

T2dm

Type 2 diabetes happens when muscle, fat, and liver cells stop responding to insulin (the key that unlocks the door for sugar), and over years the pancreas gets tired of making extra insulin and slows down. The goal is to lower blood sugar and protect the heart, kidneys, eyes, and nerves from damage.

THE ONE-LINE TRUTH

The body's cells stop listening to insulin, so sugar piles up in the blood and damages organs over time.

The chain — how it unfolds

1. Cells stop listening to insulin (insulin resistance in muscle, fat, and liver). — why: Obesity (especially belly fat), inactivity, high-calorie diet, genetics, and aging cause the insulin receptor and its downstream signaling pathway (PI3K-Akt) to stop working well. The lock gets rusty, so the key (insulin) can't open the door, and glucose can't enter the cell.
2. The pancreas makes 2–3 times more insulin to force the rusty lock open (hyperinsulinemia). — why: Beta cells sense high blood sugar and try to fix it by releasing more insulin. For years this works—fasting sugar stays under 126 mg/dL—but the beta cells are working overtime, like running an engine at redline every day.
3. Beta cells burn out and start to die; insulin production drops (beta-cell failure). — why: Chronic high blood sugar (glucotoxicity) and high free fatty acids (lipotoxicity) poison the beta cells. They lose their ability to sense glucose, make less insulin, malfunction, and undergo apoptosis (programmed cell death). By diagnosis, 50% of beta-cell function is already lost; after 10–15 years, 80% may be gone.
4. Blood sugar rises and stays high (chronic high blood sugar (hyperglycemia)); the patient now meets diagnostic criteria (fasting glucose ≥ 126 mg/dL or HbA1c $\geq 6.5\%$ or random glucose ≥ 200 with symptoms). — why: With both high resistance and low insulin, glucose can't get into cells and piles up in the blood. The kidneys try to flush it out (glucosuria), which causes frequent urination (polyuria) and intense thirst (polydipsia). The patient may feel tired because cells are starving for fuel even though blood sugar is sky-high.

5. High glucose sticks to proteins in small blood vessel walls (glycation → advanced glycation end products, AGEs), breaking down capillaries in the eyes, kidneys, and nerves (microvascular disease). — why: Glucose binds non-enzymatically to collagen and other proteins in capillary basement membranes. This forms AGEs, which stiffen and thicken the vessel wall, narrow the lumen, trigger inflammation, and produce reactive oxygen species (oxidative stress). The smallest, most delicate vessels—retinal capillaries, glomerular capillaries in the kidney, and vasa nervorum (tiny vessels that feed nerves)—are hit first because they have the thinnest walls and least smooth muscle protection.
6. Microvascular complications appear: retinopathy (blurry vision, floaters, eventual blindness), nephropathy (protein in urine → swelling → kidney failure), and neuropathy (burning, tingling, numbness in feet and hands; also damages nerves to the gut, bladder, and heart). — why: Retina: damaged capillaries leak fluid and blood, new fragile vessels grow and bleed (proliferative retinopathy), leading to vision loss. Kidney: the glomerular filter breaks down, leaking protein (albumin) into urine; over years the kidneys scar and stop filtering waste (chronic kidney disease stage 3–5). Nerves: poor blood flow and high glucose damage the myelin sheath and axon, causing pain, loss of sensation, and autonomic dysfunction (gastroparesis, neurogenic bladder, silent heart attacks).
7. Large arteries harden and clog faster (accelerated atherosclerosis), raising the risk of heart attack, stroke, and peripheral artery disease (macrovascular disease). — why: High blood sugar, high insulin, chronic inflammation, abnormal lipids (high LDL and triglycerides, low HDL), and high blood pressure all damage the endothelium (inner lining of arteries). Plaque builds up, arteries narrow and stiffen, and clots form. Diabetes doubles or triples the risk of coronary artery disease and stroke, and these events happen 10–15 years earlier than in people without diabetes.
8. In severe cases, blood sugar climbs over 600 mg/dL and the blood becomes thick like syrup (hyperosmolar hyperglycemic state, HHS): the patient gets severely dehydrated, confused, and can slip into a coma. — why: When insulin is very low and blood sugar is extremely high, the kidneys try to flush out glucose by making huge amounts of urine (osmotic diuresis). The patient loses liters of water and becomes severely dehydrated. Blood osmolality (thickness) rises above 320 mOsm/kg, pulling water out of brain cells and causing altered mental status, seizures, or coma. HHS has 10–20% mortality and is a medical emergency. (Diabetic ketoacidosis is rare in type 2 diabetes because there is usually enough insulin to prevent fat breakdown into ketones; DKA is more common in type 1.)

Spot it — what you see, and why

- Peeing a lot (polyuria): When blood sugar climbs too high, the kidneys try to flush out the extra sugar by making more urine. Your body pulls water from your tissues to help wash the sugar out, so you pee more often and in larger amounts.

