

Neonatal Sepsis

Newborn infection is a race against time — broad antibiotics within one hour can save the baby's life, and most babies caught early do well.

THE ONE-LINE TRUTH

A newborn with an infection that can turn deadly fast because the baby's immune system is brand new and cannot fight germs yet.

The chain — how it unfolds

1. Bacteria enter the baby's bloodstream during birth (from mom's birth canal) or after birth (through the umbilical stump, skin, or medical devices like IV lines or breathing tubes). — why: The baby's immune system is brand new. Neutrophils (the white blood cells that eat bacteria) are fewer and slower, and the baby has not yet made antibodies against most germs. If mom did not pass enough protective antibodies through the placenta (for example, if she was not screened or treated for Group B Strep), the baby has almost no defense. Bacteria multiply quickly in the blood because nothing is stopping them.
2. The bacteria release toxins (endotoxin from Gram-negative bacteria like *E. coli*, or exotoxins from Gram-positive bacteria like Group B Strep) into the baby's bloodstream. — why: These toxins are recognized by the baby's immune cells (macrophages and endothelial cells lining blood vessels). The immune cells release inflammatory signals called cytokines — especially tumor tissue death (necrosis) factor-alpha (TNF- α), interleukin-1 (IL-1), and interleukin-6 (IL-6) — trying to sound the alarm and recruit more defenses. But in a newborn, this response is clumsy and overshoots, causing widespread inflammation instead of staying local.
3. Cytokines make blood vessels leaky (capillary leak) and cause blood pressure to drop (distributive shock). — why: TNF- α and IL-1 tell the endothelial cells lining blood vessels to loosen their tight junctions. Fluid (plasma) leaks out of the blood into the surrounding tissues, so the baby's blood volume drops and blood pressure falls. At the same time, blood vessels dilate (widen) instead of staying firm, which also lowers blood pressure. The baby's heart tries to compensate by beating faster, but eventually cannot keep up.

4. Organs do not get enough oxygen and nutrients (multiorgan dysfunction). The baby becomes lethargic, stops feeding, breathes fast or grunts, has low blood sugar (hypoglycemia), and may have seizures or pauses in breathing (apnea) (stop breathing). — why: With low blood pressure and leaky vessels, oxygen-rich blood cannot reach the brain, kidneys, liver, and gut. The brain becomes sluggish (lethargy, poor tone, seizures if severe). The liver cannot make new glucose, and the baby's cells are burning glucose rapidly to fight infection, so blood sugar drops. The kidneys make less urine (oliguria). The gut lining is starved of oxygen, so the baby cannot digest food and stops feeding. The lungs may fill with fluid (pulmonary swelling (edema)) or become stiff (acute respiratory distress syndrome, ARDS), making it hard to breathe — the baby breathes fast (tachypnea), grunts with each breath (to keep the lungs open), or stops breathing altogether (apnea).
5. The baby's temperature becomes unstable — either too high (fever $>38^{\circ}\text{C}$) or too low (hypothermia $<36.5^{\circ}\text{C}$). — why: Cytokines (especially IL-1 and IL-6) reset the hypothalamus (the brain's thermostat) to a higher set-point, causing fever. Fever helps the immune system fight infection but uses a lot of energy. Newborns, especially premature babies, have very little body fat and a large surface area relative to their weight, so they lose heat easily. If the baby cannot generate enough heat, body temperature drops (hypothermia), which is a sign of severe, life-threatening sepsis.
6. The blood clotting system goes haywire (disseminated intravascular coagulation, DIC). Tiny clots form throughout the body, using up platelets and clotting factors, and then the baby bleeds easily. — why: Bacterial toxins and cytokines activate the clotting cascade everywhere at once. Clots form in tiny blood vessels (capillaries) in the kidneys, lungs, brain, and skin, blocking blood flow and causing organ damage. Because platelets and clotting factors (like fibrinogen) are used up making all these clots, the baby's blood cannot clot normally. Bleeding appears — pinpoint bleeding spots (petechiae) (tiny red spots) or purple bleeding blotches (purpura) (larger bruises) on the skin, oozing from IV sites, or life-threatening bleeding in the brain (intraventricular bleeding (hemorrhage)) or lungs.
7. If bacteria reach the fluid around the brain and spinal cord (cerebrospinal fluid, CSF), the baby develops meningitis. Signs include a bulging soft spot (fontanelle), high-pitched cry, seizures, and worsening lethargy. — why: The blood-brain barrier in newborns is more permeable than in older children, so bacteria can cross into the CSF more easily. Once in the CSF, bacteria multiply and trigger inflammation in the meninges (the membranes covering the brain and spinal cord). The inflammation increases pressure inside the skull (because the brain swells and CSF production rises), which causes the soft spot to bulge. The inflamed brain is irritable (seizures, high-pitched cry) and does not function normally (deep lethargy, coma). Even with treatment, meningitis can cause permanent hearing loss (because the cochlear nerve is damaged), developmental delays, cerebral palsy, or hydrocephalus (fluid buildup in the brain).

8. Without fast treatment, the baby progresses to septic shock (blood pressure so low that organs shut down), then multiorgan failure, and death. — why: Once blood pressure drops below the level needed to perfuse vital organs (hypotensive shock), the kidneys stop making urine (acute kidney injury), the liver cannot clear toxins (jaundice worsens, lactate builds up), the heart muscle weakens (myocardial dysfunction), and the brain suffers irreversible damage from lack of oxygen (hypoxic-blood-starved (ischemic) encephalopathy). Even with IV fluids, vasopressors (medicines to raise blood pressure), mechanical ventilation, and antibiotics, mortality in septic shock is high. Early recognition and treatment — ideally starting antibiotics within one hour of recognizing sepsis — is the only way to stop this cascade before it becomes irreversible.

