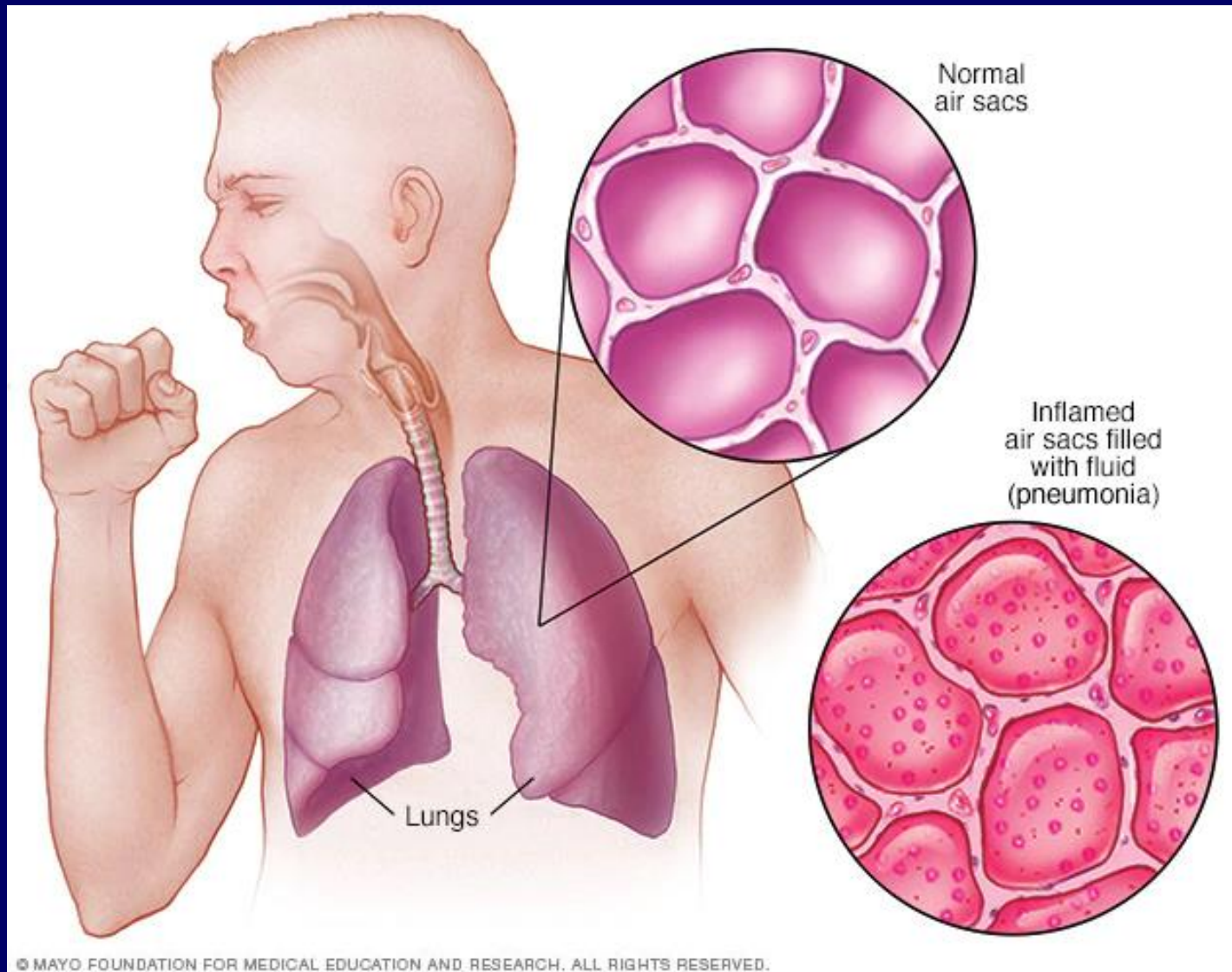


Pneumonia



Overview

- ❑ Pneumonia is common and serious
- ❑ 20% of patients with pneumonia require hospitalization
- ❑ 6th leading cause of death in US
- ❑ Higher rates in winter months
- ❑ More common in men
- ❑ Pneumonia → infection of alveoli (viral or bacterial)
- ❑ Pneumonitis → immune-mediated inflammation of alveoli

Overview

- ❑ Pneumonia is an infection that inflames the air sacs in one or both lungs.
- ❑ The air sacs may fill with fluid or pus → cough with pus, fever, chills, and difficulty breathing.
- ❑ A variety of organisms, can cause pneumonia.
- ❑ Pneumonia can range from mild to life-threatening.
- ❑ It is most serious for infants & young children, age ≥ 65 , and people with health problems or weakened immune systems.

