Community-Acquired Pneumonia

The lung's exchange counter is underwater. Every breath still moves air in and out—but the oxygen can't reach the blood.

THE ONE-LINE TRUTH

A germ (most often a bacterium called Streptococcus pneumoniae) gets into the tiny air sacs of the lung; the immune system floods those sacs with pus and liquid so oxygen cannot cross into the blood.

The chain — how it unfolds

1. Bacteria or virus enters the lung (by breathing it in, by mouth germs slipping into the airway during sleep, or rarely by spreading through the bloodstream). — why: The nose, cilia, mucus, cough reflex, and alveolar macrophages (the white cells that patrol the air sacs) are breached or overwhelmed.
2. The germ starts to multiply inside the alveoli. — why: The air sacs are warm, moist, and rich in nutrients—a perfect place for bacteria to grow.
3. Alveolar macrophages detect the germ and release cytokines (chemical alarm signals); neutrophils (infection-fighting white cells) and plasma flood into the alveoli. — why: The immune system is walling off and killing the invader.
4. Alveoli fill with leaked fluid (exudate) (a mix of white cells, dead bacteria, and liquid)—they cannot do gas exchange. — why: Liquid replaces air; oxygen cannot cross a flooded membrane.
5. Oxygen level in the blood drops (hypoxemia). — why: Fewer working alveoli means less surface for oxygen to cross over.
6. The body compensates: breathing speeds up, heart rate rises, and fever appears. — why: Trying to move more air through healthy alveoli, deliver more blood, and heat up to slow bacterial growth.
7. Cough (often bringing up yellow, green, or rust-colored coughed-up mucus (sputum)), chest pain (pleuritic—sharp with each breath), and fatigue show up. — why: Airway irritation triggers cough; inflammation of the pleura (the lining around the lung) causes sharp chest pain; low oxygen and the immune battle drain energy.

8. If untreated: bacteria can spill into the bloodstream (bacteremia) causing sepsis (body-wide inflammation and organ failure), the lung can collapse from pus in the pleural space (empyema), or breathing can fail entirely (respiratory failure requiring a ventilator). — why: Severe cases overwhelm local defenses and spread the immune storm and infection throughout the body.

Spot it — what you see, and why

- Cough that brings up thick, green or yellow mucus: The infection fills the tiny air sacs (alveoli) in the lung with fluid and pus. The body tries to cough it all out to clear the airway.
- Fever with shaking chills: The immune system raises the body's temperature to slow down germs and speed up infection-fighting cells. The shaking happens when the body's thermostat suddenly jumps higher.
- Shortness of breath and fast breathing: Infected air sacs fill with fluid instead of air, so less oxygen can cross into the blood. The body breathes faster to try to make up for it.
- Sharp chest pain that gets worse when you breathe in deeply or cough: The infection spreads to the pleura (the thin lining around the lung). When inflamed, the two layers rub together with each breath, causing sharp pain.
- Extreme tiredness and weakness: Fighting infection takes huge energy. Plus, less oxygen reaches muscles and the brain because the lungs aren't working well.
- Confusion or changes in thinking (especially in older adults): Low oxygen in the blood and inflammatory chemicals (cytokines released by the immune system) change how the brain works.

Red flags — act now

- Oxygen saturation below 90% on room air, or needing more and more oxygen → Give more oxygen right away. Consider moving to the ICU and using non-invasive breathing support like BiPAP.
- Signs of sepsis: blood pressure below 90 systolic, blood lactate above 2, confusion or very sleepy → Start the sepsis bundle within the first hour: IV fluids, blood cultures, and broad antibiotics immediately.
- Large pocket of fluid around the lung (pleural a fluid collection (effusion)) or pus in that space (empyema) → Insert a chest tube to drain the fluid. Send a sample to the lab to check for bacteria.
- Hole or cavity inside the lung on chest X-ray or CT → Broaden antibiotics to cover mouth bacteria and resistant bugs. Isolate the patient and test for TB. Call pulmonology.
- No improvement after 48 to 72 hours on the right antibiotics → Repeat chest imaging. Review culture results. Consider a CT scan and switch to broader antibiotics.

Treat it — in this order

1. Empiric antibiotics (outpatient: amoxicillin 1 g three times daily, or doxycycline 100 mg twice daily; hospitalized non-ICU: ceftriaxone 1–2 g daily + azithromycin 500 mg daily; ICU: ceftriaxone + azithromycin, or a respiratory fluoroquinolone like levofloxacin) → Kills the most common bacteria that cause community-acquired pneumonia (Streptococcus pneumoniae, Haemophilus influenzae, atypical germs like Mycoplasma and Legionella) while you wait for culture results. Starts working within hours and reduces the risk of death.
2. Supplemental oxygen (nasal cannula 1–6 L/min → high-flow nasal cannula up to 60 L/min → non-invasive positive pressure ventilation (BiPAP/CPAP) → intubation and mechanical ventilation) → Raises the amount of oxygen in the blood while the infected lung heals. Keeps the brain, heart, and kidneys fed with oxygen so they don't fail.
3. Intravenous (IV) fluids (normal saline or lactated Ringer's, typically 30 mL/kg bolus in sepsis, then maintenance rate) → Restores blood volume and blood pressure if the person is dehydrated or in septic shock. Thins thick mucus in the airways so it's easier to cough up. Helps deliver antibiotics and oxygen to the tissues.
4. Fever reducers (acetaminophen 650–1,000 mg every 6 hours, or ibuprofen 400–600 mg every 6–8 hours) → Lowers fever and makes the person more comfortable. Reduces how hard the body is working (metabolic demand), which can help if the heart or lungs are struggling.
5. Chest physiotherapy, incentive spirometry (breathing exercises), and upright positioning → Helps the person cough up thick mucus (secretions). Opens up collapsed or sticky air sacs (atelectasis). Sitting upright lets the diaphragm (main breathing muscle) work better and gravity helps drain secretions.

Your top priorities at the bedside

1. Assess respiratory status and oxygen saturation every 2–4 hours — why: Deterioration can be silent — early O_2 escalation prevents intubation.
2. Give antibiotics on time — first dose within 4 hours of arrival — why: Every hour of delay increases mortality.
3. Position: head of bed 30–45°, encourage incentive spirometry — why: Opens collapsed alveoli, improves gas exchange.