Effective March 14, 2019, the Canadian Patient Safety Institute has archived the Central Line-Associated Bloodstream Infection (CLABSI) intervention. For additional inquiries, please contact info@cpsi-icsp.ca
Safer Healthcare Now!

We invite you to join Safer Healthcare Now! to help improve the safety of the Canadian healthcare system. Safer Healthcare Now! is a national program supporting Canadian healthcare organizations to improve safety through the use of quality improvement methods and the integration of evidence in practice.

To learn more about this intervention, to find out how to join Safer Healthcare Now! and to gain access to additional resources, contacts, and tools, visit our website at www.saferhealthcarenow.ca

This Getting Started Kit has been written to help engage your interprofessional/interdisciplinary teams in a dynamic approach for improving quality and safety while providing a basis for getting started. The Getting Started Kit represents the most current evidence, knowledge and practice, as of the date of publication and includes what has been learned since the first kits were released in 2005. We remain open to working consultatively on updating the content, as more evidence emerges, as together we make healthcare safer in Canada.

Note:
The Quebec Campaign: Together, let's improve healthcare safety! works collaboratively with Safer Healthcare Now!. The Getting Started Kits for all interventions used in both Safer Healthcare Now! and the Quebec Campaigns are the same and available in both French and English.

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Acknowledgements

The Canadian Patient Safety Institute (CPSI) is acknowledged for their financial and in-kind support of the Safer Healthcare Now! Getting Started Kits.

We thank and acknowledge the Canadian ICU Collaborative and faculty members who have contributed significantly to the work of the Central Line Infection teams and the revisions to this kit. In particular, we acknowledge the work of Dr. Peter Skippen, Ms. Tracie Northway and Dr. Claudio Martin.

Ethicon, makers of BIOPATCH®, provided an unencumbered educational grant which helped make this work possible.

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December 2011

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Background

What is new?
The major update to this kit is that the recommendations have been revised based on the CDC guidelines published in early 2011. The best practices are still grouped into insertion and care bundles (formerly maintenance bundles). The insertion bundle now includes consideration of the type of line as well as optimal site selection. The care bundle now includes consideration of different dressings if infection rates remain above target levels (zero!). Recommendations are now also provided for arterial line insertion. It should be noted that attribution of a bloodstream infection to a specific intravascular device (arterial or venous) is not always possible. Best practices for insertion and care of intravascular lines also need to consider non-infectious complications; the new guidelines discuss the use of ultrasound guidance.

Goal
The goal of this campaign is to prevent catheter-related bloodstream infections by implementing the components of care called the “central line bundles”.

The Case for Preventing Catheter-Related Bloodstream Infections (BSIs)
- Central venous catheters (CVCs) are increasingly being used in the inpatient and outpatient setting to provide long-term venous access. CVCs disrupt the integrity of the skin, making infection with bacteria and/or fungi possible. Infection may spread to the bloodstream and hemodynamic changes and organ dysfunction (severe sepsis) may ensue, possibly leading to death. Approximately 90% of the central line-associated bloodstream infections (CLA-BSIs) occur with CVCs.\(^1\)
- BSI may also occur in association with arterial catheters. Many of these recommendations also can be applied to the insertion and care of all intravascular devices.
- Forty-eight per cent of intensive care unit (ICU) patients in the U.S. have central venous catheters, accounting for 15 million central-venous-catheter-days per year in U.S.-based ICUs. Studies of catheter-related bloodstream infections that control for the underlying severity of illness suggest that mortality attributable to these infections is between 4% and 20%. Thus, it is estimated that 500 to 4,000 U.S. patients die annually due to bloodstream infections.
- Nosocomial bloodstream infections prolong hospitalization by a mean of seven days. Estimates of attributable cost per bloodstream infection are estimated to be between US$3,700 and $29,000. There are no equivalent Canadian figures for burden of illness.\(^2,3,4,5\)

Central Line Bundles
The central line bundles were developed by grouping individual evidence-based best practice interventions for patients with intravascular central catheters. When the interventions are implemented together as packaged, they should result in better outcomes than when implemented individually.
The individual recommendations are grouped into the **insertion bundle** and the **care bundle**. Both are important aspects of catheter care in preventing CR-BSIs. The bundles have been demonstrated to reduce CR-BSIs by the Canadian ICU Collaborative teams, examples of which are illustrated in this guide. A large study demonstrating improved patient outcomes in a large group of hospitals has also been published.\(^6\)

Initial testing of the central line bundles occurred in intensive care units. Many hospitals have since spread the work to other areas where central lines are inserted and maintained. These areas include oncology programs, dialysis, general medical and surgical services, inpatients and outpatients. These bundles should work equally well in any of these hospital settings, if implemented with adequate communication and education. The bundles apply to any catheter whose tip lies in a central vein, including **peripherally inserted central catheter** (PICC) lines, as well as arterial catheters. Some modifications may be appropriate for these various situations, and are detailed in the evidence summary.

Best practices related to central line insertion and care should also consider non-infectious complications. The use of ultrasound guidance should be considered as this has been shown to reduce mechanical complications but not infections.

The current published guidelines include recommendations based on evidence for several change strategies. These are:

- Education (Grade of Evidence 1A)
  - Indications
  - Proper procedure
    - Insertion (“stop the line”)
    - Care
  - Infection control
  - Periodically assess knowledge and adherence (1A)
  - Designate only trained personnel (1A)
  - Appropriate nurse staff levels in ICUs (1B)

The **central line bundle** is broken into an insertion and a care bundle.

**Central Line Insertion Bundle:**

1. Hand hygiene
2. Maximal barrier precautions
3. Chlorhexidine skin antisepsis
4. Optimal catheter type and site selection
   - Avoid the femoral vein in adults; subclavian preferred to minimize infection risk.
   - Optimal catheter type and site selection in children is more complex with the internal jugular vein or femoral vein most commonly used. Site preference in children needs to be individualized.
**Central Line Care bundle:**
1. Daily review of line necessity, with prompt removal of unnecessary lines
2. Aseptic lumen access
3. Catheter site and tubing care

Compliance with the central line bundles can be measured by simple assessment of the completion of each item. The approach has been most successful when all elements are executed together—an “all or none” strategy—as demonstrated by the Canadian ICU Collaborative Pediatric teams.