High-risk groups

- ❑ Adults older than age 65
- ❑ Children younger than age 2 with signs and symptoms
- ❑ People with an underlying health condition
- ❑ People receiving chemotherapy or taking medication that suppresses the immune system
- ❑ Being hospitalized
- ❑ Chronic disease
- ❑ Smoking

Symptoms

- ❑ Chest pain when you breathe or cough
- ❑ Confusion or changes in mental awareness (age ≥ 65)
- ❑ Cough, which may produce phlegm
- ❑ Fatigue
- ❑ Fever, sweating and shaking chills
- ❑ Lower than normal body temperature (age ≥ 65 & people with weak immune systems)
- ❑ Nausea, vomiting or diarrhea
- ❑ Shortness of breath

Community-acquired pneumonia

- ❑ Community-acquired pneumonia is the most common type of pneumonia.
- ❑ It occurs outside of hospitals or other health care facilities. It may be caused by:
 - ❑ **Bacteria**. The most common cause of bacterial pneumonia (*Streptococcus pneumoniae*)
 - ❑ This type of pneumonia can occur on its own or after you've had a cold or the flu.
 - ❑ It may affect one part (lobe) of the lung, a condition called lobar pneumonia.

Community-acquired pneumonia

- ❑ Community-acquired pneumonia is the most common type of pneumonia.
- ❑ It occurs outside of hospitals or other health care facilities. It may be caused by:
 - ❑ Bacteria-like organisms.
 - ❑ *Mycoplasma pneumoniae*
 - ❑ It typically produces milder symptoms than do other types of pneumonia.
 - ❑ Walking pneumonia is an informal name given to this type of pneumonia, which typically isn't severe enough to require bed rest.

Community-acquired pneumonia

- ❑ Community-acquired pneumonia is the most common type of pneumonia.
- ❑ It occurs outside of hospitals or other health care facilities. It may be caused by:
 - ❑ Fungi, Most common in:
 - ❑ People with chronic health problems
 - ❑ People with weakened immune systems
 - ❑ People who have inhaled large doses of the organisms.

Community-acquired pneumonia

- ❑ Community-acquired pneumonia is the most common type of pneumonia.
- ❑ It occurs outside of hospitals or other health care facilities. It may be caused by:
 - ❑ Viruses, including COVID-19
 - ❑ Some of the viruses (flu) can cause pneumonia.
 - ❑ Viruses are the most common cause of pneumonia in children younger than 5 years.
 - ❑ Viral pneumonia is usually mild, can become very serious
 - ❑ Coronavirus 2019 (COVID-19) may cause pneumonia, which can become severe.

Hospital-acquired pneumonia

- ❑ Some people catch pneumonia during a hospital stay for another illness.
- ❑
- ❑ Hospital-acquired pneumonia can be serious because the bacteria causing it may be more resistant to antibiotics and because the people who get it are already sick.
- ❑
- ❑ People who are on ventilators, often used in intensive care units, are at higher risk of this type of pneumonia.

Health care-acquired pneumonia

- ❑ Health care-acquired pneumonia is a bacterial infection that occurs in people who live in long-term care facilities or who receive care in outpatient clinics, including kidney dialysis centers.
- ❑ Like hospital-acquired pneumonia, health care-acquired pneumonia can be caused by bacteria that are more resistant to antibiotics

Aspiration pneumonia

- ❑ Aspiration pneumonia occurs when you inhale food, drink, vomit or saliva into your lungs.
- ❑ Aspiration is more likely if something disturbs your normal gag reflex, such as a brain injury or swallowing problem, or excessive use of alcohol or drugs.

Microbiology of CAP Among Hospitalized Patients

Outpatient	<ul style="list-style-type: none">✓ <i>Streptococcus pneumoniae</i>✓ <i>Mycoplasma pneumoniae</i>✓ <i>Haemophilus influenzae</i>✓ <i>Chlamydophila pneumoniae</i>✓ Respiratory viruses
Inpatient (Ward)	<ul style="list-style-type: none">✓ <i>S. pneumoniae</i>✓ <i>M. pneumoniae</i>✓ <i>H. influenzae</i>✓ <i>C. Pneumoniae</i>✓ <i>Legionella</i> species✓ Respiratory viruses✓ Aspiration
Inpatient (ICU)	<ul style="list-style-type: none">✓ <i>S. pneumoniae</i>✓ <i>Legionella</i> spp.✓ <i>Staphylococcus aureus</i>✓ Gram-negative bacilli

