

CLABSI Prevention

Following strict sterile steps when placing and caring for central lines prevents bloodstream infections.

THE STORY IN ONE SENTENCE

Following strict sterile steps when placing and caring for central lines prevents bloodstream infections.

“Stop central-line bloodstream infections by using full sterile technique at insertion, scrubbing the hub before every access, checking daily if the line is still needed, and removing it as soon as possible.”

Normal anatomy — the body's job

Normally, blood flows inside veins in a completely sterile environment, sealed off from the outside world by intact skin and the vein wall.

BODY'S JOB

The skin acts as a barrier that keeps bacteria (which live on every inch of our skin surface) from reaching the bloodstream. Inside the veins, blood flows smoothly without any foreign objects, so bacteria have no place to land or stick. The immune system patrols the blood constantly, and any germ that accidentally gets in is usually caught and destroyed right away before it can multiply.

1. Skin surface: covered with billions of harmless bacteria (normal skin flora) that cannot penetrate healthy, unbroken skin.
2. Vein wall: a smooth, living layer of cells that keeps blood inside and germs outside.
3. Bloodstream: sterile fluid flowing under pressure, carrying oxygen, nutrients, and white blood cells that hunt for invaders.
4. White blood cells patrol continuously, destroying any stray bacteria before they can grow.
5. No foreign material in the vein means bacteria have no surface to cling to, so even if a few get in, they get swept away and killed.

What breaks

The break happens when a central line is placed without perfect sterile technique, left in place longer than needed, or accessed without cleaning the hub, giving bacteria a surface to stick to and a direct highway into the bloodstream.

CLINICAL TERM

Central-line-associated bloodstream infection (CLABSI) occurs when bacteria colonize the external or internal surface of the catheter, form biofilm, and seed the bloodstream, leading to systemic infection. The primary upstream failures are: (1) break in sterile insertion technique (inadequate skin antisepsis, failure to use maximal sterile barriers, choice of femoral site), (2) catheter dwell time beyond clinical necessity, and (3) contamination of catheter hubs during access without adequate disinfection.

How the body compensates

The body does not have a good way to compensate for bacteria growing on a central line, because the immune system cannot reach the biofilm that forms on the plastic surface. The only real defense is the immune response in the blood itself, which can hold off infection for a few days but eventually gets overwhelmed if the source (the contaminated catheter) is not removed.

1. At first, small numbers of bacteria stick to the catheter surface but have not yet formed a protective biofilm, so white blood cells in the blood can still kill some of them and the patient may have no symptoms.
2. Within 24 to 48 hours, bacteria start secreting a slimy substance called biofilm (also called glycocalyx), which coats the catheter and shields the bacteria from antibiotics and immune cells—this is the point where compensation starts to fail.
3. The immune system detects bacteria breaking off the biofilm into the bloodstream and responds by releasing chemicals called cytokines, which cause fever, chills, and increased heart rate (the body trying to fight the infection by raising temperature and speeding blood flow to bring more white blood cells to the area).
4. White blood cell count rises as the bone marrow pumps out more infection fighters, but because the source (the biofilm-coated catheter) is still in place, new bacteria keep seeding the blood faster than the immune system can clear them.
5. Blood pressure may stay normal for the first few hours because the body constricts blood vessels and increases heart rate to maintain flow, but this compensation is fragile and can collapse suddenly into septic shock (dangerously low blood pressure).

6. The crash point is septic shock: blood pressure drops, organs do not get enough oxygen, and the patient can die within hours if the infected catheter is not removed and antibiotics are not started immediately.
7. Watch for early warning signs before the crash: new fever in a patient with a central line, chills, tenderness or redness at the catheter site, or unexplained confusion (from bacteria or toxins affecting the brain)—these mean bacteria are seeding the blood and the window to act is closing.
8. A patient who looks stable but has a central line in place longer than seven days without daily necessity checks is on a slow downhill slope toward infection, even if vital signs are normal right now.