Additional details for each of the bundle elements and specific points related to arterial lines are provided below [Preventing Central Line Infections: Components of Care]

**Potential Impact of the Central Line Bundles**
The application of SHN’s central line bundles should at the very least result in similar reductions in the rate of CR-BSIs as have been associated with other collaborative efforts such as the IHI central line bundle.

**Example: Stollery Children’s Hospital (Edmonton, AB)**

![CR Blood Stream Infection Rate](chart)

Berenholtz et al. demonstrated that ICUs that have implemented multifaceted interventions similar to the central line bundles have nearly eliminated CR-BSIs over prolonged periods of time.  

---

June 2012
Mermel et al. demonstrated that the odds ratio are 2.2 times greater for infection without maximal barrier precautions, while Raad et al. demonstrated a 6.3 times greater likelihood for infection without precautions.8,9

<table>
<thead>
<tr>
<th>Author/date</th>
<th>Design</th>
<th>Catheter</th>
<th>Odds Ratio for infection without maximal barrier precautions</th>
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</thead>
<tbody>
<tr>
<td>Mermel 1991</td>
<td>Prospective Cross-sectional</td>
<td>Swan-Ganz</td>
<td>2.2 (p&lt;0.03)</td>
</tr>
<tr>
<td>Raad 1994</td>
<td>Prospective Randomized</td>
<td>Central</td>
<td>6.3 (p&lt;0.03)</td>
</tr>
</tbody>
</table>

Mortality associated with CR-BSIs will also likely decline over longer periods of time.

The success of these interventions is perhaps due to a combination of the mindfulness that develops when regularly applying the elements of the bundles, and the particular bundle elements themselves. For example, two studies have shown that the application of maximal barrier precautions substantially reduces the odds of developing a bloodstream infection.
Preventing Central Line Infections: Components of Care

Central Line Insertion Bundle

1. **Hand hygiene**
Washing hands or using an alcohol-based waterless hand cleaner helps prevent contamination of central line sites and resultant bloodstream infections.\(^1^\)

In addition to the standard “Four Moments for Hand Hygiene”, when caring for central lines, appropriate times for hand hygiene include:

- Before and after palpating catheter insertion sites (Note: Palpation of the insertion site should not be performed after the application of antiseptic, unless aseptic technique is maintained.)
- Before and after inserting, replacing, accessing, repairing, or dressing an intravascular catheter
- When hands are obviously soiled or if contamination is suspected
- Before donning and after removing gloves

>> **What changes can we make that will result in improvement?**

Hospital teams across the United States and Canada have developed and tested process changes that allowed them to improve performance on hand hygiene. These measures, taken together, support the implementation of the central line insertion bundle. Some of these changes are:

- Empower nursing to enforce use of a central line checklist to be sure all processes related to central line placement, including hand hygiene, are executed for each line placement.
- Include hand hygiene as part of your checklist for central line placement.
- Keep soap/alcohol-based hand hygiene dispensers prominently placed and make universal precautions equipment, such as gloves and masks, readily available
- Post signs at the entry and exits to the patient room as reminders.
- Create an environment where reminding each other about hand hygiene is encouraged.
- Initiate a campaign using posters including photos of celebrated hospital doctors/employees recommending hand hygiene.

2. **Maximal barrier precautions (Level 1B)**
A key change to decrease the likelihood of central line infections is to apply maximal barrier precautions in preparation for line insertion.

For the provider placing the central line and for those assisting in the procedure, maximal barrier precautions means strict compliance with hand hygiene and wearing a cap, mask, sterile gown, and gloves. The cap should cover all hair and the mask should cover the nose and mouth tightly.
For the patient, applying maximal barrier precautions means covering the patient with a large sterile drape, with a small opening for the site of insertion. The drape should be of sufficient size to maintain an adequate sterile working field, including when manipulating the catheter and guidewire. For arterial lines, this may be a smaller, fenestrated drape (Level II).

What changes can we make that will result in improvement?

Hospital teams across the United States and Canada have developed and tested process changes that allowed them to improve performance on maximal barrier precautions. These measures, taken together, support the implementation of the central line insertion bundle. Some of these changes include:

• Empower nursing to enforce use of a central line checklist to be sure all processes related to central line placement, including maximal barrier precautions, are executed for each line placement.
• Include maximal barrier precautions as part of your checklist for central line placement.
• Keep equipment stocked in a cart for central line placement to avoid the difficulty of finding necessary equipment to institute maximal barrier precautions.

3. Chlorhexidine skin antisepsis (Level IA)

Chlorhexidine skin antisepsis has been proven to provide better skin antisepsis than other antiseptic agents such as povidone-iodine solutions.

The technique for skin preparation with chlorhexidine 2% (minimum 0.5%) in 70% isopropyl alcohol is as follows:

• Apply chlorhexidine solution using a back-and-forth friction scrub for at least 30 seconds. Do not wipe or blot.
• Allow antiseptic solution time to dry completely before puncturing the site (~ two minutes). 11, 12

What changes can we make that will result in improvement?

Hospital teams across the United States and Canada have developed and tested process and changes that allowed them to improve performance using chlorhexidine skin antisepsis. These measures, taken together, support the implementation of the central line insertion bundle. Some of these changes include:

• Empower nursing to enforce use of a central line checklist to be sure all processes related to central line placement, including chlorhexidine skin antisepsis, are executed for each line placement.
• Include chlorhexidine antisepsis as part of your checklist for central line placement.
• Include only chlorhexidine antisepsis kits/solutions in carts or grab bags storing central line equipment.
• Ensure that solution dries completely before attempting to insert the central line.
4. Optimal catheter type and site selection

a. Adults:
While the use of the subclavian site may be associated with lower risk of infection (Level IB), other sites may have lower risks of mechanical complications. The bundle requirement for optimal site selection suggests that other factors—such as the potential for mechanical complications, the risk of subclavian vein stenosis, and catheter-operator skill—should be considered when deciding where to place the catheter (Level IA) while avoiding the femoral vein if possible (Level IA). In these instances, teams are considered compliant with the bundle element as long as they use a rational construct to choose the site. The use of ultrasound guidance (if available and personnel are trained) can reduce mechanical complications (Level IB).

