Background

A central venous catheter (CVC or “central line”) is an intravascular catheter that terminates at or close to the heart or in one of the great vessels. According to the Centers for Disease Control’s (CDC) National Healthcare Safety Network, the following are considered great vessels for the purpose of reporting central line infections and counting central line days:

- Aorta
- Pulmonary artery
- Superior vena cava
- Inferior vena cava
- Brachiocephalic veins
- Internal jugular veins
- Subclavian veins
- External iliac veins
- Common femoral veins

Neither the insertion site location nor the type of device should be used to determine if a line qualifies as a central line. The device must terminate in one of these vessels or in or near the heart to qualify as a central line. CVCs are typically used for infusion of fluids, blood, or nutrients, withdrawal of blood, or hemodynamic monitoring. Because practitioners insert CVCs using sterile techniques and because the CVC tip resides in the central vasculature, it can remain in the patient for a longer period than a traditional, short intravenous catheter.

Examples of CVCs include:

- Peripherally inserted central catheters (PICC), which are catheters inserted percutaneously through the veins of the upper extremity and passed through the veins until it resides in the superior vena cava near the junction of the right atrium.
- Nontunneled catheters, which are inserted percutaneously into the subclavian, jugular, and femoral veins.
- Tunneled catheters, which are inserted using a technique that places a segment of the catheter inside a subcutaneous tunnel to separate the vein entry site from the skin exit site. Tunnel catheters have a cuff that encircles the catheter and is position in the subcutaneous tunnel, which becomes firmly attached by the growth of a connective tissue seal.
- Implanted ports, which are surgically implanted under the surface of the skin. A pocket is created, usually in the upper chest for the port. The port body is then palpated and accessed using a noncoring needle passed through the port and into the port septum.
Infection is a possible risk associated with central line insertion. Because practitioners place the catheter into the body, it is easier for bacteria and/or fungi from the skin to enter the patient’s bloodstream through routes external and internal to the catheter lumen. Severe sepsis may also occur, potentially leading to death. Facilities must have infection prevention methods in place to decrease the risk of central line–associated bloodstream infection (CLABSI). Anything that touches the catheter site or goes into the catheter must be sterile. The practitioner and any assistants must wear maximal sterile barriers during insertion practices, including sterile gloves, impervious surgical gown, cap, mask with eye protection, and gloves.

The Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA) published Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals that outlines evidence-based and practical information on and strategies for preventing CLABSIs.

The article identified nine factors associated with increased risk of infection:

- Prolonged hospitalization before catheterization
- Prolonged duration of catheterization
- Microbial colonization at the insertion site
- Microbial colonization of the catheter hub
- Internal jugular and femoral catheterization
- Neutropenia
- Prematurity (i.e., birth at an early gestational age)
- Total parenteral nutrition and lipids
- Substandard care of the catheter (e.g., excessive manipulation of the catheter or reduced nurse-to-patient ratio)

Some would add multiple-lumen catheters as a factor associated with higher risk of infection.

Physician competency has not been widely studied as a factor contributing to infection rates. Successful catheterization has been associated with reduced complications and infection risks, and the insertion and maintenance of intravascular catheters by inexperienced staff might increase the risk for catheter colonization and catheter-related bloodstream infections (CRBSI).3, 4

As such, the CDC’s 2010 Guidelines for the Prevention of Intravascular Catheter-Related Infections (currently in draft) recommends that institutions periodically assess the knowledge of and adherence to guidelines for all practitioners who are involved in the insertion and maintenance of intravascular catheters and designate only trained personnel who demonstrate competence for the insertion and maintenance of peripheral and central intravascular catheters.

