

Acute Hypercapnic Respiratory Failure

A plain-English guide for you and your family

WHAT IS HAPPENING

Your lungs do two jobs every minute: pull oxygen in and push carbon dioxide (CO₂) waste out. Normally your brain sends the breathing signal, your diaphragm (the big dome muscle under your lungs) and chest muscles do the work, your airways stay open, and your lung tissue moves the air—all four parts working together keep CO₂ between 35 and 45 (measured in mm Hg, a pressure unit) and your blood at a healthy pH between 7.35 and 7.45. When one part breaks—common causes include a flare of COPD (chronic lung disease, usually from smoking, that narrows the airways and traps air), weak breathing muscles (from diseases like ALS or myasthenia gravis that stop muscles from working right), opioid pain medicines or sedatives that slow the brain's breathing center, severe obesity that squeezes the chest and lungs so they cannot expand (called obesity hypoventilation syndrome), a curved spine or chest wall problem that stops the lungs from filling, or a blocked upper airway (from swelling, choking, or severe sleep pauses in breathing (apnea))—CO₂ starts piling up in your blood. High CO₂ makes your blood acidic, which poisons your brain (causing confusion, sleepiness, headache, and shaking) and tires your breathing muscles even more, so the problem feeds itself and gets worse fast. Without help—treating the cause (bronchodilators that open airways for COPD, reversing opioids with naloxone, or using a breathing machine to take over the work)—the cycle spirals down until breathing stops. Every sign points back to one problem: not enough air moving out.

What you might feel

- Shortness of breath (dyspnea)
- Fast breathing at first (over 20 breaths per minute), then dangerously slow breathing later (under 12 breaths per minute)
- Using neck and shoulder muscles to breathe at first, then chest sinking in when you breathe in (paradoxical breathing) or very shallow breaths later
- Extreme sleepiness (somnolence) or confusion
- Headache
- Flapping tremor when you hold your arms out (asterixis)

- Warm, flushed (red) skin and strong, forceful pulses (bounding pulses)
- Bluish lips, tongue, or fingertips (cyanosis) if oxygen is also low
- Sweating and feeling anxious or panicky

Call the doctor right away if...

- Extreme sleepiness, stupor, or coma (CO₂ narcosis—the person may need a breathing tube within minutes)
- Breathing rate below 12, gasping breaths, or irregular 'agonal' breaths (a sign breathing is about to stop)
- Paradoxical chest movement (chest sinks in when breathing in) or the person cannot speak a full sentence (the breathing muscles are exhausted)
- New confusion or agitation in someone with known COPD or taking opioid pain medicine (assume high CO₂ until you prove otherwise with a blood gas test)
- Blood pH below 7.25 with PaCO₂ above 70 mm Hg on arterial blood gas (severe acidemia—organs can start failing)

What the care team will do

- Check oxygen saturation with pulse oximeter (the fingertip device) and give LOW-FLOW oxygen (start at 1 to 2 liters per minute by nasal cannula) to keep saturation between 88 and 92 percent—not higher.
- Set up continuous pulse oximetry and capnography (a monitor that measures CO₂ in exhaled breath) if available, and check respiratory rate and mental status every 15 minutes.
- Position the person sitting upright at 45 to 90 degrees (high Fowler position) and coach them to use pursed-lip breathing (breathe in through the nose, blow out slowly through mouth like blowing out a candle).
- Start BiPAP (bilevel positive airway pressure, a tight-fitting mask that pushes air into the lungs) with initial settings around IPAP 12 and EPAP 5 (pressure numbers your respiratory therapist will adjust) if the person is awake enough to protect their airway.
- Give the first dose of prescribed treatments for the underlying cause—prednisone 40 mg by mouth, albuterol (a bronchodilator) 2.5 mg plus ipratropium 0.5 mg by nebulizer (breathing treatment) every 4 hours for COPD flare, or naloxone 0.4 mg into the vein every 2 to 3 minutes up to 2 mg total for opioid overdose.
- Draw arterial blood gas (ABG, blood taken from the wrist artery) or venous blood gas (VBG, from a regular vein) within 30 minutes of arrival and repeat 1 to 2 hours after starting treatment.

- Hold or reduce any sedating medicines (opioids, benzodiazepines, sleeping pills) and ask the pharmacy to review the medication list for respiratory depressants.
- Have intubation equipment (endotracheal tube size 7.0 to 8.0, laryngoscope, bag-valve mask) and suction at the bedside, and notify the rapid-response team or ICU if mental status worsens or respiratory rate falls below 12.

Medicines you may be given — and why

Bronchodilators (albuterol, ipratropium)

These drugs relax the tight muscle rings wrapped around your breathing tubes so the tubes spring open wider, letting air move in and out more easily and helping trapped carbon dioxide escape.

Systemic corticosteroids (prednisone, methylprednisolone)

Steroids shut down the immune cells and chemical messengers that cause swelling and thick mucus in the airways, shrinking the puffiness so air passages stay open and carbon dioxide can flow out.

Naloxone

Naloxone kicks opioid drugs off their docking spots in the brainstem breathing center, immediately restarting the automatic signals that tell the lungs to breathe and clearing out built-up carbon dioxide.

Flumazenil

Flumazenil blocks benzodiazepine drugs from over-calming the brainstem, restarting the drive to breathe and letting the person clear carbon dioxide that built up while breathing was slowed.

Non-invasive positive pressure ventilation (BiPAP or CPAP)

The machine pushes air into the lungs under pressure through a mask, forcing open collapsed or narrowed airways and actively pulling stale carbon dioxide-rich air out, taking over part of the work of breathing when the muscles or lungs cannot keep up.

Controlled oxygen therapy (target SpO₂ 88-92% in chronic carbon dioxide retainers)

In people whose breathing drive depends on low oxygen because their brainstem has gotten used to high carbon dioxide, giving just enough oxygen to keep tissues alive without raising oxygen too high preserves the signal that tells them to breathe, preventing carbon dioxide from climbing even higher.

Antibiotics (azithromycin, doxycycline, amoxicillin-clavulanate, ceftriaxone, levofloxacin)

Antibiotics kill or stop the growth of bacteria causing lung infections like pneumonia or COPD flare-up (exacerbation), so swelling and mucus production drop, airways open back up, and breathing improves enough to clear carbon dioxide.

Diuretics (furosemide, bumetanide)

Diuretics pull extra fluid out of the lungs and body by making the kidneys dump salt and water into the urine, shrinking lung swelling so air sacs can open and gas exchange improves, helping to clear carbon dioxide.

Where this information comes from

- GOLD 2024 Global Strategy for the Diagnosis, Management, and Prevention of COPD
- British Thoracic Society (BTS) / Intensive Care Society Guideline for Non-Invasive Ventilation in Acute Respiratory Failure (2023 update)
- American Thoracic Society (ATS) Clinical Practice Guideline: Respiratory Muscle Testing at the Bedside
- Cochrane Database: Non-invasive ventilation for acute hypercapnic respiratory failure due to exacerbation of chronic obstructive pulmonary disease

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