A catheter with the minimum number of ports or lumens necessary for that patient should be selected (Level IB). Although historical practice has been to use new lines or dedicated lumens for administration of parenteral nutrition, there is insufficient evidence to make any recommendation. Antimicrobial-impregnated catheters should be considered in patients where it is expected that the central venous catheter will remain in place for more than five days, especially if CLA-BSI rates remain high after implementation of regular interventions (Level IA).

Guidewire exchange is acceptable if there is no evidence of infection at the existing site (Level IB). New sterile gloves should be donned before handling the new catheter (Level II).

For arterial lines, the use of radial, brachial or dorsalis pedis sites is preferred over the femoral or axillary sites of insertion to reduce the risk of infection (Level IB).

b. Pediatric Patients:
Insertion of central venous catheters in children can be more challenging than in adults. When selecting a line placement site, patient comfort, patient specific factors (such as preexisting catheters, irregularities in hemostasis, anatomic anomalies), risk of complications (such as bleeding risk, pneumothorax), infection risk, potential for ambulation, and operator experience should all be used to guide selection. The final decision of where to place a central venous catheter in a child should be based on an individual patient’s requirements, and an assessment of the risk/benefit analysis in each specific clinical situation. Whether a specific site has a lower rate of infection in younger children remains inconclusive. In teenage patients, similar considerations for site selection can be applied as for adult patients.

What changes can we make that will result in improvement?
Hospital teams across the United States and Canada have developed and tested process changes that allowed them to improve performance on optimal insertion site. These measures, taken together, support the implementation of the central line insertion bundle. Some of these changes include:

- Empower nursing to enforce use of a central line checklist to be sure all processes related to central line placement, including optimal catheter type and site selection, are executed for each line placement.
- Include optimal site selection as part of your checklist for central line placement with room to note appropriate contraindications, e.g., bleeding risks.
- Use a standard procedure note to document all line insertions, including use of a checklist.
When adherence to aseptic technique cannot be ensured (i.e. catheters inserted during a medical emergency), replace the catheter as soon as possible, i.e., within 48 hours (Level IB).

**Line Care Bundle**

1. **Daily review of central and arterial line necessity with prompt removal of unnecessary lines**

   Daily review of central and arterial line necessity will prevent unnecessary delays in removing lines that are no longer clearly needed for the care of the patient. Many times, central lines remain in place simply because they provide reliable access and because personnel have not considered removing them; however, it is clear that the risk of infection increases over time as the line remains in place and that the risk of infection decreases if the line is removed. A recent study (Lucet) has shown that arterial lines are common sources for blood stream infections, with similar colonization and infection rates as central venous catheters.

>> What changes can we make that will result in improvement?

   Hospital teams across the United States and Canada have developed and tested process changes that allowed them to improve performance on daily review of line necessity. These measures, taken together, support the implementation of the central line care bundle. Some of these changes include:
   
   - Include daily review of line necessity as part of your multidisciplinary rounds.
   - Include assessment for removal of central lines as part of your daily goal sheets.
   - Record time and date of line placement for record keeping purposes and evaluation by staff to aid in decision making.

2. **Aseptic Lumen Access (IA)**

   Minimize contamination risk by scrubbing the access port with an appropriate antiseptic (chlorhexidine, povidone iodine, an iodophor, or 70% alcohol) and accessing the port only with sterile devices (Level IA). Use a needleless system to access IV tubing (Level IC), preferably of the split-septum design rather than mechanical (Level 2).

>> What changes can we make that will result in improvement?

   Hospital teams have developed and tested process changes that allowed them to improve performance for accessing lumens aseptically. These actions, taken together, support the implementation of the central line care bundle. Some of these changes include:
   
   - Rely on hand washing guidelines
   - A number of centres have found it helpful to reduce choice and thus reduce possible error by making only chlorhexidine antiseptic swabs available. This includes the practice of using chlorhexidine antiseptic to swab ports. Other centres are using a hub cap that incorporates a sponge with ethanol to maintain asepsis.
3. Catheter site and tubing care (Level IB except where indicated)
Use either sterile gauze or sterile, transparent, semipermeable dressing to cover the catheter site (Level IA). Do not use topical antibiotic ointment or creams on insertion sites, except for dialysis catheters. Use a chlorhexidine-impregnated sponge dressing for temporary short-term catheters if the CLABSI rate is not decreasing despite adherence to basic prevention measures.

In patients not receiving blood, blood products or fat emulsions, replace administration sets that are continuously used, including secondary sets and add-on devices, no more frequently than at 96-hour intervals, but at least every 7 days (Level IA). If the tubing is used to administer blood, blood products, or fat emulsions (those combined with aa and glucose in a 3-in-1 admixture or infused separately), it should be replaced within 24 hours of initiating the infusion. Needleless system components should be changed at same frequency as tubing (Level 2).

Replace the catheter site dressing if the dressing becomes damp, loosened, or visibly soiled.

Replace dressings used on short-term CVC sites at least every seven days for transparent dressings or 2 days for gauze. Sterile gloves and aseptic technique should be used for dressing changes (Level IC).

Monitor the catheter sites visually when changing the dressing or by palpation through an intact dressing on a regular basis. Checking the entry site for inflammation will prevent unnecessary delays in providing appropriate interventions in care of the patient. On occasion, central line site infections may initially go unnoticed. However, it is clear that the sooner an infection is identified, the more quickly treatment can be initiated.

What changes can we make that will result in improvement?
Hospital teams have developed and tested process changes that allowed them to improve monitoring the entry site for signs of infection. Some of these changes include:

- Provide education about checking entry site for signs of inflammation as part of multidisciplinary rounds.
- Include checking insertion site in daily goals or care check sheet.
A comparison of Guidelines for Prevention of CLA-BSI

Note: The Society for Healthcare Epidemiology of America (SHEA) specifically limited to central venous catheters with occasional inclusion of arterial lines. Centers for Disease Control and Prevention (CDC) guidelines include peripheral and arterial. This summary does not include all the recommendations in the two documents. There may be other recommendations pertaining to pediatrics, tunnel or implanted central venous catheters, peripheral catheters and additional minor issues. Please refer to the original documents.