Domino effect

1. Central line is placed, creating a direct tunnel from the outside world into the bloodstream.
— The catheter goes through the skin (where billions of bacteria live) and sits inside a large vein. Even with good sterile technique, microscopic bacteria can land on the catheter surface during insertion or afterward when it is accessed.
2. Bacteria land on the catheter surface and stick to the plastic. — Plastic is not living tissue, so the body cannot send immune cells to patrol its surface. Bacteria attach using sticky proteins and find a safe place to settle, protected from the blood flow that would normally wash them away.
3. Within 24 to 48 hours, bacteria start making biofilm—a slimy, protective coating that glues them to the catheter and shields them from antibiotics and white blood cells. — Biofilm is like a fortress: bacteria inside it are up to 1,000 times more resistant to antibiotics than free-floating bacteria. Once biofilm forms, no amount of antibiotic will clear the infection unless the catheter is removed.
4. Bacteria multiply inside the biofilm, and clusters of them break off into the bloodstream every few hours. — As the biofilm gets thicker, pieces flake off and release showers of bacteria into the blood. Each release sends millions of germs throughout the body, triggering the immune system over and over.
5. The immune system detects bacteria in the blood and releases cytokines (chemical alarm signals), causing fever, chills, fast heart rate, and high white blood cell count. — Cytokines raise body temperature (because bacteria grow slower in heat), speed up the heart to deliver more oxygen and immune cells, and tell the bone marrow to make more white blood cells. This is the body's all-out defense response, but it also makes the patient feel very sick.

6. If the catheter stays in, bacteria keep seeding the blood faster than the immune system can kill them, and the infection spreads to other organs (lungs, kidneys, heart valves, brain). — Bacteria circulating in the blood can land anywhere. They can cause pneumonia in the lungs, abscesses in the kidneys, infected clots in the heart valves (endocarditis), or meningitis in the brain—all life-threatening complications.
7. Septic shock: the immune response becomes so strong that it damages the patient's own blood vessels, blood pressure drops dangerously low, and organs start to fail from lack of oxygen. — Cytokines make blood vessels leak fluid and dilate (widen), so blood pressure falls. The heart races but cannot pump enough blood to the organs. Kidneys stop making urine, the brain gets confused, and the lungs fill with fluid. Without immediate treatment (removing the catheter, giving IV fluids and antibiotics, and supporting blood pressure with medications), the patient can die within hours.
8. Even if the patient survives, they face weeks of IV antibiotics, possible surgery to drain abscesses, permanent damage to heart valves, and a much higher risk of dying in the hospital. — CLABSI turns a routine ICU stay into a life-threatening emergency, doubles the length of hospitalization, costs tens of thousands of extra dollars, and kills up to 25% of patients who develop it—yet it is completely preventable by following the bundle every single time.

Symptoms · what the patient feels, and why

- The central line is still in place but the patient no longer needs IV medicine or fluids: A line that stays in longer than needed gives bacteria extra time to crawl along the outside or inside of the tube and reach the bloodstream, causing infection.
- The line has been in for more than 7 days without a clear ongoing need: Every extra day the line stays in increases the chance that bacteria from the skin or the connection points can travel down into the vein and multiply in the blood.
- The patient can now swallow pills or drink fluids safely: When the patient can take medicines by mouth and does not need fast IV access, the central line becomes unnecessary and only adds infection risk without benefit.
- The dressing around the line is loose, wet, or dirty: A damaged dressing lets bacteria from the skin or the air touch the insertion site and crawl into the vein along the outside of the catheter.
- The care team has not documented why the line is still needed today: Without a clear daily reason written down, the line may stay in out of habit or convenience rather than true medical need, raising infection risk needlessly.
- The connection cap or hub is handled without clean gloves or alcohol scrub: Bacteria from hands or the environment can be pushed into the line during each connection, traveling straight into the bloodstream and causing a blood infection.

- Fever or chills appear while the central line is in place: Bacteria growing inside the line or at the tip release toxins into the blood, triggering the body to raise its temperature and shake to try to kill the germs.
- Redness, warmth, or pus draining at the insertion site: White blood cells rush to the area to fight bacteria that have entered through the skin opening, causing inflammation (swelling, heat, and sometimes liquid pus).

Focused exam

- Redness, warmth, swelling, or pus draining from the spot where the line enters the skin: This is where bacteria first break in. If the skin around the line looks angry or wet, germs have already slipped past your barrier and are climbing up the tube into the bloodstream. CLABSI prevention starts at this exact spot.
- New fever (temperature $\geq 38^{\circ}\text{C}$ or $\geq 100.4^{\circ}\text{F}$) with no other clear cause like pneumonia, a wound infection, or a urinary tract infection: Bacteria living on the line shed little clumps into the blood every time the heart pumps. Your immune system sees invaders and cranks up the body's thermostat to fight them. When nothing else explains the fever and a central line is in place, the line is guilty until proven innocent.
- Cloudy fluid, gunk, or crusting around the line hub (the plastic connector where you attach syringes or IV bags): Bacteria form a slimy sticky house — called a biofilm — on the inside of the tube within 24 to 48 hours. You cannot see biofilm from the outside, but a dirty hub tells you germs are likely living inside. Every time you open that hub without cleaning it with alcohol, you push more bacteria straight into the blood.
- Central line has been in place for more than 5 to 7 days, and the patient no longer has a clear medical reason to keep it: Every extra day the line stays in doubles the chance bacteria will stick to it and form a biofilm. The longer the line lives in the vein, the bigger the bacteria colony grows. Ask every single morning: 'Does this patient still need this line today?' If the answer is no, take it out.
- The line was placed in the groin (femoral vein) instead of the chest (subclavian vein) or neck (internal jugular vein): Groin lines have the highest CLABSI rate because the skin there is warm, moist, and covered with more bacteria from sweat, urine, and stool. It is much harder to keep that area sterile. The groin is riskier from the moment the line goes in.
- Dressing over the line site is loose, peeling off, wet, soiled with blood or fluid, or missing: The dressing is your shield between the outside world and the hole in the skin. If it fails, bacteria march straight down the tunnel into the vein. A clean, dry, tight dressing is not optional — it is the front-line defense. Check it every day and change it immediately if it looks bad.

