5 steps to
When your patient has an I.V. catheter in place, he’s constantly at risk for a catheter-related bloodstream infection (CR-BSI). The catheter type, the frequency of access or manipulation, and the patient’s clinical status are some of the factors that affect his level of risk and play a role in the overall rate of CR-BSIs.

Central venous catheters (CVCs) are associated with more infections—and more serious infections—than short peripheral catheters. A patient who requires a CVC is typically more ill and more vulnerable to infection than a patient who doesn’t require one. Also, the catheter for this type of patient is likely to be accessed more frequently, so his potential exposure to microorganisms is increased.

The problem of CR-BSIs is so widespread that the Institute for Healthcare Improvement (IHI) listed the reduction of CVC-related infections as one of the six major initiatives in its 100,000 Lives Campaign. The campaign aims to engage U.S. hospitals in a commitment to implement changes in care that have been shown to improve patient care and prevent avoidable deaths. The Institute of Medicine has also identified the prevention of nosocomial infections, including CR-BSI, as a priority area for national action, and the Joint Commission on Accreditation of Healthcare Organizations included reducing the risk of health-care associated infections, including CR-BSI, in its 2005 National Patient Safety Goals.

In this article, I’ll spell out the IHI’s 100,000 Lives Campaign recommendations and discuss how your facility can implement them. I’ll also review pertinent CR-BSI prevention guidelines that were released by the Centers for Disease Control and Prevention (CDC) in 2002.

The scope of the problem
About one-half of all patients in intensive care units (ICUs) have some type of CVC in place. This accounts for about 15 million catheter-days per year (see Counting catheter-days).

According to the CDC, about 80,000 patients annually develop a CVC infection. Keep in mind that these data are based on studies of ICU patients alone. Meaningful information on CR-BSIs in medical-surgical units, home
Hub manipulation is the most common factor in reducing CR-BSIs in short-term catheters.

3. True or false: Hub manipulation is not a factor in CR-BSIs in short-term catheters.

4. According to the IHI, which of these is not an important factor in reducing CR-BSIs?
   a. Routinely replacing CVCs
   b. Using maximal barriers during catheter insertion
   c. Using chlorhexidine gluconate for antisepsis

Hand hygiene: At your fingertips

Studies have repeatedly shown that health care workers inevitably have contaminated hands. Even seemingly “clean” procedures like taking vital signs or lifting a patient can leave as many as 1,000 colony-forming units of Klebsiella species on your hands. When you touch a patient or anything in his room, you can pick up Gram-negative bacilli, Staphylococcus aureus, or enterococci—all of which are reported causes of CR-BSIs. These are good reasons why you should consider performing all infusion therapy procedures before you complete your other nursing care tasks.

Decontaminating your hands with an alcohol-based hand cleaner is appropriate in most circumstances, but washing with antimicrobial soap and water is essential if your hands are visibly contaminated with blood or body fluids.

Because frequent washing can break down your skin and create cracks and fissures where more organisms can reside, be sure that you also use alcohol-based hand cleaners containing emollients to improve your skin’s integrity. If you want to use a hand lotion as well, only use one that’s compatible with the antiseptic agents your facility provides. Your favorite lotion from

How organisms invade

The first step in developing effective strategies for combating CR-BSI is to examine how infectious organisms are introduced into the body. Let’s review the most common sources.

- **Catheter insertion** breaks the skin, creating an open pathway for organisms to enter the patient’s bloodstream. Skin antisepsis with even the best agents and the most skilled technique can’t eliminate all organisms in the lower layers of the epidermis. As a result, the catheter passing through the skin can contact these organisms.

- **Accessing the catheter** to administer medication, flush the line, and change tubing or caps introduces microorganisms into the lumen. Hub manipulation is the most common source of infection in long-term catheters; however, it can trigger CR-BSIs in short-term catheters as well.

- **Infection** elsewhere in the body, such as in the urinary tract, can also lead to a CR-BSI. Organisms infecting other sites or systems can move to the foreign object—the CVC—and cause a CR-BSI.

- **Contaminated fluid or medications**, although considered rare causes of CR-BSI, nevertheless pose a risk. Outbreaks of human immunodeficiency virus (HIV) and hepatitis B and C have been attributed to contaminated multidose vials. Polymicrobial outbreaks in a liver transplant unit, an oncology unit, and a cardiac step-down unit have all been traced to large bags of sodium chloride solution that are used for multiple catheter flushes.

Armed with this information on how CR-BSIs begin, the IHI developed five components of care aimed at reducing the overall risk to patients. The primary focus is on CVC insertion and nursing interventions:

- Perform proper hand hygiene.
- Use maximal barriers during catheter insertion.
- Provide antisepsis with chlorhexidine gluconate.
- Choose an appropriate insertion site.
- Avoid routine CVC replacement.

According to the IHI, implementing just one or two of these components won’t get the desired results. The best way to avoid CR-BSIs is to follow all five recommendations. In a moment, I’ll take a closer look at each of them. But first, let’s test your knowledge.