Summary

<table>
<thead>
<tr>
<th></th>
<th>CDC</th>
<th>SHEA-IDSA</th>
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| Published      | Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011  
Marscall et al. Infect Control Hosp Epidemiol 2008;29:S22-S30 |
<p>| Authors        | Broad representation, mostly MD                                       | Same (Canadian input: 2 ID MD’s from Winnipeg)                        |
| Sponsors       | SCCM, in collaboration with many Societies/Associations (include liaison with PHAC) | SHEA/IDSA                                                             |</p>
<table>
<thead>
<tr>
<th>Evidence Grading</th>
<th>CDC</th>
<th>SHEA-IDSA</th>
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<tbody>
<tr>
<td><strong>Category IA.</strong> Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies.</td>
<td></td>
<td><strong>Strength of recommendation</strong></td>
</tr>
<tr>
<td><strong>Category IB.</strong> Strongly recommended for implementation and supported by some experimental, clinical, or epidemiologic studies and a strong theoretical rationale; or an accepted practice (e.g., aseptic technique) supported by limited evidence.</td>
<td></td>
<td><strong>Quality of evidence</strong></td>
</tr>
<tr>
<td><strong>Category IC.</strong> Required by state or federal regulations, rules, or standards.</td>
<td></td>
<td>I Evidence from ≥1 properly randomized, controlled trial</td>
</tr>
<tr>
<td><strong>Category II.</strong> Suggested for implementation and supported by suggestive clinical or epidemiologic studies or a theoretical rationale.</td>
<td></td>
<td>II Evidence from ≥1 well-designed clinical trial, without randomization; from cohort or case-control analytic studies (preferably from &gt;1 center); from multiple time series; or from dramatic results of uncontrolled experiments</td>
</tr>
<tr>
<td><strong>Unresolved issue [NR].</strong> Represents an unresolved issue for which evidence is insufficient or no consensus regarding efficacy exists.</td>
<td></td>
<td>III Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports from expert committees note.</td>
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**Major Points**

<table>
<thead>
<tr>
<th>CDC</th>
<th>SHEA-IDSA</th>
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<tr>
<td>Educating and training healthcare personnel who insert and maintain catheters</td>
<td></td>
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<tr>
<td>Using maximal sterile barrier precautions during central venous catheter insertion</td>
<td></td>
</tr>
<tr>
<td>Using a &gt; 0.5% chlorhexidine skin preparation with alcohol for antisepsis</td>
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Adapted from the Canadian Task Force on the Periodic Health Examination

[NR=No recommendation]
<table>
<thead>
<tr>
<th>Strategies</th>
<th>CDC</th>
<th>SHEA-IDSA</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Avoiding routine replacement of central venous catheters as a strategy to prevent infection</td>
<td><strong>Education:</strong> Educate physicians, nurses, and other healthcare personnel about guidelines to prevent CLABSI (e.g., with online and paper versions). These guidelines should be easily accessible.</td>
</tr>
<tr>
<td></td>
<td>Using antiseptic/antibiotic impregnated short-term central venous catheters and chlorhexidine impregnated sponge dressings if the rate of infection is not decreasing despite adherence to other strategies</td>
<td><strong>Checklist:</strong> Develop and implement a catheter insertion checklist. Educate nurses, physicians, and other healthcare personnel involved in catheter insertion, regarding the use of the catheter insertion checklist.</td>
</tr>
<tr>
<td></td>
<td><strong>Inspection:</strong> Post-education test to ensure their knowledge and competency before being allowed to insert CVCs.</td>
<td><strong>Standardization:</strong> Establish catheter insertion kits/carts containing all necessary items for insertion</td>
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## Details with Evidence Grading

<table>
<thead>
<tr>
<th>CDC</th>
<th>Grade</th>
<th>SHEA-IDSA</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educate healthcare personnel regarding the indications for intravascular catheter use, proper procedures for the insertion and care of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections</td>
<td>1A</td>
<td>a. Educate healthcare personnel involved in the insertion, care, and care of CVCs about CLABSI prevention. Include the indications for catheter use, appropriate insertion and care, the risk of CLABSI, and general infection prevention strategies.</td>
<td>A-II</td>
</tr>
<tr>
<td>Periodically assess knowledge of and adherence to guidelines for all personnel involved in the insertion and care of intravascular catheters</td>
<td>1A</td>
<td>c. Periodically assess healthcare personnel knowledge of and adherence to preventive measures.</td>
<td></td>
</tr>
<tr>
<td>Designate only trained personnel who demonstrate competence for the insertion and care of peripheral and central intravascular catheters</td>
<td>1A</td>
<td>d. Ensure that any healthcare professional who inserts a CVC undergoes a credentialing process (as established by institution)</td>
<td></td>
</tr>
<tr>
<td>Ensure appropriate nursing staff levels in ICUs</td>
<td>1B</td>
<td>Nurse-Patient ratio and float nurses</td>
<td>NR</td>
</tr>
</tbody>
</table>
## Insertion