- New confusion, low blood pressure (systolic < 90 mmHg), fast heart rate (> 100 beats per minute), fast breathing (> 20 breaths per minute), or low oxygen level — and the patient has a central line in place: These are signs the infection has spread from the line into the whole bloodstream and the body is starting to fail (sepsis). Bacteria dump toxins into the blood, blood vessels leak fluid, blood pressure drops, and organs do not get enough oxygen. CLABSI can turn into life-threatening sepsis within hours. This is a medical emergency.

Diagnostics · every test answers a question

- Blood cultures drawn from two sites: one from the central line and one from a different vein (peripheral stick) → Are bacteria growing in the bloodstream, and did they come from the central line?
- White blood cell count (WBC) → Is the immune system fighting an infection?
- C-reactive protein (CRP) or procalcitonin → Is there inflammation in the body from a bacterial infection?
- Lactate level → Is the body starting to fail because infection is blocking oxygen delivery to cells?
- Complete metabolic panel (CMP) including creatinine and liver enzymes → Are the kidneys and liver still working, or is sepsis damaging organs?
- Chest X-ray → Is there pneumonia or another lung problem causing the fever instead of the line?
- Urinalysis and urine culture (if the patient has a urinary catheter or urinary symptoms) → Is a urinary tract infection causing the fever instead of the central line?

Treatment logic

- Strict hand hygiene, full sterile barrier precautions (cap, mask, sterile gown, sterile gloves, large sterile drape covering the whole body), and chlorhexidine antiseptic skin scrub at the insertion site when placing the line → Stops bacteria on your hands and the patient's skin from hitching a ride onto the catheter the moment it goes in. This is the single most important second — bacteria either get onto the line now or they do not. Full sterile technique cuts CLABSI risk by more than half.
- Daily chlorhexidine skin bath (2% cloths or solution), sterile transparent dressing changes every 7 days (or every 2 days if gauze), and scrub every hub and port with alcohol or chlorhexidine for at least 15 seconds before every single access → Kills bacteria living on the skin around the line before they crawl up the outside of the tube. Keeps the entry site clean and the connectors sterile so you do not push germs into the bloodstream every time you touch the line.

- Ask every single day during morning rounds: 'Does this patient still need this central line today?' Remove the line the moment it is no longer medically necessary → Eliminates the surface bacteria stick to. No line = no place for biofilm to grow = no CLABSI. Early removal is the most powerful prevention step after the line is already in.
- Use chlorhexidine-impregnated dressings or antimicrobial-coated central lines (silver, antibiotics, or antiseptics bonded to the catheter surface) when the line must stay in for more than a few days → Makes the catheter surface toxic to bacteria so they cannot stick and build a biofilm home as easily. Buys you extra protection when the line has to stay in longer.
- Avoid placing the line in the groin (femoral vein) whenever possible; choose the chest (subclavian vein) or neck (internal jugular vein) instead → Moves the line away from the warm, moist, bacteria-rich groin area to a cleaner site that is easier to keep sterile. Upper-body lines have half the CLABSI rate of groin lines.
- Do NOT use antibiotic locks (filling the line with concentrated antibiotic solution between uses) or systemic antibiotics as routine prevention in patients without infection → Prevents bacteria from becoming resistant to antibiotics by not exposing them to drugs unnecessarily. Saves antibiotics for when you truly need them to treat an active infection.
- If CLABSI is confirmed, remove the infected central line and start appropriate IV antibiotics based on blood culture results (usually vancomycin plus an antipseudomonal beta-lactam like cefepime or piperacillin-tazobactam as initial empiric therapy) → Removes the bacteria house (the biofilm-coated catheter) and kills bacteria circulating in the blood. Antibiotics alone cannot sterilize a biofilm-covered line, so the line must come out.