**Self-Test**

1. According to the CDC, how many patients develop a CR-BSI each year?
   a. 50,000
   b. 80,000
   c. 100,000

2. True or false: The most common means of introducing infectious organisms into the body is contaminated medications.
Chipped nail polish may support the growth of more organisms. Although freshly applied nail polish doesn’t increase bacteria on the skin around the nails, chipped nail polish may support the growth of more organisms. Fingernail care is an important aspect of hand hygiene. Short, natural nails are best. If you have direct contact with high-risk patients, don’t wear artificial nails or nail extenders. They can keep Gram-negative pathogens at your fingertips even after you’ve performed hand hygiene. CDC guidelines also state that although freshly applied nail polish doesn’t increase bacteria on the skin around the nails, chipped nail polish may support the growth of more organisms.

Maximal barrier precautions: Dressing for success
To decrease the risk of contamination and infection, all members of the infusion therapy team should use maximal barriers during insertion of all CVCs, including peripherally inserted central catheters (PICCs). This preventive measure carries the highest recommendation in the CDC guidelines.

If you assist with a CVC insertion, you must first perform appropriate hand hygiene. Next, put on a cap that covers all your hair, a mask that covers your mouth and nose, a sterile gown, and sterile gloves. The patient should be covered from head to toe with a large sterile drape, leaving a small opening for catheter insertion. If the insertion site is the subclavian or jugular vein, the patient’s face should also be covered, and he’ll probably be asked to wear a mask during PICC insertion.

Keep all catheter insertion supplies, including items for maximal barrier precautions, in a convenient and nearby place. This reduces the time and effort required to gather them when they’re needed.

Self-Test
5. You should decontaminate your hands with an alcohol-based hand cleaner
   a. when they’re visibly contaminated with blood.
   b. before putting on gloves and after removing them.
   c. after you change a catheter dressing, but not before.

6. True or false: Chipped fingernail polish can be a breeding ground for microorganisms.

7. Which item is not part of maximal barrier precautions when inserting a CVC?
   a. cap to cover all of your hair
   b. sterile gown
   c. shoe covers

Chlorhexidine gluconate: Rubbing the right way
Studies show that chlorhexidine gluconate offers better skin antisepsis than other agents. The IHI strongly advocates its use, and CDC guidelines identify it as the preferred agent. (The CDC also suggests tincture of iodine, iodosphors, and 70% alcohol as acceptable substitutes.)

The formulations available in the United States—2% or 3.15% chlorhexidine gluconate in 70% isopropyl alcohol—allow you to perform antisepsis in one step. Swab with the applicator in a gentle back-and-forth motion during application. This creates friction and lets the solution more effectively penetrate epidermal layers. Without scrubbing, apply chlorhexidine for at least 30 seconds and let it air-dry thoroughly. Because this antiseptic contains alcohol, skin should dry rapidly. Never wipe or blot the area.

Use chlorhexidine for skin antisepsis before catheter insertion and during dressing changes as well. In recent studies comparing chlorhexidine with povidone-iodine for routine insertion-site care, chlorhexidine was superior for preventing CR-BSIs and didn’t cause adverse reactions at the puncture site.

Insertion-site selection: Choosing the best target
CDC guidelines state that dense skin flora at the subclavian, internal jugular, and femoral sites pose a

Counting catheter-days
Catheter-related bloodstream infections (CR-BSIs) are reported by the number of cases per 1,000 catheter-days. Catheter-days are calculated by dividing the total number of CR-BSIs by the total number of days that all catheters are indwelling, then multiplying the result by 1,000.

For example, if 15 patients had CVCs for 5 days (75 days total) and 15 had CVCs for 3 days (45 days total), the totals would be 30 patients and 120 days. If 10 of these 30 patients developed a CR-BSI, the calculation would be: \((10/120) \times 1,000 = 83.3\) catheter-days.

In addition to tracking the number of patients who develop an infection, this figure assesses the length of catheter dwell time.

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major risk of CR-BSIs. Although more studies are needed, the CDC recommends using a subclavian site in adults with nontunneled, non-cuffed catheters. The internal jugular site is associated with greater infection risk, and the femoral site is associated with a greater risk of deep vein thrombosis and is presumed to have a greater infection risk because of high colonization rates in adults.

Many studies have shown that using arm veins for PICC insertion poses a lower risk of CR-BSIs, but the data are predominantly from alternative care settings. Generally, PICCs are used in settings other than ICUs and for longer periods than other percutaneously inserted CVCs, but a recent study of high-risk, hospitalized patients demonstrated a similar infection rate.

**Self-Test**

8. According to the IHI, the preferred solution for skin antisepsis is
   a. iodophors.  
   b. 70% alcohol.  
   c. chlorhexidine gluconate.  

9. Which catheter insertion site poses the greatest risk for deep vein thrombosis?
   a. femoral  
   b. subclavian  
   c. jugular  

**Catheter replacement: The ins and outs of change**

Routinely replacing a patient’s CVC at scheduled intervals doesn’t reduce his risk of CR-BSIs. CVCs should be replaced only when signs of a local or systemic complication are evident or if the catheter isn’t functioning properly.