Comorbidities & Associated Pathogens

Alcoholism	<ul style="list-style-type: none">✓ Strep pneumoniae✓ Oral anaerobes✓ Klebsiella pneumoniae✓ Acinetobacter spp✓ M. tuberculosis
COPD and/or Tobacco	<ul style="list-style-type: none">✓ Hemophilus influenzae✓ Pseudomonas aeruginosa✓ Legionella spp✓ S. pneumoniae✓ Moraxella catarrhalis✓ Chlamydophila pneumoniae

Diagnosing CAP

❑ Common signs and symptoms:1

❑ Cough and/or sputum production (90%)

❑ Fever (>90%)

❑ Less common in older patients

❑ Chills (50%)

❑ Tachypnea (45%)

❑ Pleuritic chest pain (30%)

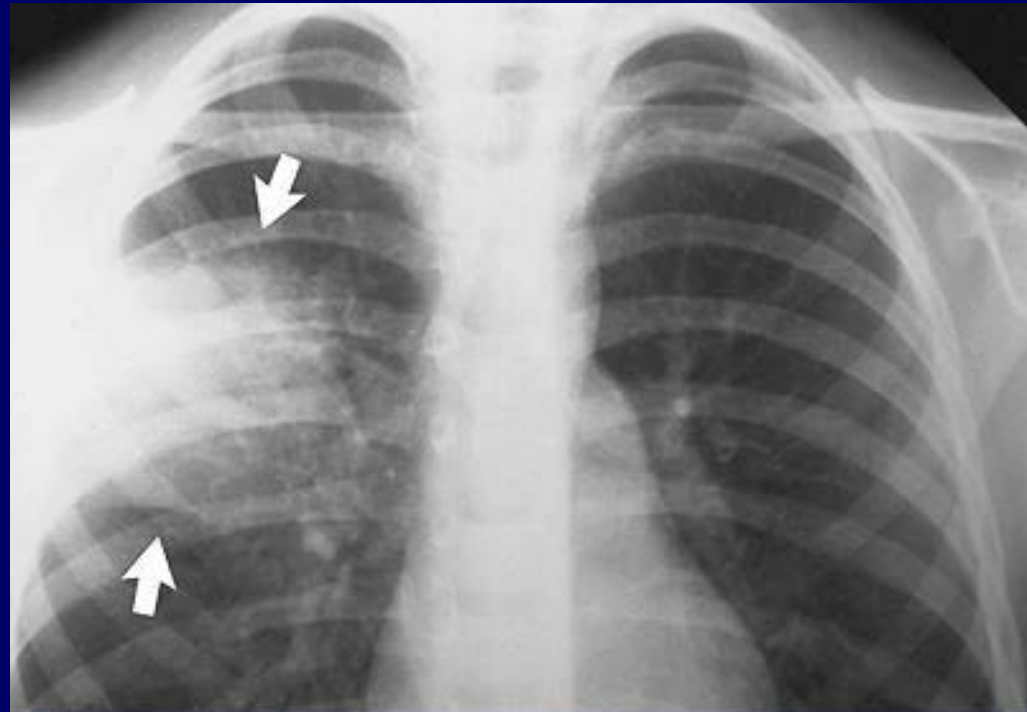
❑ Crackles during chest auscultation

Diagnosing CAP

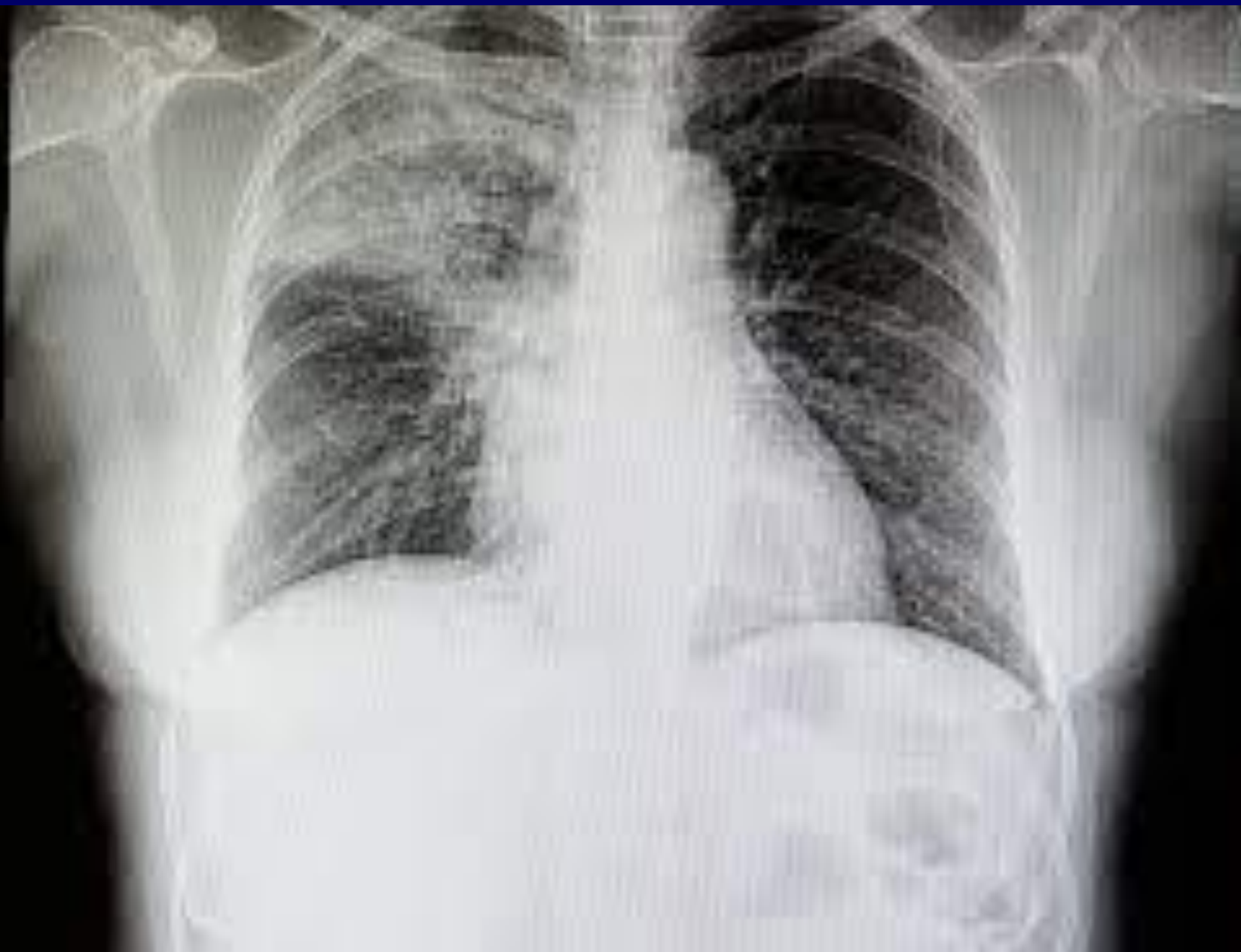
❑ If common signs and symptoms are present:

❑ Chest x ray

❑ Chest CT-Scan









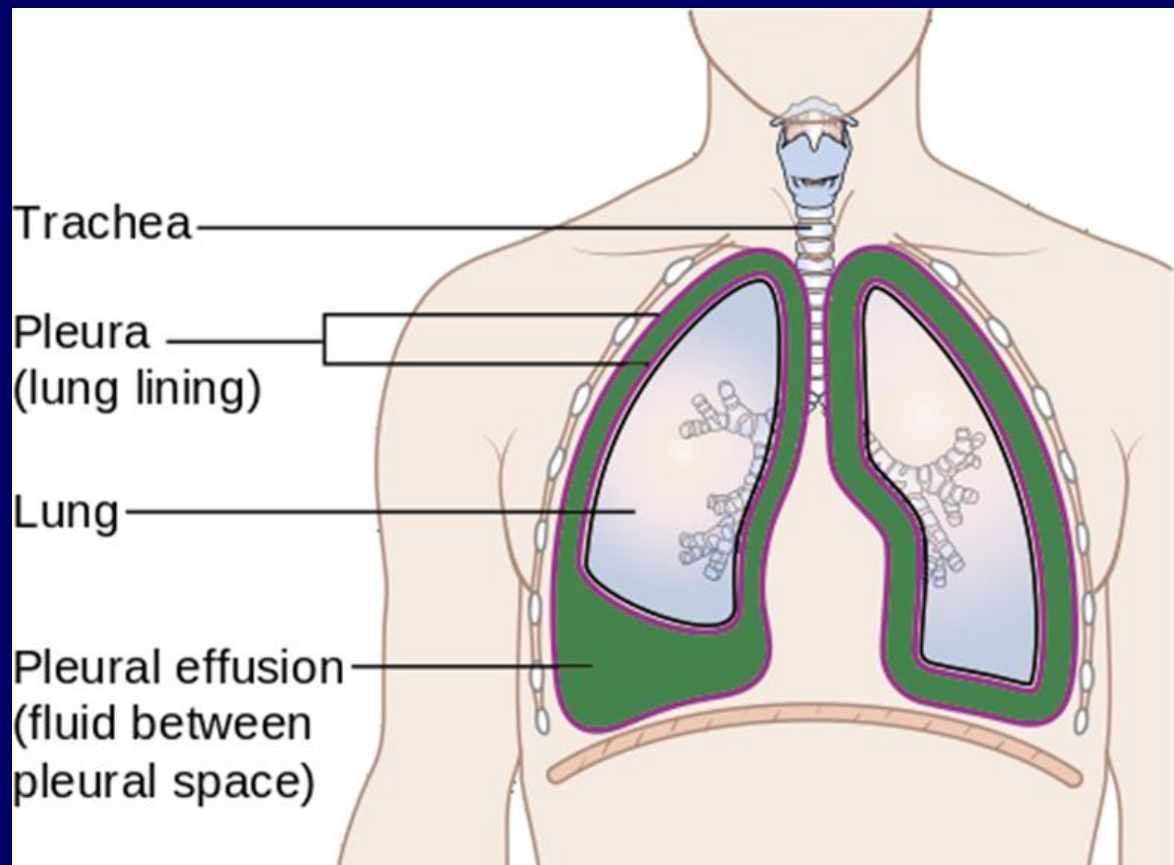


Diagnostic Tests

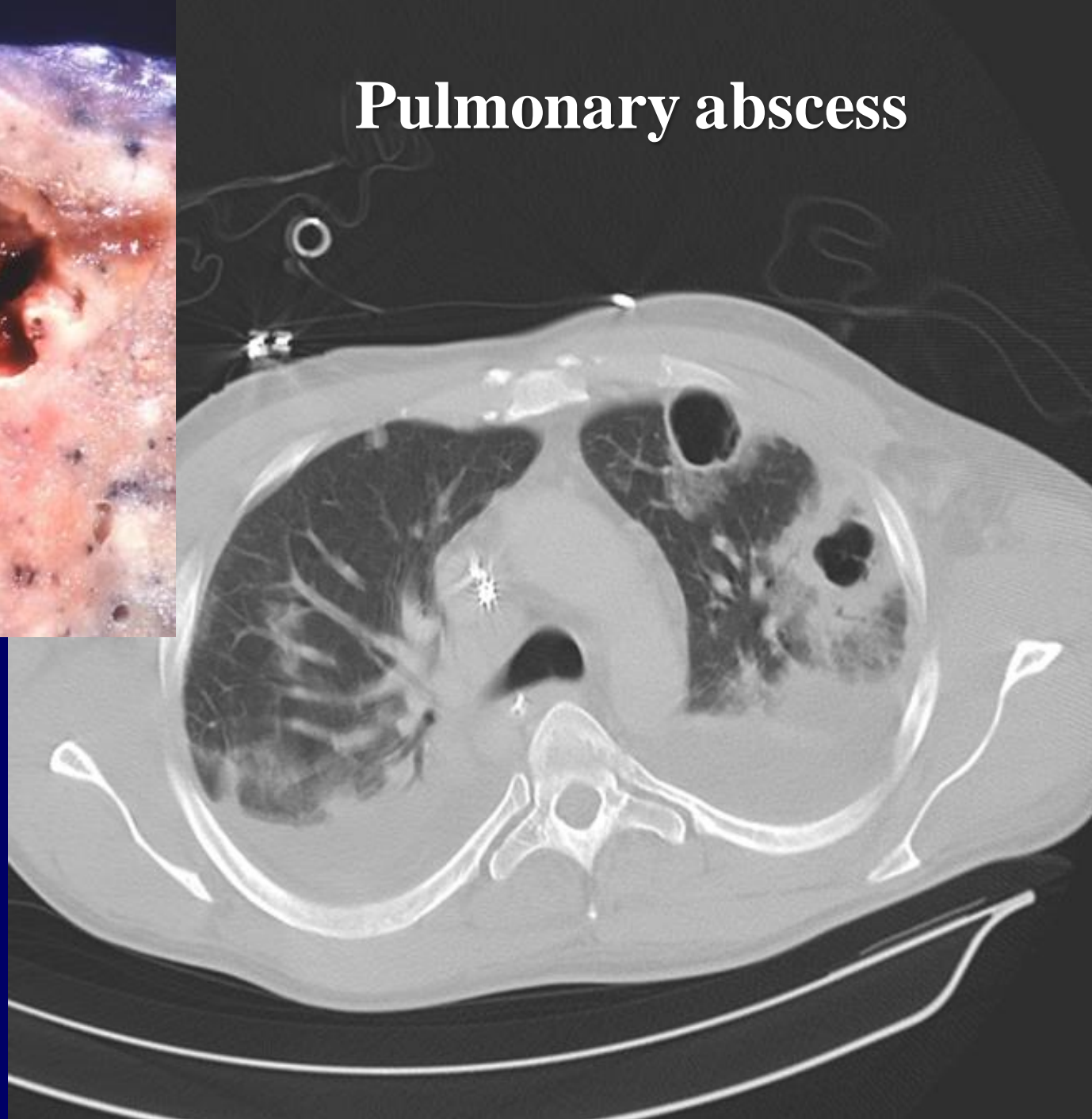
- ❑ Blood cultures
- ❑ Sputum Gram stain and culture
- ❑ Respiratory viral panel
- ❑ *S. pneumoniae* urinary antigen
- ❑ *Legionella* urinary antigen
- ❑ Bronchoscopy