Spot it — what you see, and why

- Temperature instability — baby is too hot (fever over 100.4°F) or too cold (under 97.7°F): When bacteria or viruses invade a newborn's blood, the hypothalamus (the brain's temperature dial) gets confused by infection signals and can't hold a steady temperature, so the baby swings too hot or too cold.
- Poor feeding or won't suck: The infection uses up the baby's energy and makes the baby feel too tired and sick to eat; also, low blood sugar from fighting the infection dulls hunger.
- Breathing fast (over 60 breaths per minute) or grunting with each breath: Bacteria in the blood can spill into the lungs (pneumonia) or trigger inflammation that stiffens the lungs, so the baby has to work harder and breathe faster to pull in enough oxygen.
- Floppy or limp body (low muscle tone): The infection releases toxins that slow down signals in the nervous system, and low blood pressure from sepsis means less oxygen reaches the muscles, making the baby weak and floppy.
- Irritability or high-pitched cry: Bacteria or their toxins can irritate the meninges (the protective wrapping around the brain and spinal cord), causing pain and making the baby unusually fussy or cry in a shrill way.
- Skin looks pale, mottled (blotchy), or has a blue-gray tint: In sepsis, blood vessels leak and clamp down unevenly, so blood doesn't flow smoothly to the skin; also, low oxygen in the blood makes the skin look dusky or patchy.

Red flags — act now

- Pauses in breathing (Apnea) (baby stops breathing for more than 20 seconds) or turning blue
- Shock signs: very fast or very slow heart rate, weak pulses, capillary refill over 3 seconds, blood pressure dropping

- Bulging fontanelle (the soft spot on top of the head pushes outward) or stiff neck — signs meningitis may be present
- Pinpoint bleeding spots (Petechiae) or purple bleeding blotches (purpura) (tiny red or purple dots or larger bruises on the skin that don't fade when you press them) — may mean bacteria are causing blood to clot in small vessels

Treat it — in this order

1. IV ampicillin + gentamicin (early-onset sepsis, under 72 hours) or IV vancomycin + gentamicin (late-onset sepsis, over 72 hours) → Ampicillin kills Group B Streptococcus (GBS), Listeria, and Enterococcus by breaking down their cell walls. Gentamicin (an aminoglycoside) stops E. coli and Klebsiella from making proteins they need to survive. Vancomycin is used late because hospital germs are often methicillin-resistant Staph aureus (MRSA). Together they cover the most likely bacteria while you wait for the culture.
2. IV fluids with dextrose (sugar), usually D10W (10% dextrose in water) at 60–80 mL/kg/day → Delivers glucose directly into the bloodstream when the baby cannot eat. The brain uses 5 grams of glucose per kilogram per day, and without it, neurons die. IV fluids also keep blood volume up so blood pressure does not crash.
3. Supplemental oxygen or mechanical ventilation (CPAP, intubation with a ventilator) → Oxygen raises the amount of O₂ dissolved in blood (measured as SpO₂, kept above 90–95%). CPAP (continuous positive airway pressure) holds the alveoli (air sacs) open so they do not collapse. A ventilator breathes for the baby when the diaphragm (breathing muscle) is too tired or the brain is too sick to send breathing signals.
4. IV acyclovir (60 mg/kg/day divided every 8 hours) if herpes simplex virus (HSV) is suspected → Acyclovir stops herpes virus from copying its DNA, so it cannot spread to the brain, liver, and lungs. Herpes in newborns (caught from mom's genital herpes during birth) is deadly without treatment and looks like bacterial sepsis—blisters on the skin, seizures, lethargy. If there is any suspicion (mom with herpes history, vesicles on the baby, CSF with high red cells), start acyclovir while waiting for the HSV PCR test.
5. Fluid bolus (10–20 mL/kg normal saline IV push) and vasopressors (dopamine 5–20 mcg/kg/min or epinephrine) if blood pressure is low → A bolus of saline fills the blood vessels quickly, raising blood pressure by increasing volume. Dopamine and epinephrine (catecholamines) squeeze blood vessels (vasoconstriction) and make the heart pump harder, pushing blood to the brain, kidneys, and heart. In septic shock, vessels leak and widen (vasodilation) because bacterial toxins (like endotoxin from Gram-negative bacteria) damage the lining, so you need pressure support to keep organs alive.

Your top priorities at the bedside

1. Check blood sugar (glucose) every 2 to 4 hours and keep it above 40 to 50 mg/dL with IV dextrose (sugar water) — why: Sepsis burns through the baby's small sugar stores very fast causing low blood sugar (hypoglycemia) (low blood sugar) which damages the developing brain; newborns cannot make enough glucose on their own when they are sick
2. Monitor vital signs every 1 to 2 hours including temperature, heart rate, respiratory rate, blood pressure, and oxygen saturation — why: Sepsis causes instability in temperature control (too hot or too cold), a fast heart rate (tachycardia) (fast heart rate over 160) or a slow heart rate (bradycardia) (slow heart rate under 100), fast breathing (tachypnea) (fast breathing over 60), low blood pressure from vasodilation (widening blood vessels), and low oxygen (hypoxia) (low oxygen) from lung inflammation
3. Give IV antibiotics within 1 hour of sepsis recognition and before blood culture results come back — why: Every hour of delay in antibiotics increases mortality (death rate) and risk of permanent brain damage; broad-spectrum antibiotics kill the most likely bacteria while we wait 24 to 48 hours for cultures to grow and identify the specific germ