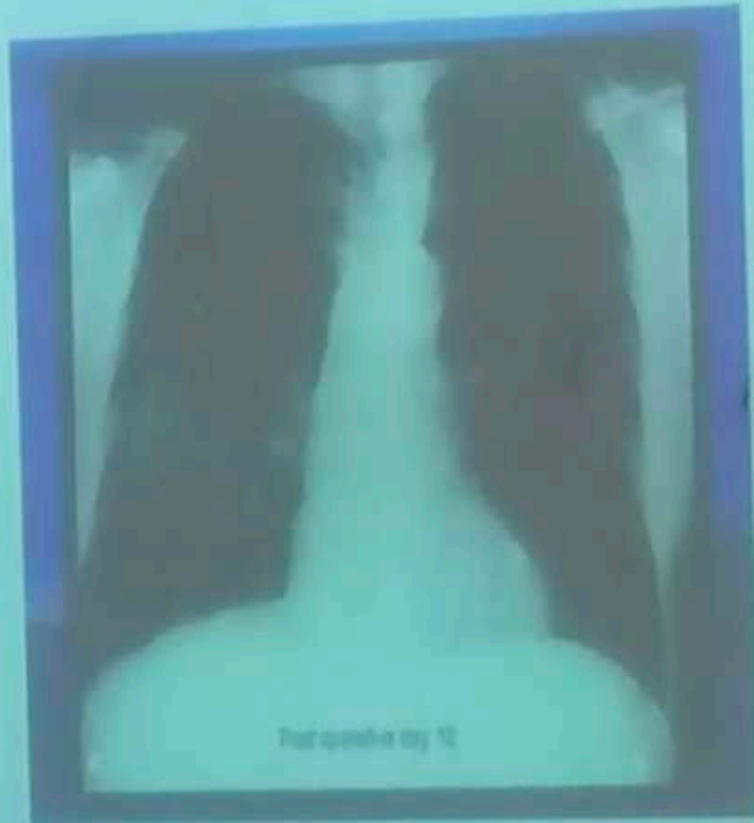
Physical examination: BP 90/60, Temperature 103 C, An abdominal CT scan revealed Appendicitis, and was operated accordingly

On Postoperative day 5 he Developed fever (39.5C) and once again his WBC increased to 12,000 and a brochial breath sounds were audible in right middle chest.

Case presentation

- A chest x-ray at that time revealed a new right mid-lung infiltrate

- Diagnosis?



Nosocomial Pneumonias

➤ **Community-acquired PNA (CAP)**

develops in the outpatient setting or within 48 hrs of admission to a hospital.

➤ **Healthcare-associated PNA (HCAP)**

develops within 48 hours of admission in pts with:

- Hospitalization in acute care hospital for ≥ 2 d in past 90 days.
- Chronic dialysis within 30 days
- Home IV therapy, home wound care in past 30 days
- Family member with MDR pathogen