Complications

- ❑ Bacteremia
- ❑ Pleural effusion
- ❑ Lung abscess
- ❑ Infective endocarditis
- ❑ Bacterial meningitis



Pulmonary abscess



To Admit or Not?

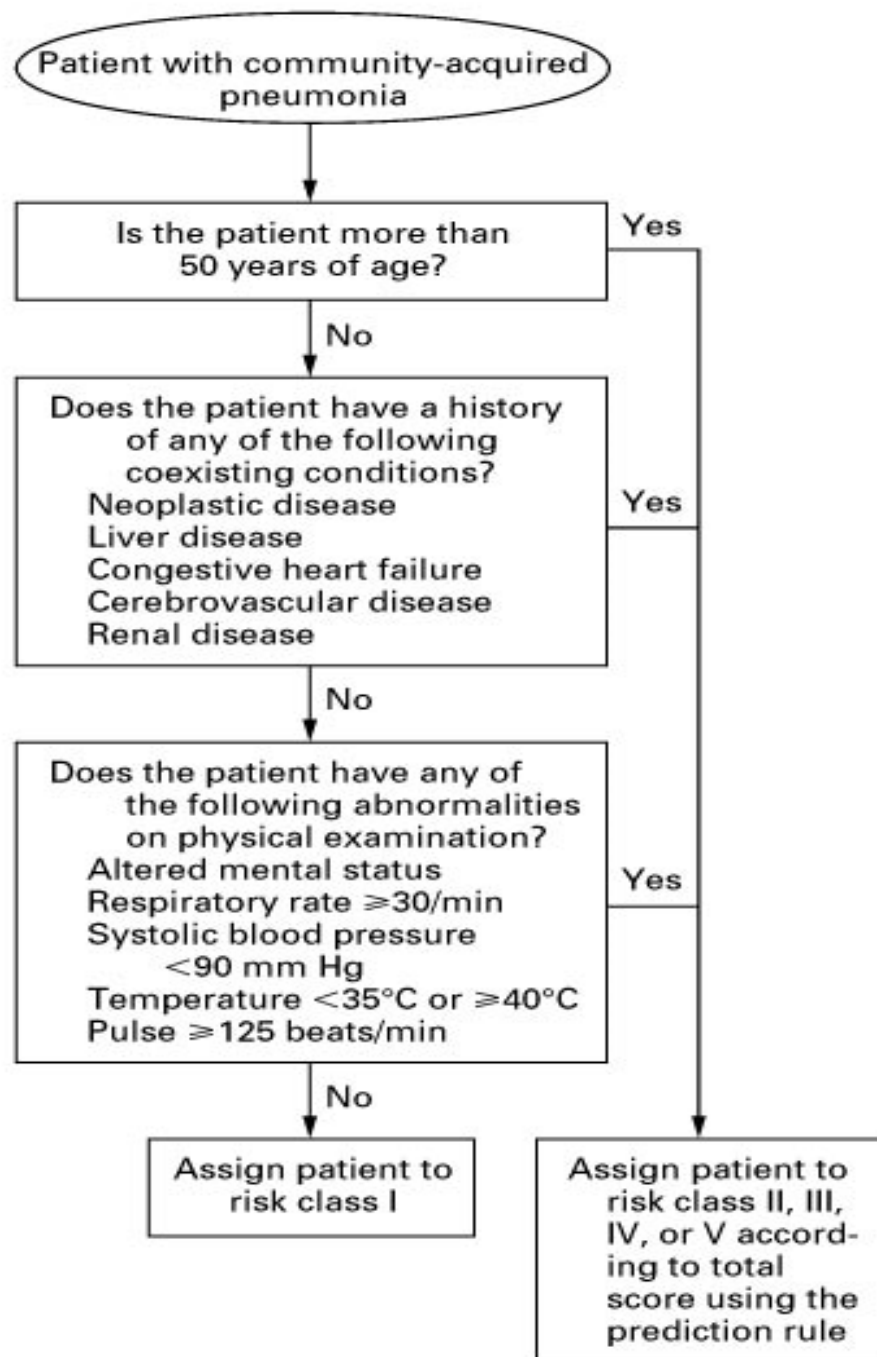
- ❑ Using objective criteria to risk stratify & assist in decision outpatient vs inpatient management

