Opioid Overdose

Opioid overdose shuts down the brain stem's breathing control center, so the body forgets to breathe and runs out of oxygen.

THE ONE-LINE TRUTH

Opioids turn off the brain's breathing switch, oxygen drops, and the person stops breathing.

The chain — how it unfolds

1. Opioids (heroin, fentanyl, morphine, oxycodone) bind to mu opioid receptors in the medulla oblongata. — why: These receptors normally help dampen pain signals, but when opioids flood them—especially in overdose—they shut down the medulla's automatic breathing rhythm.
2. The medulla stops sending 'breathe' signals to the diaphragm and rib muscles. — why: Without that signal, the chest does not expand, air does not flow in, and breathing slows to under twelve breaths per minute (normal is twelve to twenty).
3. Blood oxygen drops (hypoxemia) and carbon dioxide climbs (hypercapnia). — why: The lungs are not exchanging gases, so oxygen cannot enter the blood and carbon dioxide cannot leave; the blood becomes acidic.
4. Pupils shrink to tiny pinpoints (miosis). — why: Opioids also stimulate the parasympathetic Edinger–Westphal nucleus in the brainstem, which tightens the iris muscle and makes the pupil as small as a pinhead.
5. The person becomes confused, then unconscious. — why: The brain needs oxygen every second; when the level drops below about 90%, neurons misfire (confusion), then shut down (coma).
6. Heart rate slows and blood pressure falls. — why: Low oxygen weakens the heart muscle; it cannot pump hard, so pressure drops and organs get even less blood.
7. Skin and lips turn blue or gray (cyanosis). — why: Hemoglobin in the blood carries less oxygen and looks darker; you see this blue color through the skin, especially at the lips, fingernails, and face.

8. Without naloxone or rescue breathing, the heart stops (cardiac arrest) and the person dies. — why: The heart cannot run without oxygen; once it stops, brain death begins within four to six minutes unless CPR and naloxone reverse the overdose.

Spot it — what you see, and why

- Pinpoint pupils (tiny dots for eyes): Opioids turn on mu receptors (special docking spots) in the oculomotor nucleus (the brain's eye-control center in the midbrain), which makes the pupil muscles squeeze tight and stay small — even in dim light when they should get bigger.
- Slow, shallow breathing (often under 12 breaths per minute): Opioids quiet the mu receptors in the medulla (the base of the brain that sets your breathing rhythm), so the brain stops sending strong 'breathe now' signals. The person takes fewer and shallower breaths, and carbon dioxide builds up in the blood.
- Drowsiness or being completely unresponsive (won't wake up to voice or touch): Opioids flood mu receptors across the whole brain, especially in the reticular activating system (the brain's on/off switch for wakefulness), so the person drifts into deep sleep or even coma and cannot stay alert.
- Blue or gray lips, fingernails, or skin (cyanosis): When breathing slows too much, not enough oxygen gets into the blood. Oxygen-poor blood looks dark purple-blue instead of bright red, and you can see that color show through at the lips, nails, and skin — especially in people with lighter skin tones.
- Limp, floppy muscles (low muscle tone): Opioids dampen signals in the spinal cord and motor centers of the brain that usually keep muscles firm and ready. As a result, the person's arms, legs, and head feel loose and heavy, like a rag doll.
- Choking sounds, gurgling, or snoring (noisy breathing): When the brain's breathing drive drops, the person cannot keep their airway muscles tight. The tongue falls back, saliva pools in the throat, or vomit creeps up, so air has to push past all that — making a snore, gurgle, or choke noise.

Red flags — act now

- Breathing slower than 12 breaths per minute or stopping for more than 10 seconds at a time (apnea)
- Person will not wake up even when you rub their chest hard or shout their name
- Lips, fingernails, or face turning blue or gray
- Choking, gurgling, or gasping sounds — the airway may be blocked
- Heart rate below 50 or no pulse you can feel

Treat it — in this order

1. Bag-valve-mask ventilation with 100% oxygen (or high-flow nasal cannula at 15 L/min if breathing is present but slow) → Forces oxygen into the lungs and raises blood oxygen saturation back above 90%. This keeps the brain and heart alive while you wait for naloxone to kick the opioid off the receptors and restart normal breathing.
2. Naloxone 0.4–2 mg IV push (or 4 mg intranasal spray), repeat every 2–3 minutes until breathing resumes or total dose reaches 10 mg → Naloxone is a mu-receptor antagonist—it binds to the same receptors as the opioid but kicks the opioid off and does not activate the receptor. This wakes up the respiratory center in the medulla and restores the brain's own drive to breathe. Breathing usually starts within 2–5 minutes.
3. Continuous naloxone infusion (typically two-thirds of the wake-up dose per hour IV) for long-acting opioids (fentanyl, methadone, sustained-release formulations) → Keeps naloxone in the bloodstream at a steady level so it occupies the mu receptors longer than the opioid does. This prevents the opioid from re-binding and shutting down breathing again before the drug leaves the body (fentanyl can last 3–4 hours in fatty tissue, methadone up to 24–36 hours).
4. Start buprenorphine 4–8 mg sublingual in the emergency department once the person is awake and in mild withdrawal (COWS score ≥8) → Buprenorphine is a partial mu-receptor agonist—it sits on the receptor just tightly enough to stop cravings and withdrawal, but does not activate the receptor enough to cause overdose or euphoria. This stabilizes the brain's reward circuit and cuts the risk of leaving and overdosing again by 50% (JAMA 2015;313:1636).
5. IV normal saline bolus (1–2 liters) if systolic BP below 90 mmHg or creatine kinase is elevated → Restores blood volume and blood pressure so the heart can pump oxygen to the brain and kidneys. Flushes muscle breakdown products (myoglobin) out of the kidneys before they clog the filters and cause acute kidney injury.

Your top priorities at the bedside

1. Open the airway with head-tilt-chin-lift or jaw-thrust maneuver, suction any vomit or secretions, and start bag-valve-mask ventilation at 10 to 12 breaths per minute with 100% oxygen if respirations are under 12 per minute or pauses in breathing (apnea) is present. — why: Opioids bind to mu receptors (special proteins) in the brainstem respiratory center and turn off the automatic breathing drive, so low oxygen (hypoxia) (low oxygen in the blood) kills brain cells within 4 to 6 minutes unless you breathe for the patient.

2. Give naloxone 0.4 to 2 mg IV push or 4 mg intranasal spray immediately, then repeat every 2 to 3 minutes until the patient breathes on their own at a rate above 12 per minute or until you have given a total of 10 mg. — why: Naloxone is a competitive antagonist (a blocker) that kicks opioids off the mu receptors and reverses respiratory depression, but fentanyl binds so tightly that you often need multiple doses or higher total amounts.
3. Monitor oxygen saturation continuously with pulse oximetry and keep SpO_2 above 94% with supplemental oxygen or bag-valve-mask support. — why: Even after naloxone wakes the patient up, low oxygen in the blood (hypoxemia) (low oxygen in the blood) can persist because aspiration pneumonitis (lung inflammation from inhaled vomit or stomach acid) or pulmonary edema (fluid flooding the lungs) (fluid in the lungs from opioid toxicity) takes hours to resolve.