Staff education on proper protocols for central line insertion is also critical to preventing CLABSIs. The Joint Commission (formerly JCAHO), the CDC, and several other
patient safety groups suggest specific, mandatory training on central line insertion as a method for reducing infections for all personnel involved in the insertion, care, and maintenance of central lines. Education programs should cover topics such as, indications for catheter use, appropriate insertion and maintenance, and risk of CLABSI. The CDC’s guidelines state that staff education that focuses on hand hygiene, use of maximal sterile barriers during insertion, appropriate insertion site selection, proper site care using chlorhexidine gluconate, and prompt removal of unnecessary catheters has proved successful. Facilities should also test healthcare workers’ knowledge of and adherence to preventive measures.

Several staff education interventions have been linked to significant decreases in infection control rates. Warren and colleagues describe a mandatory training program for ICU nurses and physicians that highlighted proper practices for preventing CLABSIs. Training included a 10-page self-study module on risk factors and practice modifications involved in CRBSIs and in-services at scheduled staff meetings. Participants completed a pretest and an identical test after completion of the study module. Fact sheets and posters reinforcing the information in the study module were also posted throughout the ICU. Other institutions have used self-study modules along with pictorials to educate nursing staff on insertion and maintenance practices.

Administering a pretest to those practitioners involved in inserting and maintaining central lines allows hospitals to identify areas of knowledge deficits. Hospitals can then focus training and educational interventions on those areas.

Additionally, the hospitals that constitute the Michigan Health and Hospital Association created the Keystone Center for Patient Safety & Quality, which has been very successful at incorporating staff training to reduce CLABSIs. This initiative centralized training and facilitated sharing of best practices for preventing CLABSIs, and the model could be replicated by other large hospital systems. A faculty expert conducted workshops and monthly calls to present evidence-based best practices for central line insertion and infection prevention. Open discussion among participants allowed the group to identify best practices and areas for improvement.

In response to the potentially deadly complications associated with CVCs, hospitals have embraced ultrasound-guided central line insertion. The technology allows practitioners to locate the patient’s vein quickly and decreases the likelihood of complications. Additionally, the CDC’s Guidelines for the Prevention of Intravascular Catheter-Related Infections recommend that practitioners use ultrasounds to place central lines in order to reduce cannulation attempts and mechanical complications.

Practitioners must apply for privileges to use ultrasound for central line insertion. To be privileged to use ultrasound, they must show evidence of successful completion of training and demonstrate the appropriate experience, current competency, and outcomes.
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Recent literature has also focused on the importance of properly maintaining central lines to prevent infection.\(^3\), \(^4\), \(^13\), \(^14\) Practitioners responding to survey questions regarding the post-insertion care of CVCs often show deficiencies in knowledge, indicating the need for further training on central line maintenance.

The CDC’s *Guidelines for the Prevention of Intravascular Catheter-Related Infections* makes several evidence-based recommendations regarding maintenance of central lines.

References

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**Involved specialties**

Proceduralist physicians (MDs and DOs), nurse practitioners (NP), RNs, and physician assistants (PA) who are part of a procedure team

**Positions of interested parties**

The CDC is in the process of updating its document titled *Guidelines for the Prevention of Intravascular Catheter-Related Infections*. The CDC has released a draft that provides recommendations hospitals should implement to prevent catheter-related infections.

The document points to reports demonstrating that the insertion and maintenance of intravascular catheters by inexperienced staff might increase the risk for catheter colonization and CRBSI. The performance indicators for reducing CRBSI include implementing educational programs such as didactic and interactive components for those who insert and maintain catheters.

In regard to healthcare worker education and training, the draft document states that programs should:

- Educate healthcare personnel regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections.
- Periodically assess knowledge of and adherence to guidelines for all persons who are involved in the insertion and maintenance of intravascular catheters.
- Designate only trained personnel who demonstrate competence for the insertion and maintenance of peripheral and central intravascular catheters (the document does not specify guidelines for determining competency).
- Ensure appropriate nursing staff levels in ICUs to minimize the incidence of CRBSIs. Observational studies suggest a ratio of 2:1 in ICUs where nurses are managing patients with CVCs.

