

Type 2 Diabetes

Type 2 Diabetes — insulin resistance plus beta-cell failure; lifestyle and metformin first, add SGLT2 inhibitors or GLP-1 agonists for heart and kidney protection.

THE ONE-LINE TRUTH

The body's cells ignore insulin's signal, and the pancreas cannot make enough to overcome that silence.

The chain — how it unfolds

1. Insulin resistance starts silently — why: Extra weight (especially belly fat), genes, and lack of movement make muscle, fat, and liver cells ignore insulin's signal. Sugar cannot get inside cells, so it piles up in the blood. The pancreas tries to compensate by making extra insulin, so for years your blood sugar looks normal and you feel fine—but damage is already starting in your vessels.
2. The pancreas wears out — why: Beta cells in the pancreas work overtime for months or years, pumping out two to three times the normal insulin. High blood sugar itself poisons these cells (glucotoxicity), and they shrink or die. By the time blood sugar is high enough to diagnose diabetes, you have lost about half your beta cells. Insulin output drops, and blood sugar climbs fast.
3. Hemoglobin A1c rises and you start to feel symptoms — why: When beta cells fail, blood sugar stays high all day. Hemoglobin A1c (a three-month average of blood sugar) climbs above 6.5 percent. High sugar spills into urine, so you pee a lot and lose water (polyuria, excessive thirst (polydipsia)). Cells are starving for fuel even though blood is sweet, so you feel tired. High sugar swells the lens in your eye, making vision blurry.
4. Small blood vessels get damaged (microvascular disease) — why: High blood sugar is thick and sticky. It damages the smallest vessels first—the retina (back of the eye, causing blurry vision and eventually blindness), the glomeruli (filters in the kidneys, causing protein to leak into urine and eventually kidney failure), and the nerves (especially in feet and hands, causing numbness, tingling, and pain called diabetic neuropathy).

5. Large blood vessels get damaged (macrovascular disease) — why: High sugar and high insulin inflame and scar the walls of big arteries (atherosclerosis). Plaques grow in the coronary arteries (heart attack), carotid arteries (stroke), and leg arteries (poor circulation, wounds that will not heal). People with diabetes have two to four times the risk of heart attack and stroke compared to people without diabetes.
6. The liver keeps making sugar overnight — why: Insulin resistance blocks the liver's stop signal, so it keeps releasing stored glucose into the blood all night. You wake up with high fasting sugar (over 126 mg/dL) even if you did not eat. This is why fasting glucose is one of the main tests used to diagnose diabetes.
7. Acute crises can happen—hyperosmolar hyperglycemic state or severe low blood sugar (hypoglycemia) — why: If blood sugar climbs extremely high (over 600 mg/dL), blood becomes syrup-thick, you lose huge amounts of water through urine, and you can become confused or unconscious (hyperosmolar hyperglycemic state, or HHS). If you take too much insulin or a sulfonylurea medication and skip a meal, blood sugar can drop dangerously low (below 70 mg/dL), causing sweating, shaking, confusion, seizures, or coma (severe low blood sugar (hypoglycemia)). Both are medical emergencies.
8. Trace it all back to the one upstream break — why: Every weird finding—peeing a lot, tired, blurry vision, numb feet, heart attacks—points backward to cells that will not listen to insulin and a pancreas that cannot keep up. The body is not trying to hurt you; it is trying to survive by dumping sugar in urine and releasing stress hormones to keep blood flowing. But this survival mode trades short-term balance for long-term damage. Fix the upstream break—lose weight, move daily, eat fewer refined carbs, take metformin to lower liver sugar output, add SGLT2 inhibitors (which make kidneys dump sugar) or GLP-1 agonists (which help beta cells and slow stomach emptying)—and you stop the dominoes before they knock over your heart, kidneys, eyes, and nerves.

Spot it — what you see, and why

- Drinking much more water than usual (polydipsia): When sugar builds up in the blood, the kidneys try to flush it out by making more urine. The body loses a lot of water that way, so you feel really thirsty and need to drink more to replace what you lost.
- Peeing a lot more often, especially at night (polyuria): High blood sugar spills into the urine and pulls extra water along with it (like salt pulling water out of a vegetable). The kidneys make much more urine to get rid of the extra sugar, so you have to go to the bathroom more often.
- Feeling tired or worn out most of the time: Insulin is like a key that unlocks the door to let sugar into cells for fuel. In type 2 diabetes, the body's cells don't respond well to insulin (insulin resistance), so sugar stays stuck in the blood instead of getting inside cells. Without enough fuel, your cells and body feel tired.

