Catheter-Related Bloodstream Infections (CRBSIs): Guidelines for Prevention

What We Know

› Catheter-related bloodstream infection (CRBSI) is defined as bacteremia or fungemia in a patient with an intravascular catheter, one or more positive blood cultures from a peripheral vein, no other apparent source of infection, and clinical signs and symptoms of infection (e.g., fever, chills, and/or hypotension).\(^{(15)}\) CRBSI is the result of bacterial or fungal seeding from biofilm that develops on the inside or outside surface of an indwelling catheter or from contamination of the fluid that is being administered through the device\(^{(1)}\)

• A central line-associated bloodstream infection (CLABSI) is defined as a laboratory-confirmed bloodstream infection (LCBI) in a patient who has a central venous catheter (CVC; i.e., vascular access device placed in one of the large veins of the central venous system) or an umbilical catheter (i.e., a central vascular device inserted through the umbilical artery or vein of a neonate)\(^{(4)}\)

› According to guidelines for prevention of intravascular catheter-related infection issued by the United States Centers for Disease Control and the Prevention Healthcare Infection Control Practices Advisory Committee (CDC/HICPAC) and endorsed by the Infectious Diseases Society of America (IDS) and the Association for Professionals in Infection Control and Epidemiology (APIC), the following is recommended:\(^{(10,11,12,13,14,15,16)}\)

• Hand hygiene should be performed before and after contact with intravascular catheter insertion sites (e.g., contact during insertion, replacing, accessing, repairing, dressing, and palpating)

• Use of aseptic technique
  – General aseptic nontouch technique (ANTT; i.e., the skin is not touched after it is prepared with antiseptic cleanser) should be observed for most catheter-related care
  – Surgical aseptic technique should be followed during insertion of CVCs

• Use of personal protective equipment (PPE)
  – Peripheral intravascular catheters: Nonsterile gloves can be worn during insertion and care if ANTT is observed
  – Arterial, central, and midline catheters: Sterile gloves should be worn for insertion; nonsterile or sterile gloves can be worn during dressing changes

• Using maximal sterile barrier precautions: All maximal barrier precautions (e.g., cap, mask, sterile gloves and gown, and a sterile full-body drape) should be utilized for insertion of CVC and arterial and midline catheters, and for performing guidewire exchange

• Using an antiseptic agent for skin preparation and for cleaning intravascular devices
  – Peripheral intravascular catheters: 70% alcohol, tincture of iodine, an iodophor, or chlorhexidine gluconate (CHG) with alcohol can be used to prepare the skin prior to catheter insertion and to clean injection ports before accessing the intravascular device
  – CVC and peripheral arterial catheters: > 0.5% CHG with alcohol is recommended for cleansing the skin prior to catheter insertion, during dressing changes, and to clean injection ports before accessing the intravascular device. If CHG is contraindicated, tincture of iodine, an iodophor, or 70% alcohol can be used as an alternative
− No recommendation was made for the safety or efficacy of CHG in infants < 2 months of age; povidone-iodine, 70% alcohol, or other antiseptic solution should be considered for these patients

- The U.S. Food and Drug Administration (FDA) has advised that CHG be used with caution in premature infants and infants < 2 months of age because CHG can cause irritation or chemical burns (18)

- Other than noting that a sufficient amount of solution must be used to cover the site and establish an adequate border, a literature search does not produce a definitive answer regarding the correct amount of solution or the number of swabs (e.g., 3 swabs with 3 mL of solution or a single swab with 10 mL of solution) to be used to cleanse the insertion site

− Although the CDC issued guidelines in 1999 that were updated in 2002 that recommended using concentric circles based on Category II evidence (i.e., supported or suggested by results of clinical or epidemiologic studies or theoretical rationale), the 2011 guidelines, which are the most current available guidelines issued by the CDC, do not contain a recommendation regarding the proper technique to be used in cleansing the skin. The majority of sources agree that simply painting the skin with antiseptic solution is inadequate and recommend a scrubbing technique that employs friction to loosen dead skin so the cleansing prep can penetrate the surface layers of skin. A friction scrub is important because many newer applicators are cotton swabs instead of gauze sponges

− The antiseptic solution should be allowed to completely air dry according to manufacturer recommendation before inserting the catheter or applying a dressing

− Some sources recommend removing povidone-iodine residue with isopropyl alcohol 70% to minimize skin irritation resulting from the iodine

− Although the FDA called for a class-wide label change outlining minimum drying times for topical skin preparation products containing alcohol, including ChloraPrep (2% CHG in 70% isopropyl alcohol; an FDA-approved product line manufactured by CareFusion), the impetus for the label change was not a concern about the effectiveness of CHG as an antiseptic skin cleanser, it was concern for patient safety during surgical procedures related to the flammable property of alcohol, and applies only to surgical settings where risk for ignition is a concern (3)

− Use of dressings: Use either sterile gauze or sterile, transparent, semipermeable dressings to cover the catheter site unless the patient is diaphoretic or the site is bleeding or oozing, in which case a gauze dressing should be used until the bleeding or oozing is resolved; CHG-impregnated dressings may be used

− Researchers in a study reported a significantly lower CLABSI rate in patients with CHG-impregnated dressings (1.51:1,000 central venous line [CVL] days) than in patients with standard dressings (5.87:1,000 CVL days) (2)

− Use of antibiotic ointment: Except for dialysis catheters, the CDC recommends against use of a topical antibiotic ointment or cream at the insertion site due to the increased risk of promoting fungal infection and antimicrobial resistance