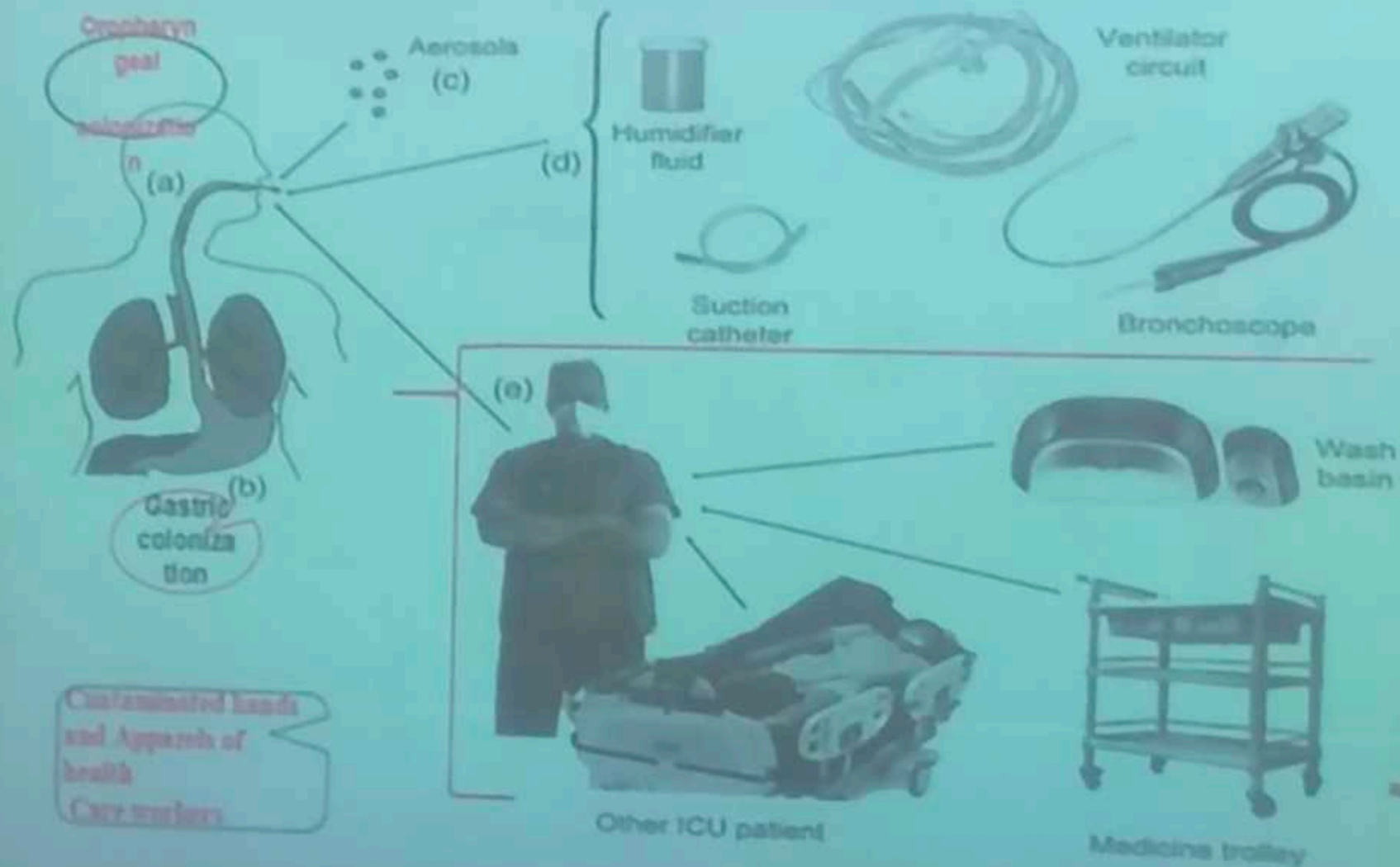
➤ **Hospital-acquired PNA (HAP)**

- Pneumonia ≥ 48 hours after admission

➤ **Ventilator-associated PNA (VAP)**

- Pneumonia ≥ 48 -72 hours after intubation

Source of pathogens For HCAP



Common pathogens associated with HAP

Early onset bacteria pneumonia	
Pathogens	Frequency*
<i>Streptococcus pneumoniae</i>	5 to 20
<i>H. influenzae</i>	<5-15
Late onset bacterial pneumonia:	
Aerobic Gram-negative bacilli: <i>P. aeruginosa</i> <i>Acinetobacter spp</i> <i>K. pneumoniae</i> <i>S. marcescens</i> <i>E. coli</i>	20-60
Gram-positive cocci	20-40
<i>S. aureus</i>	
Early and late onset pneumonia:	
Anaerobic bacteria	0-35
Virus	<1
Fungal	<1