Regarding site selection for CVCs, the CDC recommends practitioners perform the following actions:
Weigh risks and benefits of placing a central venous device at a recommended site to reduce infectious complications against the risk for mechanical complications (e.g., pneumothorax, subclavian artery puncture, subclavian vein laceration, subclavian vein stenosis, hemothorax, thrombosis, air embolism, and catheter misplacement).

Use a subclavian site, rather than a jugular or a femoral site, in adult patients to minimize infection risk for non-tunneled CVC placement.

Place catheters used for hemodialysis and pheresis in a jugular or femoral vein, rather than a subclavian vein, to avoid venous stenosis.

Use ultrasound guidance to place CVCs to reduce the number of cannulation attempts and mechanical complications if this technology is available.

The CDC states that it cannot make a recommendation for a preferred site of insertion to minimize infection risk for a tunneled CVC.

The CDC also recommends methods for performance improvement. Specifically, the guidelines state that hospitals that use institution-specific or collaborative-based performance improvement initiatives in which multifaceted strategies are bundled together improve compliance with evidence-based recommended practices. The CDC says studies show that education of healthcare personnel, audit and feedback, organizational change, and clinical reminders have led to performance improvement.

SHEA/IDSA published *Compendium of Strategies to Prevent Healthcare-Associated Infections*, which included a supplement article titled *Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals*.

SHEA/IDSA state that any healthcare worker who inserts a central line should undergo a credentialing process to establish competency prior to independently inserting a central line. Additionally, accountability for infection rates is a critical component of prevention of central line–related infections.

Accountability measures include:

- Hospital administration supports infection control and prevention programs
➤ Management ensures that a sufficient number of trained personnel constitute the infection control and prevention program
➤ Management ensures that licensed and nonlicensed healthcare personnel are competent to perform their jobs
➤ All healthcare providers are responsible for following appropriate infection control practices
➤ The person managing infection control and prevention programs is responsible for ensuring the monitoring of CLABSI data and regularly providing data to those who can use the data to improve quality of care
➤ Education is available to both healthcare personnel and patients

SHEA/IDSA also recommend education for physicians, nurses, and other healthcare workers on the insertion, care, and maintenance of central lines and CLABSI prevention. The strategies include several clinical recommendations as well; you can review the complete document at www.premierinc.com/quality-safety/tools-services/safety/topics/HAI/downloads/Consumer-Guide-clabsi.pdf.

IHI
The Institute for Healthcare Improvement (IHI) has published materials to help the healthcare community prevent CLABSI.

The IHI Central Line Bundle is a group of evidence-based interventions related to patients with intravascular central catheters. When implemented together as a bundle, the IHI states that better outcomes will result. The IHI recommends that facilities empower nurses to enforce use of a central line checklist to ensure that practitioners execute all related processes for each line placement.

The Central Line Bundle elements include:
➤ Hand hygiene
➤ Maximal barrier precautions upon insertion
➤ Chlorhexidine skin antisepsis
➤ Optimal catheter site selection, with avoidance of the femoral vein for central venous access in adult patients
➤ Daily review of line necessity with prompt removal of unnecessary lines

In regards to hand hygiene, washing hands or using an alcohol-based, waterless hand cleaner reduces the risk of infection by preventing contamination of central line sites and device access
hubs. Practitioners should practice hand washing before and after invasive procedures.

The use of maximal barrier precautions in preparation for the line insertion will decrease the likelihood of central line infection.

According to the IHI, an ICU patient with a central line should be reviewed daily to prevent unnecessary delays in removing lines that are no longer needed. The risk of infection increases over time as the line remains in place. The daily goals sheet or medication record should indicate the continued need for the central line.

The IHI also offers tips on improving staff compliance with its Central Line Bundle, such as initiating a campaign, requiring that nurses use a central line checklist, and keeping hand washing dispensers in a central location. For more information, visit www.ihi.org/IHI/Topics/CriticalCare/IntensiveCare/Changes/ImplementtheCentralLineBundle.htm.

Paul M. Maggio, MD, is an assistant professor in the Department of Surgery at Stanford University School of Medicine. He is board certified in general surgery with added qualifications in surgical critical care.