<table>
<thead>
<tr>
<th>CDC</th>
<th>Grade</th>
<th>SHEA-IDSA</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use a catheter checklist to ensure adherence to infection prevention practices at the time of CVC insertion</td>
<td>B-II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform hand hygiene procedures, either by washing hands with conventional soap and water or with alcohol-based hand rubs</td>
<td>1B</td>
<td>Perform hand hygiene before catheter insertion or manipulation</td>
<td>B-II</td>
</tr>
<tr>
<td>Avoid using the femoral vein for central venous access in adult patients</td>
<td>1A</td>
<td>Avoid using the femoral vein for central venous access in adult patients</td>
<td>A-I</td>
</tr>
<tr>
<td>Weigh the risks and benefits of placing a central venous device at a recommended site to reduce infectious complications against the risk for mechanical complications</td>
<td>1A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use a subclavian site, rather than a jugular or a femoral site, in adult patients to minimize infection risk for nontunneled CVC placement</td>
<td>1B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use a CVC with the minimum number of ports or lumens essential for the management of the patient</td>
<td>1B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of a designated lumen for parenteral nutrition.</td>
<td>NR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use ultrasound guidance to place central venous catheters (if this technology is available) to reduce the number of cannulation attempts and mechanical complications. Ultrasound guidance should only be used by those fully trained in its technique</td>
<td>1B</td>
<td></td>
<td></td>
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<tr>
<td>CDC</td>
<td>Grade</td>
<td>SHEA-IDSA</td>
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</tr>
<tr>
<td>Sterile gloves should be worn for the insertion of arterial, central, and midline catheters</td>
<td>1A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintain aseptic technique for the insertion and care of intravascular catheters</td>
<td>1B</td>
<td>Use an all-inclusive catheter cart or kit</td>
<td>B-II</td>
</tr>
<tr>
<td>Use maximal sterile barrier precautions, including the use of a cap, mask, sterile gown, sterile gloves, and a sterile full body drape, for the insertion of CVCs, PICCs, or guidewire exchange</td>
<td>1B</td>
<td>Use maximal sterile barrier precautions during CVC Insertion</td>
<td>A-I</td>
</tr>
<tr>
<td>Use new sterile gloves before handling the new catheter when guidewire exchanges are performed</td>
<td>II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare clean skin with a &gt;0.5% chlorhexidine preparation with alcohol before central venous catheter and peripheral arterial catheter insertion and during dressing changes. If there is a contraindication to chlorhexidine, tincture of iodine, an iodophor, or 70% alcohol can be used as alternatives</td>
<td>1A</td>
<td>Use a chlorhexidine-based antiseptic for skin preparation in patients older than 2 months of age</td>
<td>A-I</td>
</tr>
<tr>
<td>Antiseptics should be allowed to dry according to the manufacturer’s recommendation prior to placing the catheter</td>
<td>1B</td>
<td>The antiseptic solution must be allowed to dry before making the skin puncture</td>
<td></td>
</tr>
</tbody>
</table>
## Post-Insertion

<table>
<thead>
<tr>
<th>CDC</th>
<th>Grade</th>
<th>SHEA-IDSA</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use a sutureless securement device to reduce the risk of infection for intravascular catheters</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use either sterile gauze or sterile, transparent, semipermeable dressing to cover the catheter site</td>
<td>1A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If the patient is diaphoretic or if the site is bleeding or oozing, use a gauze dressing until this is resolved</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace catheter site dressing if the dressing becomes damp, loosened, or visibly soiled</td>
<td>1B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimize contamination risk by scrubbing the access port with an appropriate antiseptic (chlorhexidine, povidone iodine, an iodophor, or 70% alcohol) and accessing the port only with sterile devices</td>
<td>1A</td>
<td>Disinfect catheter hubs, needleless connectors, and injection ports before accessing the catheter</td>
<td>B-II</td>
</tr>
<tr>
<td>Promptly remove any intravascular catheter that is no longer essential</td>
<td>1A</td>
<td>Remove nonessential catheters</td>
<td>A-II</td>
</tr>
<tr>
<td>When adherence to aseptic technique cannot be ensured (i.e. catheters inserted during a medical emergency), replace the catheter as soon as possible (i.e, within 48 hours)</td>
<td>1B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wear either clean or sterile gloves when changing the dressing on intravascular catheters</td>
<td>1C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace dressings used on short-term CVC sites every 2 days for gauze dressings</td>
<td>2</td>
<td></td>
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<tr>
<td>CDC</td>
<td>Grade</td>
<td>SHEA-IDSA</td>
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<tr>
<td>Replace dressings used on short-term CVC sites at least every 7 days for transparent dressings</td>
<td>1B</td>
<td>For nontunneled CVCs in adults and adolescents, change transparent dressings and perform site care with a chlorhexidine-based antiseptic every 5-7 days or more frequently if the dressing is soiled, loose, or damp; change gauze dressings every 2 days or more frequently if the dressing is soiled, loose, or damp</td>
<td>A-I</td>
</tr>
<tr>
<td>Monitor the catheter sites visually when changing the dressing or by palpation through an intact dressing on a regular basis, depending on the clinical situation of the individual patient. If patients have tenderness at the insertion site, fever without obvious source, or other manifestations suggesting local or bloodstream infection, the dressing should be removed to allow thorough examination of the site</td>
<td>1B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In patients not receiving blood, blood products or fat emulsions, replace administration sets that are continuously used, including secondary sets and add-on devices, no more frequently than at 96-hour intervals, but at least every 7 days</td>
<td>1A</td>
<td>Replace administration sets not used for blood, blood products, or lipids at intervals not longer than 96 hours</td>
<td>A-II</td>
</tr>
<tr>
<td>Replace tubing used to administer blood, blood products, or fat emulsions (those combined with amino acids and glucose in a 3-in-1 admixture or infused separately) within 24 hours of initiating the infusion</td>
<td>1B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use a needleless system to access IV tubing.</td>
<td>1C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDC</td>
<td>Grade</td>
<td>SHEA-IDSA</td>
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<td>--------------------------------------------------------------------</td>
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</tr>
<tr>
<td>When needleless systems are used, a split septum valve may be</td>
<td>2</td>
<td>Do not routinely use positive-pressure</td>
<td>B-II</td>
</tr>
<tr>
<td>preferred over some mechanical valves due to increased risk of</td>
<td></td>
<td>needleless connectors with mechanical</td>
<td></td>
</tr>
<tr>
<td>infection with the mechanical valves</td>
<td></td>
<td>valves</td>
<td></td>
</tr>
<tr>
<td>Change the needleless components at least as frequently as the</td>
<td>2</td>
<td></td>
<td></td>
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<tr>
<td>administration set. There is no benefit to changing these more</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>frequently than every 72 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do not use topical antibiotic ointment or creams on insertion</td>
<td>1B</td>
<td>Use antimicrobial ointments for</td>
<td>A-I</td>
</tr>
<tr>
<td>sites, except for dialysis catheters, because of their potential</td>
<td></td>
<td>hemodialysis catheter insertion sites</td>
<td></td>
</tr>
<tr>
<td>to promote fungal infections and antimicrobial resistance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use povidone iodine antiseptic ointment or bacitracin/gramicidin/</td>
<td>1B</td>
<td>Use antimicrobial ointments for</td>
<td></td>
</tr>
<tr>
<td>polymyxin B ointment at the hemodialysis catheter exit site</td>
<td></td>
<td>hemodialysis catheter insertion sites</td>
<td></td>
</tr>
<tr>
<td>after catheter insertion and at the end of each dialysis session</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>only if this ointment does not interact with the material of the</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hemodialysis catheter per manufacturer’s recommendation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use hospital-specific or collaborative-based performance</td>
<td>1B</td>
<td>Perform surveillance for CLABSI</td>
<td>B-II</td>
</tr>
<tr>
<td>improvement initiatives in which multifaceted strategies are</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“bundled” together to improve compliance with evidence-based</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>recommended practices</td>
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</tbody>
</table>
### Special Measures