To decrease the risk of CR-BSIs, your patient’s CVC should be removed as soon as it’s no longer needed. Each day, assess his condition, infusion therapy, and required length of therapy remaining to determine the earliest possible removal time.

The typical infection source in short-term, nontunneled CVCs is colonization from the skin along the insertion site to the vein. This is why routinely inserting the new catheter over a guidewire into the same site as the old catheter (“exchanging”) isn’t recommended: The newly inserted catheter would reside in a tract that’s already colonized. If a catheter is damaged, the health care provider will assess the risks and benefits of catheter exchange versus inserting a new catheter at a new site to determine what’s best and safest for the patient.

**How equipment helps**

Certain catheter design features and add-on devices can affect CVC infection rates. Let’s take a look at them.

- **Single vs. multiple lumens.** Recent studies comparing CR-BSI rates showed that multiple-lumen catheters pose a slightly greater infection risk than single-lumen catheters. Researchers concluded that the risk of CR-BSI was 3.4 times greater with multiple-lumen catheters, but this risk was offset by a greater risk of mechanical complications (pneumothorax, brachial nerve plexus injury, pinch-off syndrome) associated with using several single-lumen catheters.

- **Antimicrobial-impregnated catheters.** Several major studies have shown a 40% reduction in CR-BSIs when antimicrobial-impregnated CVCs are used. Nontunneled percutaneously inserted CVCs are available with one of three impregnated antimicrobial combinations: chlorhexidine/silver sulfadiazine, rifampin/minocycline, and silver/platinum ionic metals. One PICC brand impregnated with rifampin/minocycline is available. Antimicrobial-impregnated catheters should be used for adults whose anticipated dwell time is longer than 5 days and in institutions where CR-BSI rates are higher than the targeted rate after all other strategies have been employed.

- **Chlorhexidine dressing.** A recent randomized trial of 589 patients showed significant reduction in localized catheter insertion-site infection and CR-BSI with the use of chlorhexidine-impregnated sponge patches, and two smaller studies have shown similar results. It’s estimated that the use of chlorhexidine patches could save 3,906 patient lives and up to $1.97 billion annually in the United States.

- **Needleless injection devices.** Comparisons of CR-BSI rates using needleless devices after changing from multiple brands of mechanical valve devices showed that CR-BSI rates with mechanical valves is 1.5 to 5 times greater than with needleless devices. It’s not clear, however, whether the difference in rates is the result of infection control practices or the device design.

Regardless of the device design, a simple but extremely important step in preventing CR-BSI is to thoroughly clean the injection surfaces of all needleless devices before each injection. Clean the entire surface with an alcohol pad and let it air dry. For a typical intermittent infusion of medication, this means that you must wipe the injection surface four times: before the initial saline injection to assess catheter patency, before attaching the sterile infusion tubing or syringe, before flushing the catheter with saline after administering the medication, and before injecting heparinized saline, if needed. One wipe before the entire med-
ications administration procedure isn’t sufficient. All infusion tubing connected to a needleless device must be sterile as well.

**Self-Test**

10. True or false: For a typical intermittent infusion of a medication, you only need to wipe the injection port once during the entire procedure.

11. A CVC should be replaced
a. at regularly scheduled intervals.
b. if the patient develops signs of systemic complications.
c. over a guidewire into the same site as the old catheter.

12. Antimicrobial-impregnated catheters should be used if the dwell time is expected to be longer than
a. 1 day.
b. 3 days.
c. 5 days.

**Education is key**

Educating hospital staff members plays a significant role in reducing CR-BSI rates. One study showed that establishing a training course on basic insertion procedures and infection control practices led to a 28% decrease in CR-BSIs. Another study showed that a mandatory self-study process with a pretest and posttest, fact sheets, and posters placed in patient-care areas reduced CR-BSIs by about half.

Nurse/patient staffing ratios play a key role in infection rates as well. A case-control study conducted at a health care facility during an outbreak of CR-BSI revealed a direct relationship between understaffing and CR-BSI rates.

The CDC guidelines state that a dedicated infusion therapy team can reduce the incidence of catheter-related infections and other complications and can lower the costs of therapy. Toward that end, the Infusion Nurses Society recently released an implementation module to help hospitals develop an infusion therapy team. The techniques include role discussions among team members, data collection processes, and financial considerations.

Some hospitals have instituted programs that permit nurses to carefully observe CVC insertion and stop the process if all necessary precautions aren’t being met. The nurse follows a checklist to collect data and documents the procedure in the patient’s medical record (see *Keeping tabs on catheter insertion*).

To successfully establish such CR-BSI prevention recommendations in your facility, you need an interdisciplinary team in which all members are eager to participate. Organizational leaders who promote the process add to the team’s motivation to succeed. Infection control and quality improvement experts, who are already involved in data collection, should integrate new methods of infection prevention with existing ones that have shown good results.

**Changing the statistics**

The research supporting medical and nursing strategies for reducing CR-BSIs is overwhelming. With your understanding of the latest prevention recommendations, your advocacy, and your involvement in team efforts, you can play a vital role in reducing infection rates in patients with CVCs and improving their outcomes. **LPN**

**Selected references**


**Self-Test Answers**

11-b, 12-b, 12-c