Stanford University has a formal central line training process that includes a pre- and posttest and simulated training for all incoming health staff, says Maggio. The tests include questions related to The Joint Commission’s Universal Protocol™.

“Residents have to be supervised by our ICU fellows for a minimum of five central lines—and more if they don’t feel comfortable,” says Lisa Shieh, MD, PhD, FHM, a clinical associate professor of medicine who developed curriculum training on central line placement. “For most people, it’s much more. Competence is up to the person doing the supervision and the person doing it.”

Shieh states that a person must perform central line insertions regularly. “The number is different per person, but I do think that there should be a particular number required per year, because if you haven’t done them in a couple of years, you will forget,” she says.

In the past, the Accreditation Council for Graduate Medical Education (ACGME) required practitioners inserting central lines...
to complete a minimum of five procedures during residency training to become competent, says Shieh. “People realized that the number was too low and that the number depended on the person, too,” she says. “Just because you did five didn’t mean you were competent to do the procedure. People argue that it’s much higher—50 or so.”

As a result, Shieh says the ACGME moved away from a national number. She says that different medical programs are developing their own programs to train their physicians. The use of procedure teams and centers are increasing in popularity.

In the case of procedure teams, Shieh says that the hospital may have a dedicated proceduralist on staff who teaches rotating residents how to perform procedures with the team. “Most programs I know are going to procedure teams and some sort of curriculum with simulation training,” she says, adding that some studies have shown that the use of simulation training and ultrasound-guided insertion results in fewer complications.

Some institutions have moved to procedure centers. “They send all of their patients for central lines to a center where they are performed by someone who is experienced. Then they have trainees rotate through that center,” she says.

Regardless of the training model facilities use, Shieh says that there needs to be increased standardization with evidence-based guidelines. She points to the abundance of evidence that exists in regards to making the procedure safer for patients. She adds that most facilities should be using central line bundles and checklists to increase patient safety.

According to Maggio, facilities implementing evidence-based data are using sterile barriers and ultrasound guidance, and they are placing the central line in the internal jugular as opposed to the anatomical markers of the subclavian.

Stanford also uses the IHI Central Line Bundle group. As part of this, it includes nurses during central line insertions. By following this protocol, the nurse can stop the procedure at any point in time if, for example, there is a break in the sterile barrier.

The physicians who typically insert central lines include intensivists, interventional radiologists, surgeons, and proceduralists, says Shieh. In general, non-proceduralist specialists do not perform
central line insertions. They can obtain this training as part of their residency training or through workshops.

Some RNs may insert central lines if they are part of a procedure team and if they are trained to perform the procedure. They can obtain this training as part of their nursing program or through workshops.

_Everett, WA_ Eva Wall, MD, is a freelance emergency general surgeon and surgical intensivist. Her interests are in general surgery, critical care, and emergency care. Wall currently serves as first assistant to a surgical oncologist.

Unlike PICC lines, which anyone with training and experience can insert, practitioners insert central lines for specific applications. For example, a cardiac anesthesiologist may insert a central line before performing major heart surgery on a patient. Wall suggests that facilities look to other technical skills that have evidence-based guidelines to determine the number of cases a practitioner should complete before being privileged. She points to endoscopy for colonoscopy and upper endoscopy as examples.

Although her opinion is based on speculation and not on data (because there currently aren’t any data to support the number of central lines a practitioner should insert to be deemed competent), Wall says a practitioner should perform 20–50 insertions per year under supervision before being allowed to perform them independently. “Maintenance of the skill or technique is going to be contingent on doing it on a regular basis,” she says.

In regards to current issues in central line insertion, Wall points to the use of ultrasound and portable ultrasound guidance as a new standard of care. The technology allows practitioners to increase their accuracy and decrease the likelihood of complications while performing the procedure. She notes that although recent residents may have experience with this technology, existing practitioners may require additional training.