Clinical

- Clinical

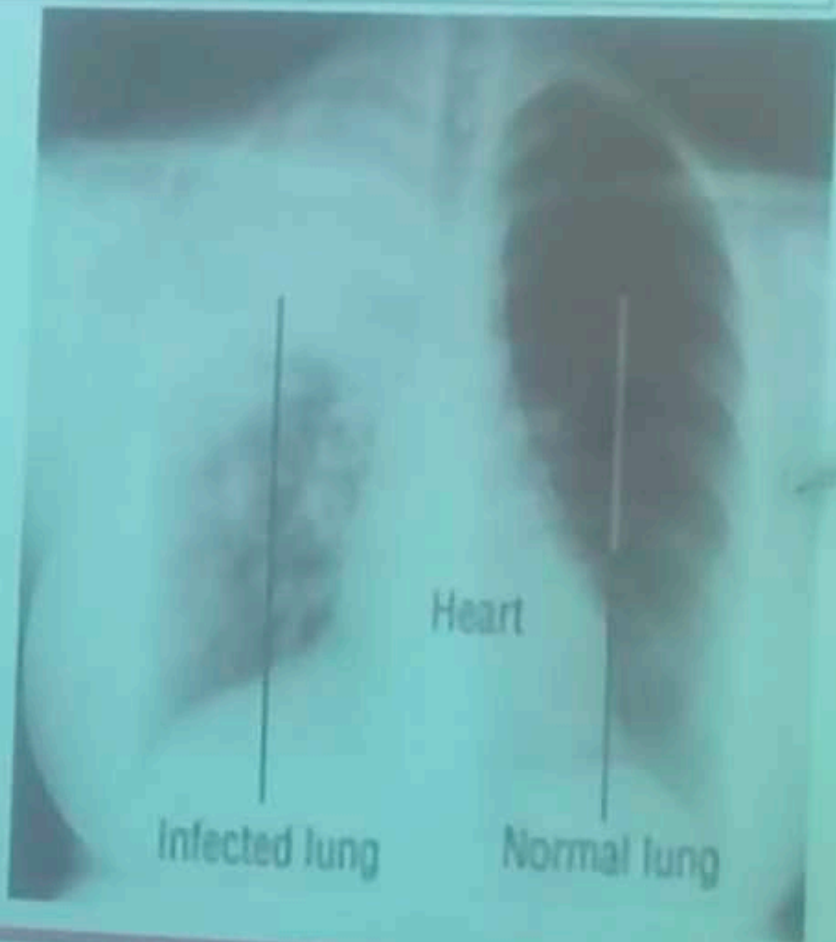
- Fever ($>38^{\circ}\text{C}$)
- Cough with purulent sputum

- Radiographic

- New or progressive infiltrates on Chest X-ray

- Laboratorial

- Leukocytosis or leukopenia (Increase or decrease WBC)



Routiene Labs

CBC

CXR

LDH

Procalcitonin level

Gram stain

Cultures of
Blood

Samples of lower respiratory tract secretion should be obtained including, Endotracheal aspirate, BAL.

Initial empiric therapy for HAP/VAP in patients with risk factors for MDR pathogens and all disease severity

Potential Pathogens

Pathogens listed in Table 3 and MDR pathogens
Pseudomonas aeruginosa
Klebsiella pneumoniae (ESBL⁺)¹
Acinetobacter species²

Methicillin-resistant *Staphylococcus aureus* (MRSA)
*Legionella pneumophila*³

Combination Antibiotic Therapy*

Antipseudomonal cephalosporin
(cefepime, ceftazidime)

or

Antipseudomonal carbapenem
(imipenem or meropenem)

or

β -Lactam/ β -lactamase inhibitor
(piperacillin-tazobactam)

plus

Antipseudomonal fluoroquinolone⁴
(ciprofloxacin or levofloxacin)

or

Aminoglycoside
(amikacin, gentamicin, or tobramycin)

plus

Linezolid or vancomycin⁵

Duration of Therapy

- Efforts should be made to shorten the duration of therapy from the traditional 14 to 21 days to periods as short as 7 to 8 days, provided that the etiologic pathogen is **not *P. aeruginosa***, and that the patient has a good clinical response with resolution of clinical features of Infection.
-



- 68-year-old man presents with History of cough, blood in the sputum, and a 6.8-kg weight loss.

- He had extensive tooth decay and gingival inflammation. Didn't drink alcohol or abuse illicit drugs

- But did take antidepressant which are known to cause somnolence.

- The radiograph shows a cavitary infiltrate in the left lower lobe and an infiltrate in the left upper lobe

RADIOGRAPH - A

50% of healthy persons aspirate during sleep, which usually goes unrecognized, and has no sequelae.