- ❑ PSI

- ❑ CURB-65

Community-Acquired Pneumonia Severity Index (PSI) for Adults

- ❑ Sex
- ❑ Demographic factors
- ❑ Comorbid illnesses
- ❑ Physical examination findings
- ❑ Laboratory and radiographic findings
 - ❑ Total Criteria Point Count
 - ❑ Pneumonia Score Interpretation



CHARACTERISTIC

NO. OF POINTS ASSIGNED

Demographic factors

Age

Men

Women

Age (in yr)

Age (in yr) - 10

Nursing home resident

+10

Coexisting illnesses

Neoplastic disease

+30

Liver disease

+20

Congestive heart failure

+10

Cerebrovascular disease

+10

Renal disease

+10

Findings on physical examination

Altered mental status

+20

Respiratory rate $\geq 30/\text{min}$

+20

Systolic blood pressure $< 90 \text{ mm Hg}$

+20

Temperature $< 35^\circ\text{C}$ or $\geq 40^\circ\text{C}$

+15

Pulse $\geq 125 \text{ beats/min}$

+10

Laboratory and radiographic findings

Arterial pH < 7.35

+30

Blood urea nitrogen $\geq 30 \text{ mg/dl}$
(11 mmol/liter)

+20

Sodium $< 130 \text{ mmol/liter}$

+20

Glucose $\geq 250 \text{ mg/dl}$ (14 mmol/liter)

+10

Hematocrit $< 30\%$

+10

Partial pressure of

+10

arterial oxygen $< 60 \text{ mm Hg}$

or oxygen saturation $< 90\%$

Pleural effusion

+10

Stratification of Risk Score

RISK	RISK CLASS	SCORE	MORTALITY
Low	I	Based on algorithm	0.1%
Low	II	≤ 70	0.6%
Low	III	71-90	0.9%
Moderate	IV	91-130	9.3%
High	V	> 130	27.0%

Pneumonia Severity Index

Step 2: Risk Factors and Assigned Points*

Risk factors

Points

Demographic factors

Age for men

Age for women

Age (yr)

Age (yr) - 10

Class	Points	Mortality*	Site of Care
I	<51	0.1%	OutPatient
II	51-70	0.6%	OutPatient
III	71-90	2.8%	In or OutPatient
IV	91-130	9.5%	Inpatient
V	>130	26.7%	Inpatient

Arterial pH <7.35

+30

Blood urea nitrogen ≥30 mg/dL (11 mmol/L)

+20

Sodium <130 mmol/L

+20

Glucose ≥250 mg/dL

+10

Hematocrit <30 percent

+10

Partial pressure of arterial oxygen <60 mmHg†

+10

Pleural effusion

+10

† Or an oxygen saturation of <90 percent on pulse oximetry.

* Adapted from Fine, MJ, Auble, TE, Yealy, DM, et al. N Engl J Med 1997; 336:243.