In regards to available literature on the procedure, Wall says that it is still evolving. “It would certainly be an interesting study to do in a training center to track complications after insertion based on the experience of the practitioner,” she says. “The field is evolving, and research studies remain to be com-
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The Joint Commission

In regards to CVC insertion, The Joint Commission developed NPSG.07.04.01, which states that facilities must “implement evidence-based practices to prevent central-line associated bloodstream infections.” The requirement covers short- and long-term CVCs and PICC lines. The goal is to reduce the risk of healthcare associated infections.

EPs for NPSG.07.04.01 include:

1. Educate staff and licensed independent practitioners who are involved in managing central lines about central line–associated bloodstream infections and the importance of prevention. Education occurs upon hire, annually thereafter, and when involvement in these procedures is added to an individual’s job responsibilities.

2. Prior to insertion of a CVC, educate patients and, as needed, their families about central line–associated bloodstream infection and prevention.

3. Implement policies and practices aimed at reducing the risk of CLABSIs. These policies and practices meet regulatory requirements and are aligned with evidence-based standards, such as the CDC and/or professional organization guidelines.

4. Conduct periodic risk assessments for CLABSIs, monitor compliance with evidence-based practices, and evaluate the effectiveness of prevention efforts. The risk assessments are conducted in time frames defined by the hospital, and this infection surveillance activity is hospitalwide, not targeted.

5. Provide CLABSI rate data and prevention outcome measures to key stakeholders, including leaders, licensed independent practitioners, nursing staff, and other clinicians.

6. Use a catheter checklist and a standard protocol for CVC insertion.

7. Perform hand hygiene prior to catheter insertion or manipulation.

8. For adult patients, do not insert catheters into the femoral vein unless other sites are unavailable.

9. Use a standardized supply cart or kit that contains all necessary components for the insertion of CVCs.
10. Use a standardized protocol for sterile barrier precautions during CVC insertion.

11. Use a chlorhexidine-based antiseptic for skin preparation during CVC insertion in patients over 2 months of age, unless contraindicated.

12. Use a standardized protocol to disinfect catheter hubs and injection ports before accessing the ports.

13. Evaluate all CVCs routinely and remove nonessential catheters.

The Joint Commission has no formal position concerning the delineation of privileges for central line insertion. However, in its Comprehensive Accreditation Manual for Hospitals, The Joint Commission states, “The hospital collects information regarding each practitioner’s current license status, training, experience, competence, and ability to perform the requested privilege” (MS.06.01.03).

In the rationale for MS.06.01.03, The Joint Commission states that there must be a reliable and consistent system in place to process applications and verify credentials. The organized medical staff then reviews and evaluates the data collected. The resultant privilege recommendations to the governing body are based on the assessment of the data.

The Joint Commission further states, “The organized medical staff reviews and analyzes information regarding each requesting practitioner’s current licensure status, training, experience, current competence, and ability to perform the requested privilege” (MS.06.01.07).

In the EPs for standard MS.06.01.07, The Joint Commission says that the information review and analysis process is clearly defined. The organization, based on recommendations by the organized medical staff and approval by the governing body, develops criteria that will be considered in the decision to grant, limit, or deny a request for privileges.

The Joint Commission further states, “Ongoing professional practice evaluation information is factored into the decision to maintain existing privilege(s), to revise existing privileges, or to revoke an existing privilege prior to or at the time of renewal” (MS.08.01.03).

In the EPs for MS.08.01.03, The Joint Commission says that there is a clearly defined process that facilitates the evaluation
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of each practitioner’s professional practice, in which the type of information collected is determined by individual departments and approved by the organized medical staff. Information resulting from the ongoing professional practice evaluation is used to determine whether to continue, limit, or revoke any existing privilege.

CRC draft criteria

The following draft criteria are intended to serve solely as a starting point for the development of an institution’s policy regarding this procedure.

Minimum threshold criteria for requesting core privileges in central line insertion.

Basic education: MD, DO, PA, or NP

Minimum formal training: Applicants must have successfully completed an accredited residency training program, or PA program that included instruction in central line insertion.