<table>
<thead>
<tr>
<th>CDC</th>
<th>Grade</th>
<th>SHEA-IDSA</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use a 2% chlorhexidine wash for daily skin cleansing to reduce CRBSI</td>
<td>2</td>
<td>Bathe ICU patients older than 2 months of age with a chlorhexidine preparation on a daily basis</td>
<td>B-II</td>
</tr>
<tr>
<td>Use a chlorhexidine-impregnated sponge dressing for temporary short-term catheters in patients older than 2 months of age if the CLABSI rate is not decreasing despite adherence to basic prevention measures, including education and training, appropriate use of chlorhexidine for skin antisepsis, and maximal sterile barrier (MSB) precautions</td>
<td>1B</td>
<td>Use chlorhexidine-containing sponge dressings for CVCs in patients older than 2 months of age [if regular measures have not achieved target, and/or high risk patient]</td>
<td>B-I</td>
</tr>
<tr>
<td>Use a chlorhexidine/silver sulfadiazine or minocycline/rifampin -impregnated CVC in patients whose catheter is expected to remain in place &gt;5 days if, after successful implementation of a comprehensive strategy to reduce rates of CLABSI, the CLABSI rate is not decreasing</td>
<td>1A</td>
<td>Use antiseptic- or antimicrobial-impregnated CVCs for adult patients [if regular measures have not achieved target, and/or high risk patient]</td>
<td>A-I</td>
</tr>
<tr>
<td>Use prophylactic antimicrobial lock solution in patients with long term catheters who have a history of multiple CRBSI despite optimal maximal adherence to aseptic technique</td>
<td>2</td>
<td>Use antimicrobial locks for CVCs [if regular measures have not achieved target, and/or high risk patient]</td>
<td>A-I</td>
</tr>
<tr>
<td>Use a guidewire exchange to replace a malfunctioning non-tunneled catheter if no evidence of infection is present</td>
<td>1B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use new sterile gloves before handling the new catheter when guidewire exchanges are performed</td>
<td>2</td>
<td></td>
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</tr>
</tbody>
</table>
## Not recommended

<table>
<thead>
<tr>
<th>CDC</th>
<th>Grade</th>
<th>SHEA-IDSA</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not administer systemic antimicrobial prophylaxis routinely before insertion or during use of an intravascular catheter to prevent catheter colonization or CRBSI</td>
<td>1B</td>
<td>Do not use antimicrobial prophylaxis for short-term or tunneled catheter insertion or while catheters are in situ</td>
<td>A-I</td>
</tr>
<tr>
<td>Do not routinely replace CVCs, PICCs, hemodialysis catheters, or pulmonary artery catheters to prevent catheter-related infections.</td>
<td>1B</td>
<td>Do not routinely replace CVCs or arterial catheters</td>
<td>A-I</td>
</tr>
<tr>
<td>Do not routinely replace arterial catheters to prevent catheter-related infections</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do not routinely use anticoagulant therapy to reduce the risk of catheter-related infection in general patient populations</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do not remove CVCs or PICCs on the basis of fever alone. Use clinical judgment regarding the appropriateness of removing the catheter if infection is evidenced elsewhere or if a noninfectious cause of fever is suspected</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do not use guidewire exchanges routinely for non-tunneled catheters to prevent infection</td>
<td>1B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do not use guidewire exchanges to replace a non-tunneled catheter suspected of infection</td>
<td>1B</td>
<td></td>
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</tbody>
</table>
### Arterial lines

<table>
<thead>
<tr>
<th>CDC</th>
<th>Grade</th>
<th>SHEA-IDSA</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>In adults, use of the radial, brachial or dorsalis pedis sites is preferred over the femoral or axillary sites of insertion to reduce the risk of infection</td>
<td>1B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A minimum of a cap, mask, sterile gloves and a small sterile fenestrated drape should be used during peripheral arterial catheter insertion</td>
<td>1B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During axillary or femoral artery catheter insertion, maximal sterile barriers precautions should be used</td>
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<td>2</td>
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</table>

### Unresolved

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<tr>
<th>CDC</th>
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<tbody>
<tr>
<td>IV teams</td>
<td></td>
<td></td>
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<tr>
<td>Arterial line surveillance</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Estimating catheter days for reporting</td>
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</table>
Implementing the Central Line Bundles

Getting Started
Hospitals will not successfully implement the central line bundle overnight. If they do, chances are they did something sub-optimally. A successful program involves careful planning, testing to determine if the process is successful, making modifications as needed, retesting, and careful implementation.