Determinants who gets infection?

⇒ 50% of healthy persons aspirate during sleep, which usually goes unrecognized, and has no sequelae.

⇒ **Determinants who gets infection?**

- Frequency of aspiration,
- Volume of the aspiration,
- Character of the aspirated material,
- Host defenses

Impaired Swallowing

- Head, neck & esophageal cancer, strictures causing dysphagia
- Neurologic diseases: seizures, multiple sclerosis, parkinsonism, stroke, dementia
- COPD
- Mechanical ventilation extubation

Impaired Consciousness

- Neurologic disease: Stroke
- Cardiac arrest
- Medications: Anti-psychotics, narcotics, anti-depressants
- General anesthesia
- Alcohol consumption

Gastric contents reaching lungs

- Reflux
- Tube Feeding (Nasogastric feeding is better than percutaneous enteral feeding)

Impaired cough reflex

- Medications & Alcohol
- Degenerative neurological diseases
- Impaired consciousness

Aspiration

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graph TD; A[Aspiration] --> B[Aspiration pneumonia]; A --> C[Chemical pneumonitis]; B --> D["Infection caused by specific microorganism"]; C --> E[ ]
```

Aspiration pneumonia

Infection
caused by
specific
microorganism

Chemical pneumonitis



• The main isolates are

- *Streptococcus pneumoniae*
- *Staphylococcus aureus*
- *Haemophilus influenzae*
- *Enterobacteriaceae* in community-acquired cases

• Whereas **gram-negative bacilli**, including *Pseudomonas aeruginosa*, were found without anaerobes in hospital-acquired cases

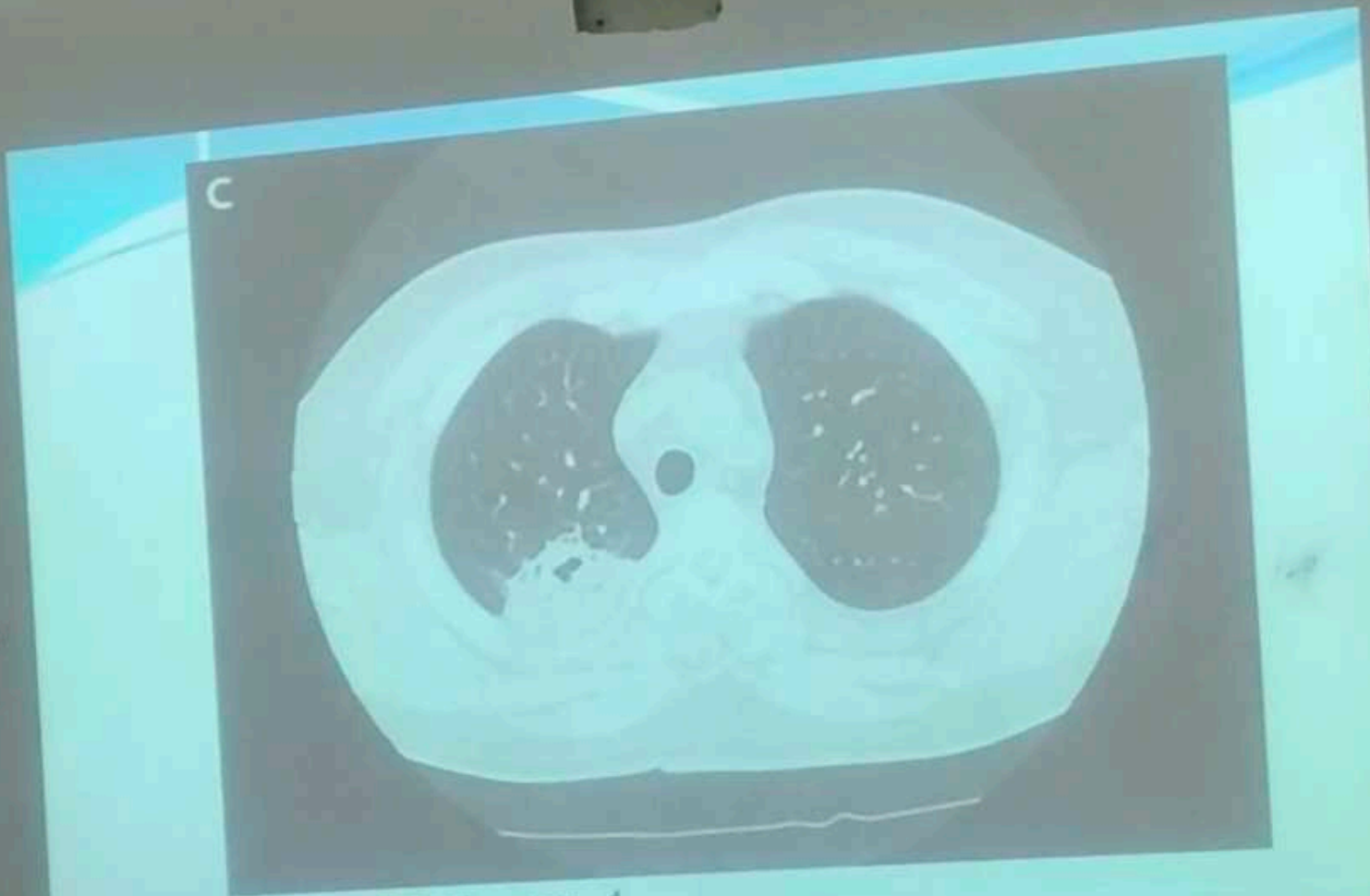
• In cases of poor dental hygiene, the anaerobes isolated are *Porphyromonas gingivalis*, *Treponema denticola*, *Prevotella*,

	ASPIRATION PNEUMONIA	CHEMICAL PNEUMONITIS
ONSET OF SYMPTOMS	HOURS TO A FEW DAYS	SUDDEN ONSET (MINUTES TO HOURS)
SYMPTOMS	FEVER, COUGH WITH EXPECTORATION, TACHYPNEA, SHOCK	DYSPNEA, HYPOXIA, TACHYCARDIA, DIFFUSE WHEEZE (NO FEVER)