CURB-65	Clinical Feature	Points
C	Confusion	1
U	Urea > 7 mmol/L	1
R	RR \geq 30	1
B	SBP \leq 90 mm Hg OR DBP \leq 60 mm Hg	1
65	Age > 65	1

CURB-65 Score	Risk group	30-day mortality	Management
0 -1	1	1.5%	Low risk, consider home treatment
2	2	9.2%	Probably admission vs close outpatient management
3-5	3	22%	Admission, manage as severe

Pneumonia Treatment Considerations

☐ Outpatient – Oral Therapy

☐ Inpatient – Parenteral Therapy

Outpatient Empiric CAP Abx

☐ Healthy; no abx in past 3 months

☐ Macrolide → azithromycin, clarithromycin

☐ 2nd choice → Doxycycline

☐ Comorbidities; Abx in past 3 months:

☐ Respiratory FQ : Moxifloxacin, levofloxacin, gemifloxacin

☐ Beta-lactam + macrolide

☐ Regions with >25% high-level macrolide-resistant *S. pneumo*, consider alternative agents

Current recommended antibiotic therapy for community-acquired pneumonia

Patient Category	Recommended	Alternative
Outpatient: previously healthy	Macrolide	Doxycycline
Outpatient: underlying disease/ previous treatment	Fluoroquinolone	Beta-lactam combined with macrolide or doxycycline
Non-ICU inpatient	Beta-lactam combined with macrolide or fluoroquinolone monotherapy	Beta-lactam combined with doxycycline
ICU patient	Beta-lactam combined with macrolide or beta-lactam combined with fluoroquinolone	Add linezolid or vancomycin for suspected MRSA Change to anti-pseudomonal beta-lactam and quinolone if suspect pseudomonas

Empirical Choice of Antimicrobial Agent

PATIENT CHARACTERISTICS	PREFERRED TREATMENT OPTIONS
Outpatient	
<i>Previously Healthy</i>	
No recent antibiotic therapy	Macrolide ^a or doxycycline (100 mg 2 times/day)
Recent antibiotic therapy ^b	A respiratory fluoroquinolone ^c alone, an advanced macrolide ^d plus oral β -lactam ^e
<i>Comorbidities (COPD, Diabetes, Renal Failure or Congestive Heart Failure, or Malignancy)</i>	
No recent antibiotic therapy	An advanced macrolide plus oral β -lactam or a respiratory fluoroquinolone
Recent antibiotic therapy	A respiratory fluoroquinolone alone or an advanced macrolide plus a β -lactam
Suspected aspiration with infection	Amoxicillin-clavulanate or clindamycin (600 mg IV q8h or 300 mg PO q6h)
Influenza with bacterial superinfection	Vancomycin, linezolid, or other coverage for MRSA, including community-acquired MRSA ^f
Inpatient	
<i>Medical Ward</i>	
No recent antibiotic therapy	A respiratory fluoroquinolone alone or an advanced macrolide plus an intravenous β -lactam ^g
Recent antibiotic therapy	An advanced macrolide plus an intravenous β -lactam, or a respiratory fluoroquinolone alone (regimen selected will depend on nature of recent antibiotic therapy)
<i>Intensive Care Unit (ICU)</i>	
<i>Pseudomonas</i> infection is not a concern	A β -lactam ^g plus either an advanced macrolide or a respiratory fluoroquinolone
<i>Pseudomonas</i> infection is not a concern but patient has a β -lactam allergy	A respiratory fluoroquinolone, with or without clindamycin
<i>Pseudomonas</i> infection is a concern ^h (cystic fibrosis, impaired host defenses)	Either (1) an antipseudomonal β -lactam ⁱ plus ciprofloxacin (400 mg IV q8h or 750 mg PO q12h), or (2) an antipseudomonal agent plus an aminoglycoside ^j plus a respiratory fluoroquinolone or a macrolide
<i>Pseudomonas</i> infection is a concern but the patient has a β -lactam allergy	Aztreonam (2 g IV q8h) plus aminoglycoside plus a respiratory fluoroquinolone
Health Care–Associated Pneumonia^k	
—	Either (1) an antipseudomonal β -lactam plus ciprofloxacin or levofloxacin or (2) an antipseudomonal agent plus an aminoglycoside plus a respiratory fluoroquinolone or a macrolide plus vancomycin or linezolid (for MRSA coverage)

TABLE 69-6 Evidence of Clinical Stability

Temperature $\leq 37.8^{\circ}\text{C}$ (100°F)

Pulse ≤ 100 beats/min

Respiratory rate ≤ 24 breaths/min

Systolic blood pressure ≥ 90 mm Hg

Arterial oxygen saturation $\geq 90\%$ or $\text{PO}_2 \geq 60$ mm Hg on room air

Ability to maintain oral intake

Normal mental status

Prevention

- ☐ Get vaccinated
- ☐ Practice good hygiene
- ☐ Don't smoke
- ☐ Keep your immune system strong



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