- Select the team and the venue. It is often best to start in one ICU. Many hospitals will have only one ICU, making the choice easier.
- Assess where you stand presently. What precautions are currently taken when placing lines? Is there a process in place? If so, work with staff to begin preparing for changes.
- Contact the infectious diseases/infection control department. Learn about your catheter-related bloodstream infection rate and how it is determined and reported. In addition, how frequently the hospital reports it to regulatory agencies.
- Organize an educational program. Teaching the core principles to the ICU staff will open many people’s minds to the process of change. Knowing your current reality (e.g., rates and current practices) assists in highlighting strengths and gaps in practices.
- Introduce the central line bundles to the staff. Start testing changes using the insertion bundle and as progress is made, add testing of the care bundle. This order is recommended as the insertion bundle is often easier to measure. The care bundle is less straightforward and less predictable to measure due to the nature of the care and environment.

Forming the Team
SHN recommends a multidisciplinary team approach to patient care beginning in the ICU. Improvement teams should be heterogeneous in makeup, but homogeneous in mindset. The value of bringing diverse personnel together is that all members of the care team are given a stake in the outcome and work to achieve the same goal. In preventing CR-BSIs, the team must include an intensive care physician and:
- Intensive Care Nurses
- Infection Control Practitioners
- Pharmacists

All the stakeholders in the process must be included in order to gain the buy-in and cooperation of all parties. For example, teams without nurses are bound to fail. Teams led by nurses and allied health professionals may be successful, but often lack leverage; physicians must also be part of the team.

Some suggestions to attract and retain excellent team members include:
- using data to define and solve the problem;
- utilizing the champions;
- working with those who want to work on the project, rather than trying to convince those who do not;
• schedule meetings in advance with dates/times that are MD friendly;
• ensure that meetings are structured (agenda and minutes);
• ensure meetings are managed effectively (attention to time allocation);
• ensure that there is clarity about task delegation and time lines;
• engage them in the overall goal of the campaign;
• find champions within the hospital that are of sufficiently high profile to lend the effort immediate credibility

The team needs encouragement and commitment from an authority in the intensive care unit. Identifying a champion increases a team’s motivation to succeed. When measures are not improving fast enough, the champion re-addresses the problems with staff and helps to keep everybody on track toward the aims and goals.

Eventually, the changes that are introduced become established. At some point, however, changes in the field or other changes will require revisiting the processes that have been developed. Identifying a “process owner,” a figure who is responsible for the functioning of the process now and in the future, helps to maintain the long-term integrity of the effort.

Setting Aims
Improvement requires setting aims. An organization will not improve without a clear and firm intention to do so. The aim should be time-specific and measurable; it should also define the specific population of patients that will be affected. Agreeing on the aim is crucial; so is allocating the people and resources necessary to accomplish the aim.

An example of an aim that would be appropriate for reducing CR-BSIs can be as simple as, “Decrease the rate of CR-BSIs by 50% within one year.”

Teams are more successful when they have unambiguous, focused aims. Setting realistic numerical goals clarifies the aim, helps to create tension for change, directs measurement, and focuses initial changes. Once the aim has been set, the team needs to be careful not to back away from it deliberately or "drift" away from it unconsciously.

Using the Model for Improvement
In order to move this work forward, SHN and IHI recommend using the Model for Improvement. Developed by Associates in Process Improvement, the Model for Improvement is a simple yet powerful tool for accelerating improvement that has been used successfully by hundreds of healthcare organizations to improve many different healthcare processes and outcomes.

The model has two parts:
• Three fundamental questions that guide improvement teams to 1) set clear aims, 2) establish measures that will tell if changes are leading to improvement, and 3) identify changes that are likely to lead to improvement.
• The Plan-Do-Study-Act (PDSA) cycle to conduct small-scale tests of change in real work settings—by planning a test, trying it, observing the results, and acting on what is learned. This is the scientific method, used for action-oriented learning.
Implementation: After testing a change on a small scale, learning from each test, and refining the change through several PDSA cycles, the team can implement the change on a broader scale—for example, do a PDSA cycle for the insertion bundle using the medical team leader on one patient. Learn from your PDSA and make the necessary adjustments. Continue to test the refined process with a larger number of patients, with different physicians. Once it is assessed that the process works it can be implemented, using PDSA, to the entire unit for all physicians to follow for all central line insertions.

Spread: After successful implementation of a change or package of changes for a pilot population or an entire unit, the team can spread the changes to other parts of the organization or to other organizations.

You can learn more about the Model for Improvement at:
http://www.patientsafetyinstitute.ca/English/toolsResources/ImprovementFramework/Documents/Improvement%20Frameworks%20GSK%20EN.PDF
Measurement
Measurement is a way to know whether a change represents an improvement. There are three measures of interest for central line catheter-related bloodstream infections. Appendix A contains further details on the technical descriptions of these measures, including definitions of terms, numerators, denominators, exclusions, and collection strategies. It may be appropriate to collect some or all measures retrospectively, through chart review, but ideally your data will be collected concurrently.

1. Central line-associated primary bloodstream infection rate per 1000 central line-days
The first measure is a rate. In this case, for a particular time period, we are interested in the total number of cases of CR-BSIs. For example, if in February there were 12 cases of CR-BSIs, the number of cases would be 12 for that month. We want to be able to understand that number as a proportion of the total number of days that patients had central lines. Thus, if 25 patients had central lines during the month and each, for purposes of example, kept their line for three days, the number of catheter days would be 25 x 3 = 75 for February. The CR-BSI Rate per 1000 catheter days then would be (12/75) x 1000 = 160.

\[
\text{Total no. of CR-BSI cases} \times 1000 = \text{CR-BSI rate per 1000 catheter days}
\]

No. of catheter days

2. Central Line Insertion Bundle Compliance
The second measure is an assessment of how well the team is adhering to the central line insertion bundle. Our experience has been that teams begin to demonstrate improvement in outcomes when they implement each of the four components of a central line bundle:
1. Hand hygiene
2. Maximal barrier precautions
3. Chlorhexidine skin antisepsis
4. Optimal catheter type and site selection
   a. Avoid the femoral vein in adults; subclavian preferred to minimize infection risk.
   b. Optimal catheter type and site selection in children is more complex with the internal jugular vein or femoral vein most commonly used. Site preference in children needs to individualized.

\[
\text{No. with ALL four elements of central line care bundle} \times 100 = \text{Central Line Insertion bundle compliance}
\]

No. with CVCs on the day of the sample
On a given day, select all the patients with central line insertions and assess them for compliance with the central line insertion bundle. If even one element is missing, the case is not in compliance with the bundle. For example, if central lines were inserted in seven patients on a given day, and six have all four bundle elements completed, then 6/7 (86%) is the compliance with the bundle. If all seven had all elements completed, compliance would be 100%. If all seven were missing even a single item, compliance would be 0%. This measure is always expressed as a percentage.