Medications

Chlorhexidine gluconate 2% solution (skin antiseptic) · Topical antiseptic disinfectant

Chlorhexidine kills bacteria and some fungi by punching holes in their outer walls and making their insides spill out. Think of it like popping a water balloon—once the wall breaks, the germ can't survive. It works fast (within seconds) and leaves a thin protective film on the skin that keeps killing germs for hours after you apply it.

1. You scrub the skin with chlorhexidine solution in a back-and-forth motion for at least 30 seconds.
2. The chlorhexidine molecules stick to the negatively charged bacterial cell walls.
3. They punch through the wall and leak into the germ's interior.
4. Critical proteins and salts pour out; the germ dies within seconds.

5. A thin film of chlorhexidine stays on the skin and keeps killing new germs that land there for up to 48 hours.

SAFETY WATCH

Never let chlorhexidine touch the eyes, ears, or brain tissue—it can cause permanent damage to those delicate areas. · Do NOT use it on babies younger than 2 months; their thin skin can absorb too much and cause rare but serious reactions. · Rarely, some people are allergic and get a rash, itching, or (very rarely) trouble breathing—stop using it and switch to another antiseptic if this happens. · Let it dry completely (at least 30 seconds) before inserting the catheter, or it won't work as well.

Chlorhexidine-impregnated dressing or sponge (e.g., Biopatch) · Topical antiseptic dressing

This is a small foam pad or clear bandage soaked with chlorhexidine. You place it directly over the spot where the catheter enters the skin. It slowly releases chlorhexidine for days, creating a germ-killing zone right at the entry site—like a tiny guard standing at the door. This constant low dose keeps bacteria from crawling along the outside of the catheter into the bloodstream.

1. You place the chlorhexidine sponge or dressing snugly around the catheter base after cleaning the site.
2. Chlorhexidine seeps out slowly and continuously over 5 to 7 days.
3. Any bacteria that land on the skin or try to travel along the catheter surface meet the chlorhexidine and die.
4. The dressing is changed weekly (or sooner if it gets wet or loose) to keep protection going.

SAFETY WATCH

Same allergy and skin-irritation risks as liquid chlorhexidine—watch for redness, itching, or rash. · Do NOT use on premature infants or babies under 2 months without clear benefit, because their skin can absorb too much. · If the dressing gets wet or peels off, replace it right away—it loses its protection once compromised.

Chlorhexidine gluconate 2% or 4% cloths or liquid (daily skin bath) · Topical antiseptic cleanser

Every day in the ICU, the patient's whole body (or at least the upper body and catheter area) is wiped down with chlorhexidine-soaked cloths or washed with diluted chlorhexidine liquid. This cuts down the total number of bacteria living on the skin all over the body. Fewer bacteria on

the skin means fewer chances for germs to sneak into the catheter site or onto the nurses' hands when they touch the patient.

1. A nurse wipes the patient's skin with pre-moistened chlorhexidine cloths (no rinsing needed) or washes with chlorhexidine solution and then rinses.
2. Chlorhexidine kills surface bacteria the same way it does at the insertion site—by breaking their outer walls.
3. The patient's skin germ count drops sharply and stays lower for hours.
4. This is repeated every 24 hours while the central line is in place.

SAFETY WATCH

Avoid the face, eyes, ears, and mucous membranes (mouth, genitals). · Watch for skin dryness or irritation with daily use—some patients need moisturizer. · Same allergy cautions; stop if rash or breathing trouble occurs. · Not recommended for routine use in newborns under 2 months.

Antimicrobial-coated or impregnated catheters (e.g., chlorhexidine-silver sulfadiazine or minocycline-rifampin) · Antimicrobial-impregnated medical device

These special catheters have antiseptic or antibiotic chemicals baked into the plastic tubing itself. As bacteria land on the catheter or try to form a sticky film (biofilm) on its surface, the chemicals slowly leak out and kill the germs before they can multiply. It's like the catheter has its own built-in germ defense. This helps when the central line will stay in for more than a few days and the patient is at high risk for infection.

1. The catheter is inserted using the same full sterile technique as a standard line.
2. Antimicrobial agents embedded in the catheter material slowly release over days to weeks.
3. Bacteria that touch the catheter surface are killed or cannot stick and grow.
4. This reduces the chance of biofilm formation and bloodstream infection.