− Daily use of a cleansing agent: A 2% CHG wash should be used for routine skin cleansing

− Investigators at a regional medical center that tracked the rate of CLABSI reported a statistically significant reduction in the rate of CLABSI (from 5.7 to 0.2) after implementation of a CHG bathing policy that required daily patient baths using 2% CHG (9)

− All stopcocks should be capped when not in use

− Chlorhexidine/silver sulfadiazine or minocycline/rifampin-impregnatedCVCs should be used in patients whose catheter is expected to remain in place for > 5 days in circumstances in which CLABSI rates have not decreased despite the implementation of a comprehensive CLABSI risk reduction program (13)

− Cochrane reviewers found that the magnitude of the benefit of the use of antimicrobial-impregnated CVCs varies by clinical setting, and the practice is associated with significant reduction in rates of CRBSI only in ICU settings; they reported that antimicrobial-impregnated CVCs do not appear to reduce rates of sepsis and mortality (8)

› The CDC/HICPAC 2011 guidelines recommend the following schedule for replacement of dressings for intravascular catheters: (13)

− Gauze dressings should be changed every 2 days

− Transparent dressings should be changed every 7 days, except in pediatric patients when the risk of dislodging the catheter may outweigh the value of changing the dressing

− Tunneled or implanted CVC sites with transparent dressings should be changed once per week until healed

− No recommendation is made for the necessity of a dressing on well-healed exit sites of long-term cuffed or tunneled CVCs

− Regardless of scheduled change, dressings should be replaced if they become visibly soiled, damp, or loosened. The dressing should be removed to allow thorough examination of the insertion site if the patient reports tenderness at the site, when unexplained fever is present, or when there are other clinical indications of local or bloodstream infection
The CDC/HICPAC 2011 guidelines for scheduled replacement of administration sets, which include equipment extending from the spike of tubing entering the fluid container to the hub of the vascular access device, including extension tubing, are as follows:\(^{(13)}\)

- Administration sets, secondary sets, and add-on devices that are in continuous use should be replaced no more frequently than at 96-hour-intervals, but at least every 7 days
- Tubing used for blood, blood products, or fat emulsions (i.e., lipid mixtures combined with amino acids and glucose in a 3-in-1 admixture or infused separately) should be replaced within 24 hours of beginning the infusion
- Tubing used to administer propofol should be replaced in 6–12 hours of initiation of the infusion, when the medication container/cartridge is replaced, or according to manufacturer instructions
- The CDC did not make a recommendation regarding the frequency of changing intermittently used administration sets

The Clinical Practice Guidelines of the IDS recommend the following in the event of suspected CRBSI:\(^{(11)}\)

- Exudate at the catheter exit site should be swabbed in order to collect specimens for culture analysis and Gram stain
- The CVC should be removed and the proximal tip (not the subcutaneous segment) should be cultured

The CDC/HICPAC 2011 guidelines recommend that if the rate of CLABSI in temporary short-term catheters is refractory to basic prevention strategies (e.g., education and training, appropriate use of CHG for skin antisepsis and maximal barrier precautions), CHG-impregnated sponge dressings can be used for patients who are older than 2 months of age\(^{(13)}\)

- In 2011, investigators reported that CHG-impregnated sponges were a cost-effective method of preventing CRBSI in patients with CVCs\(^{(19)}\)

The evidence-based Central Line Bundle (referred to as the Bundle; i.e., a group of evidence-based interventions for patients with intravascular central catheters) delineated by the Institute for Healthcare Improvement (IHI) was reviewed for this paper. However, even though the interventions recommended by the Bundle have been validated as manageable and reproducible, it was excluded as a source because recommended techniques for key components (e.g., hand hygiene, chlorhexidine skin antisepsis) are not reflective of the most current available evidence\(^{(6,7)}\)

Cochrane reviewers found insufficient evidence to determine which interventions for improving professional adherence to guidelines for prevention of CLABSI are most effective\(^{(5)}\)

- Legal mandates for reporting of CLABSI may lead to improved adherence to prevention practices. Investigators reported that the rate of 95% compliance to at least one CLABSI prevention practice in NICUs ranged from 52.3% to 66.4% in states with legal mandates for data submission of CLABSI, compared with 28.9–48.2% in states without such mandates\(^{(20)}\)

Researchers who developed a historical economic model estimated that CLBSI prevention efforts of the CDC resulted in net economic benefits ranging from $640 million to $1.8 billion during the period 1990–2008\(^{(17)}\)

### What We Can Do

- Learn about the risk of CRBSI so you can accurately assess your patients’ personal characteristics and health education needs; share this information with your colleagues
- Adhere to the clinical practice guidelines and recommendations of the CDC, IDS, and APIC regarding the prevention of CRBSIs
- Educate and encourage discussion with your colleagues about the risk of CRBSI and strategies for prevention, treatment, and management of CRBSI
- Be aware of the recommendations of the CDC/HICPAC and IDS regarding management of suspected CRBSI and refractory CLBSI

### Coding Matrix

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<th>Code</th>
<th>Description</th>
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<td>Published meta-analysis</td>
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<td>SR</td>
<td>Published systematic or integrative literature review</td>
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<tr>
<td>RCT</td>
<td>Published research (randomized controlled trial)</td>
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<td>R</td>
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<td>Case histories, case studies</td>
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References