- **Blurry vision:** High blood sugar pulls fluid out of the lens of the eye (the clear part that focuses light), changing its shape. That makes it harder to focus clearly, so things look blurry. This usually gets better when blood sugar comes back down.
- **Cuts, sores, or infections that heal slowly:** High sugar in the blood damages small blood vessels and nerves over time, so less blood (and the oxygen and nutrients it carries) reaches the skin. White blood cells that fight germs also don't work as well when sugar is high. Together, these slow down healing.
- **Tingling, numbness, or pain in the hands or feet:** Over time, high blood sugar damages the nerves that carry signals from your hands and feet to your brain (peripheral neuropathy). Damaged nerves send mixed-up signals—sometimes numbness, sometimes tingling, sometimes burning pain—or stop sending signals at all.

Red flags — act now

- Confusion, extreme sleepiness, or trouble waking up (can mean very high blood sugar or a dangerous complication called hyperosmolar hyperglycemic state)
- Fruity-smelling breath, deep fast breathing, nausea, or vomiting (can mean diabetic ketoacidosis (the acid crisis of missing insulin), though rare in type 2; more common if also low insulin)
- New severe belly pain, especially with nausea or fever (can mean pancreatitis or infection that spreads fast in high sugar)
- Sudden vision loss or severe eye pain (can mean bleeding in the eye or pressure buildup from diabetic eye damage)
- A foot wound or ulcer that won't heal, with redness, warmth, or bad smell (can mean serious infection or loss of blood flow that may lead to amputation if not treated quickly)

Treat it — in this order

1. Lose 5–10% of body weight through portion control, more vegetables and whole grains, and at least 150 minutes of moderate exercise (like brisk walking) each week → Weight loss shrinks fat cells; they stop releasing the inflammatory chemicals (tumor tissue death (necrosis) factor-alpha, resistin, free fatty acids) that block insulin receptors on muscle and liver cells. Insulin can work again—muscle cells grab glucose, the liver stops overproducing it, and blood sugar drops. Exercise also moves GLUT4 transporters (the doors glucose uses) to the muscle-cell surface even without insulin. This fixes the root cause: insulin resistance.

2. Start metformin 500–850 mg once or twice daily with food, then titrate up to 2000–2550 mg/day as tolerated → Metformin turns down glucose production in the liver (it blocks mitochondrial complex I and activates AMP-kinase, which tells the liver 'stop making sugar'), and it makes muscle cells more sensitive to insulin so they pull glucose out of the blood better. It lowers A1c by about 1–2% and does not cause low blood sugar or weight gain.
3. Add a GLP-1 receptor agonist (like semaglutide, dulaglutide, or liraglutide) by injection once weekly or daily, especially if the patient is overweight, has heart disease, or needs to avoid weight gain → GLP-1 agonists copy the gut hormone GLP-1 (glucagon-like peptide-1). They make the pancreas release insulin only when blood sugar is high (so you do not get dangerous lows), slow stomach emptying so you feel full longer and eat less (weight drops 5–15 pounds on average), and tell the brain 'you are satisfied, stop eating.' They also reduce heart attacks, strokes, and kidney-disease progression in people with existing heart or kidney problems.
4. Add an SGLT2 inhibitor (like empagliflozin, dapagliflozin, or canagliflozin) by mouth once daily, especially if the patient has heart failure, chronic kidney disease (eGFR ≥ 20), or needs to avoid weight gain → SGLT2 inhibitors block a transporter (sodium-glucose cotransporter 2) in the kidney tubules that normally pulls glucose back into the blood; instead, glucose spills into the urine (you pee out 60–80 grams of sugar a day), which lowers blood sugar and causes modest weight loss (3–5 pounds). They also protect the heart (fewer hospitalizations for heart failure) and slow kidney-disease progression even in people without diabetes.
5. Start basal insulin (like insulin glargine or degludec) injected once daily at bedtime, titrating the dose until fasting blood sugar is 80–130 mg/dL, when A1c stays $\geq 7\%$ despite metformin, GLP-1, and SGLT2 inhibitor → Basal insulin provides a steady, low level of insulin all day and night (like the pancreas normally does). It stops the liver from dumping glucose into the blood overnight and between meals, lowering fasting blood sugar. It directly forces glucose into muscle, fat, and liver cells—no need for the cells to 'listen' to a broken insulin signal.

Your top priorities at the bedside

1. Check blood glucose (blood sugar level) with fingerstick or review recent hemoglobin A1c (a blood test showing average sugar over 3 months) to confirm diagnosis and measure how high sugar is right now — why: Blood glucose above 126 when fasting or A1c above 6.5 percent confirms diabetes, and very high glucose above 400 may cause diabetic ketoacidosis (the acid crisis of missing insulin) or hyperosmolar state requiring emergency treatment

2. Measure blood pressure and confirm it is below 130 over 80, or notify provider if above this target — why: High blood pressure damages the kidneys' tiny filters (glomeruli) and causes heart attacks and strokes much faster in diabetes patients, so tight control prevents these complications
3. Calculate body mass index and discuss losing 5 to 10 percent of current weight through eating fewer calories and exercising 150 minutes each week — why: Weight loss improves insulin resistance by making muscle and fat cells respond better to insulin, often lowering A1c by 0.5 to 2 percent and may even reverse early diabetes