- Being very thirsty (polydipsia): Peeing a lot drains water from your body, so your brain's thirst center (the hypothalamus) signals you to drink more to replace what you've lost. High blood sugar also makes your blood thicker, which your body senses and tells you to drink.
- Losing weight without trying: Your cells can't use sugar for fuel without enough insulin working properly, so your body breaks down muscle and fat instead to get energy. You also lose calories in your urine because the sugar spills out instead of staying in your body.
- Feeling tired and weak all the time: Your cells aren't getting enough sugar to burn for energy because insulin isn't letting it in properly. It's like having a full gas tank but a broken fuel line — the fuel is there, but your engine can't use it.
- Blurry vision: High blood sugar pulls water out of the lens in your eye, changing its shape so it can't focus light clearly. This is usually temporary and gets better when blood sugar comes back down.
- Dark, velvety patches of skin (acanthosis nigricans): High insulin levels make skin cells grow faster in body folds like the neck, armpits, and groin. The extra cells pile up and make thick, dark patches. This is a sign that your body is struggling with insulin resistance.

Red flags — act now

- Confusion, extreme thirst, or very dry mouth with blood sugar over 600 (sign of hyperosmolar hyperglycemic state, a life-threatening emergency)
- Chest pain, trouble breathing, or pain in the jaw or arm (possible heart attack — diabetes raises heart disease risk)
- Sudden vision loss or floaters and flashes (could be bleeding in the eye from damaged blood vessels)
- A wound or sore that won't heal, is red and hot, or smells bad (sign of a serious infection that can spread)
- Severe belly pain, nausea, and vomiting with high blood sugar (could be diabetic ketoacidosis (the acid crisis of missing insulin), rare in type 2 but dangerous)

Treat it — in this order

1. Metformin (started at 500–850 mg once or twice daily, increased slowly to 1000 mg twice daily) → Metformin tells the liver to stop dumping extra sugar into the blood and makes muscle and fat cells listen to insulin better, so blood sugar drops and the pancreas does not have to work as hard. A1c typically falls 1–2 percentage points over 3 months.

2. GLP-1 receptor agonist (like semaglutide, liraglutide, or dulaglutide) if heart disease, heart failure, or high cardiovascular risk is present → GLP-1 agonists mimic a gut hormone that tells the pancreas to release insulin only when blood sugar is high, slows the stomach so you feel full longer (leading to weight loss), and directly protects the heart muscle. They lower A1c by 1–1.5 points and cut the risk of heart attack and stroke by about 15–25%.
3. SGLT2 inhibitor (like empagliflozin, dapagliflozin, or canagliflozin) if heart failure, chronic kidney disease ($\text{eGFR} \geq 20$), or high cardiovascular risk is present → SGLT2 inhibitors block a transporter in the kidney that normally pulls sugar back into the blood, so extra sugar (50–80 grams per day) leaves the body in urine. This lowers blood sugar, causes modest weight loss (2–3 kg), drops blood pressure slightly, and protects the heart and kidneys by reducing strain and inflammation. They cut heart-failure hospitalizations by about 30% and slow kidney decline.
4. Statin (like atorvastatin 10–80 mg daily or rosuvastatin 5–40 mg daily) → Statins block the liver enzyme that makes cholesterol, so LDL cholesterol drops by 30–50%. They also calm inflammation inside artery walls, making plaques less likely to rupture and cause heart attack or stroke. In diabetes, statins cut cardiovascular events by about 25–35%.
5. ACE inhibitor (like lisinopril 10–40 mg daily) or ARB (like losartan 50–100 mg daily) if blood pressure $\geq 130/80$ mmHg or if protein is leaking into urine ($\text{UACR} \geq 30$ mg/g) → ACE inhibitors and ARBs block hormones (angiotensin II) that squeeze blood vessels tight. This relaxes the tiny vessels in the kidneys, lowers the pressure inside the filters, and cuts protein leakage in half over months. Blood pressure also drops by 10–15 mmHg, protecting the heart and brain.

Your top priorities at the bedside

1. Check blood sugar with fingerstick glucometer and review the last hemoglobin A1c (3-month average sugar) result — why: A1c above 7 percent means blood sugar is too high for months. Current glucose shows if patient is safe now or needs immediate treatment. Both numbers guide which medicines to start or adjust.
2. Examine both feet completely including between toes, checking for cuts, blisters, redness, warmth, or foul smell — why: Neuropathy blocks pain signals so patients do not feel injuries. Infection can spread to bone causing osteomyelitis (bone infection) requiring amputation. Early detection saves limbs.
3. Measure blood pressure and check if patient is on a statin and ACE inhibitor or ARB — why: High blood pressure damages kidneys and increases stroke risk. Statins prevent heart attacks. ACE inhibitors or ARBs protect kidneys when protein leaks into urine. Most diabetic deaths are from heart disease, not high sugar.