CLINICALLY / RADIOLOGICALLY	<p>DEPENDENT BRONCHOPULMONARY SEGMENT INVOLVEMENT</p> <p>(Aspirated while Supine—posterior segment of upper lobe, usually Rt side or <u>superior segments of either or both lower lobes</u>)</p> <p>Aspirated while Upright—Basal lung</p>	B/L OPACITY ON CXR

- ↳ Clinical history (witnessed aspiration) & findings
- ↳ Risk factors
- ↳ Chest X-ray (may be negative in the early course)
- ↳ CT scan of thorax
- ↳ Bronchoalveolar lavage cultures

Handwritten notes on a whiteboard:

card	Movels -
water	and se
flour	40mmHg
60mmHg	25mmHg



CT Thorax -1

Community acquired

1. Beta-lactams-
ampicillin-sulbactam,
amoxicillin-clavulanate,
ceftriaxone

OR

2. Fluoroquinolone
(levofloxacin,
anaerobes)
moxifloxacin)

OR

3. Carbapenem
(ertapenem)

PLUS Clindamycin (If

Hospital acquired or long-term care acquired

Same T/T as that of CAP

But, if risk of MDR,

- Piperacillin-tazobactam,
- Cefepime
- Levofloxacin,
- Carbapenem (meropenem, imipenem)

✚ either Aminoglycoside or Colistin

- If MRSA, then PLUS^d Vancomycin or Linezolid

Table 2. Prevention of Aspiration Pneumonia.

Recommended in the appropriate clinical setting

Antibiotic therapy for 24 hr in comatose patients after emergency intubation

No food for at least 8 hr and no clear liquids for at least 2 hr before elective surgery with general anesthesia

To be considered in the appropriate clinical setting

Swallowing evaluation after stroke and after extubation from mechanical ventilation

Preference for angiotensin-converting-enzyme inhibitors for blood-pressure control after stroke

Oral care with brushing and removal of poorly maintained teeth

Feeding in a semirecumbent position for patients with stroke

Not yet recommended; more data needed

Swallowing exercises for patients with dysphagia after stroke

Oral chlorhexidine in patients at risk for aspiration