Or

The applicant must show evidence of successful completion of training in central line insertion.

And/or

Current certification or active participation in the examination process (with achievement of certification within [n] years) leading to certification by the appropriate board is required.

And

A minimum of five initial central line placements will be proctored by a physician to ensure the applicant’s competency in the procedure.

Required previous experience: Completion of 50 central line insertion procedures over a two-year period.

For PICC lines, NPs and PAs must be able to provide evidence of two years of experience in placement, maintenance, and removal of PICC lines.

References

Letters of reference must come from the director of the applicant’s residency training, NP training, or PA training program. Alternatively, a letter of reference regarding competence should come from the chief of the applicant’s department at the institution where the applicant most recently practiced.

Reappointment

Reappointment should be based on unbiased, objective results of care according to a hospital’s quality assurance mechanism, which may include a review of a practitioner’s CLABSI rates.
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and whether the practitioner can demonstrate that he or she followed evidence-based protocol during central line placement, care and maintenance, and removal.

Applicants must be able to demonstrate that they have maintained competence by documenting that they have successfully performed at least 25 central line insertions annually over the reappointment cycle.

In addition, continuing education related to central line insertion should be required.

For more information

For more information regarding this procedure, contact:

Centers for Disease Control and Prevention  
1600 Clifton Road  
Atlanta, GA 30333  
Telephone: 800/232-4636  
Website: www.cdc.gov

The Society for Healthcare Epidemiology of America  
1300 Wilson Boulevard, Suite 300  
Arlington, VA 22209  
Telephone: 703/684-1006  
Fax: 703-684-1009  
Website: www.shea-online.org

Institute for Healthcare Improvement  
20 University Road, 7th Floor  
Cambridge, MA 02138  
Telephone: 866/787-0831  
Fax: 617/301-4848  
Website: www.ihi.org

Stanford University  
450 Serra Mall  
Stanford, CA 94305  
Telephone: 650/723-2300  
Website: www.stanford.edu

The Joint Commission  
One Renaissance Boulevard  
Oakbrook Terrace, IL 60181  
Telephone: 630/792-5000  
Fax: 630/792-5005  
Website: www.jointcommission.org
To be eligible to request CVC insertion privileges, an applicant must meet the following minimum threshold criteria:

- **Basic education:** MD, DO, PA, or NP

- **Minimum formal training:** Applicants must have successfully completed an accredited residency training program, or PA program that included instruction in central line insertion. **Or**
  - The applicant must show evidence of successful completion of training in central line insertion. **And/or**
  - Current certification or active participation in the examination process (with achievement of certification within \[n\] years) leading to certification by the appropriate board is required. **And**
  - A minimum of five initial central line placements will be proctored by a physician to ensure the applicant’s competency in the procedure.

- **Required previous experience:** Completion of 50 central line insertion procedures over a two-year period. For PICC lines, NPs and PAs must be able to provide evidence of two years of experience in placement, maintenance, and removal of PICC lines.

- **References:** Letters of references must come from the director of the applicant’s residency training, NP training, or PA training program. Alternatively, a letter of reference regarding competence should come from the chief of the applicant’s department at the institution where the applicant most recently practiced.

- **Reappointment:** Reappointment should be based on unbiased, objective results of care according to a evidence-based quality assurance mechanism, which may include a review of a practitioner’s CLABSI rates and whether the practitioner can demonstrate that he or she followed hospital protocol during central line placement, care and maintenance, and removal.

  Applicants must be able to demonstrate that they have maintained competence by documenting that they have successfully performed at least 25 central line insertions annually over the reappointment cycle.

  *In addition, continuing education related to central line insertion should be required.*

I understand that by making this request, I am bound by the applicable bylaws or policies of the hospital, and hereby stipulate that I meet the minimum threshold criteria for this request.

**Practitioner’s signature:** ________________________________
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Typed or printed name: _________________________________________________________

Date: _________________________________________________________________________