SAFETY WATCH

Rarely, patients can be allergic to the coating chemicals (especially sulfa drugs in silver sulfadiazine)—check allergy history first. · Minocycline-rifampin catheters should not be used in patients allergic to tetracycline antibiotics or rifampin. · Antimicrobial catheters cost more and are usually reserved for patients at highest risk (e.g., long ICU stays, prior CLABSI, weak immune system) when basic prevention is not enough. · They do NOT reduce the need for daily line necessity checks and prompt removal when no longer needed.

70% isopropyl alcohol or alcohol-chlorhexidine swabs (hub and connector disinfection) · Topical antiseptic disinfectant

Every time a nurse or doctor opens the catheter hub (the cap or connection point) to give medicine or draw blood, germs from hands or the air can sneak in. Scrubbing the hub with an alcohol pad (or alcohol-chlorhexidine combination) for at least 15 seconds kills those surface germs instantly. Alcohol works by dissolving the fatty outer layer of bacteria and viruses and drying them out—like pouring rubbing alcohol on a spill; the germs can't survive. This simple step is one of the most important daily prevention actions.

1. Before accessing the line, scrub the hub or port with an alcohol pad using friction for 15 seconds (some guidelines say 'scrub the hub' like scrubbing a doorknob).
2. Alcohol dissolves the germ's outer membrane and evaporates, carrying water out of the germ and killing it.
3. Let the hub dry completely (a few seconds) so alcohol has time to work.
4. Then attach the syringe or IV tubing using clean, no-touch technique.

SAFETY WATCH

Alcohol is flammable—keep away from open flames or cautery devices during procedures. · Let it dry fully before inserting anything; wet alcohol can be pushed into the bloodstream and sting or (rarely) cause vein irritation. · Repeated use can dry out and crack rubber or silicone hub materials over time, so hubs are changed regularly (every 3–7 days or per protocol). · Non-toxic and safe for nearly everyone; allergic reactions to isopropyl alcohol are extremely rare.

Red flags

- Fever, chills, or low blood pressure in a patient with a central line (may signal bloodstream infection)
- Central line left in place without a clear documented reason for ongoing use
- Redness, swelling, warmth, or pus at the line insertion site

Nursing priorities

1. Perform hand hygiene with soap and water or alcohol-based hand rub before and after every contact with the central line or dressing. — Hand hygiene removes bacteria from the nurse's hands, preventing transfer of germs to the catheter site or hub that could enter the bloodstream.

2. Scrub every catheter hub and needleless connector with 70% alcohol or chlorhexidine-alcohol for at least 15 seconds and let it dry completely before accessing the line. — Vigorous scrubbing and drying kills bacteria on the hub surface that would otherwise be pushed into the bloodstream during medication or fluid administration.
3. Assess daily whether the central line is still medically necessary and advocate for removal as soon as it is no longer needed. — Each extra day a central line remains in place increases the cumulative risk of bloodstream infection; prompt removal is the most effective prevention strategy.
4. Give the patient a daily bath using 2% chlorhexidine cloths or solution from the neck down, avoiding mucous membranes and open wounds. — Chlorhexidine reduces the number of bacteria living on the skin surface, decreasing the reservoir of germs that can migrate along the catheter into the bloodstream.
5. Change the transparent dressing every 7 days or immediately if it becomes loose, damp, soiled, or visibly contaminated; use sterile gloves and clean the skin with chlorhexidine antiseptic. — An intact dressing creates a barrier against skin bacteria; chlorhexidine antiseptic at dressing changes kills organisms at the insertion site before they enter the catheter tract.
6. Inspect the insertion site every shift for redness, swelling, warmth, tenderness, or drainage, and report abnormal findings immediately. — Early signs of local infection can progress rapidly to bloodstream infection if not detected and treated; visual inspection allows early intervention.
7. Monitor the patient's temperature, heart rate, and blood pressure every 4 to 8 hours and report fever above 100.4°F (38°C), chills, or unexplained low blood pressure. — Fever and hemodynamic changes may be the first signs that bacteria from the catheter have entered the bloodstream, requiring immediate blood cultures and treatment.
8. Ensure all IV tubing and caps are changed according to facility policy, typically every 96 hours for continuous infusions and every 24 hours for blood products or lipid infusions. — Biofilm (a sticky layer of bacteria) builds up inside tubing over time; scheduled changes reduce the bacterial load that can migrate back into the catheter and bloodstream.

Sources

- SHEA/IDSA Practice Recommendation: Strategies to Prevent Central Line-Associated Bloodstream Infections in Acute Care Hospitals, 2014
- CDC Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011 (updated 2017)
- Institute for Healthcare Improvement (IHI) Central Line Bundle

Last reviewed: 2026-07-07