3. Central Line Care Bundle Compliance
The third measure is an assessment of how well the team is adhering to the central line care bundle. On a given day, select all the patients with central lines and assess them for compliance with the central line care bundle, in the same way described above for insertion bundle compliance, ensuring all three steps have been completed:

1. Daily review of line necessity, with prompt removal of unnecessary lines
2. Aseptic lumen access
3. Catheter site and tubing care

Safer Healthcare Now! recommends that before your facility, team or unit begins implementing the intervention, you obtain baseline data, using the worksheets provided. Baseline data will give you a sense of where you are starting from, and what some of the potential areas of focus are for your facility or unit. We suggest that you take a “snapshot” of three months or more, or whatever is feasible for your organization.

Track Measures over Time
Improvement takes place over time. Determining if improvement has really occurred and if it is a lasting effect requires observing patterns over time. Run charts are graphs of data over time and are one of the single most important tools in performance improvement.
Using run charts has a variety of benefits:

- They help improvement teams formulate aims by depicting how well (or poorly) a process is performing.
- They help in determining when changes are truly improvements by displaying a pattern of data that you can observe as you make changes.
- They give direction as you work on improvement and information about the value of particular changes.

**First Test of Change**

Once a team has prepared the way for change by studying the current process and educating the affected parties, the next step is to begin testing the central line bundles at your institution.

- Begin using the bundle with one patient from the time of catheter placement.
- Work with each nurse who cares for the patient to be sure they are able to follow the bundle and implement the checklist and daily goals sheet.
- Make sure that the approach can be carried over from shift to shift to eliminate gaps in teaching and utilization.
- Process feedback and incorporate suggestions for improvement.
- Once the bundle has been applied to one patient and subsequent shifts, increase utilization to the remainder of the ICU.
- Engage in additional PDSA cycles to refine the process and make it more reliable.
- After achieving reduction in CR-BSI in the pilot ICU, spread the changes to other ICUs, and eventually to other places in the hospital where central lines are inserted.

**Barriers That May be Encountered**

- **Fear of change**
  All change is difficult. The antidote to fear is knowledge about the deficiencies of the present process and optimism about the potential benefits of a new process.

- **Communication breakdown**
  Organizations have not been successful when they failed to communicate with staff about the importance of central line care, as well as when they failed to provide ongoing teaching as new staff become involved in the process.

- **Physician and staff “partial buy-in” (i.e. “Just another flavor of the week?”)**
  In order to enlist support and engage staff, it is important to share baseline data on CR-BSI rates and to share the results of improvement efforts. If the run charts suggest a large decrease in CR-BSIs compared to baseline, issues surrounding “buy-in” tend to fade. Other centres have cited their “CR-BSI rates are below” recommended acceptable levels. They struggle with how to motivate staff to move towards best practice. Questioning those who challenge the change is important. Refocusing on the goal of best practice to prevent infections and consequently decrease risk to the patient is suggested as helpful motivator.
Work To Achieve a High Level of Compliance

The experience of the hospitals that have used the central line bundles thus far has been that the greater the level of compliance with all of the items in a bundle, the greater the reduction in the CR-BSI rates. Of course, compliance is only as good as the element least adhered to in the bundle. The Johns Hopkins Hospital’s experience with compliance with some elements of central line care analogous to the central line bundle is depicted below: 16

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand hygiene</td>
<td>62%</td>
</tr>
<tr>
<td>Chlorhexidine antiseptic at the procedure site</td>
<td>100%</td>
</tr>
<tr>
<td>Draped the entire patient in a sterile fashion</td>
<td>85%</td>
</tr>
<tr>
<td>Used a hat, mask, and sterile gown</td>
<td>92%</td>
</tr>
<tr>
<td>Used sterile gloves</td>
<td>100%</td>
</tr>
<tr>
<td>Sterile dressing applied</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note that for Johns Hopkins Hospital, bundle compliance cannot be higher than 62%, given the score obtained for hand hygiene. Aiming for a high level of compliance will improve outcomes and prevent infections.

Tips for Gathering Data

Implementing a central line insertion checklist at the time of insertion will help to ensure a reliable process. Nurses should be empowered to supervise the preparations using the checklist prior to line insertion and to stop the process if necessary. (See Appendix B for a sample checklist.)

Use a form that allows you to record your efforts and track your success. In addition to helping improvement teams create run charts each month, a contemporaneous record documenting line placement and site care can help with prompting early removal.

These strategies are particularly effective if used in conjunction with a “daily goals” assessment sheet. (See Appendix C for a sample.) This form can be completed during daily rounds on the patient. Many organizations implement the central line bundle in tandem with the VAP bundle to improve systematic care to patients in ICUs. (For information on the VAP bundle, see the Getting Started Kit for “Prevention of Ventilator-Associated Pneumonia.”)
Appendix A: Measures Technical Descriptions

Technical Description of the Measurement Worksheets:

<table>
<thead>
<tr>
<th>Implementation Stages</th>
<th>Definitions apply to all interventions and measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Stage (Pre-intervention)</td>
<td>Data collected for Baseline should be collected prior to implementing small tests of change and reflect the current process.</td>
</tr>
<tr>
<td>Early (Partial) Implementation Stage</td>
<td>The team has set a clear aim(s) for the intervention, identified which measures will indicate if the changes will lead to improvement, and started to implement small tests of change (PDSA) to identify and refine processes, procedures and practices which will lead to improvement and achieving the aim. When the team is close to goal they are ready to move to Full Implementation.</td>
</tr>
<tr>
<td>Full Implementation Stage (At Goal)</td>
<td>The processes, procedures and practices are finalized and have led to significant improvement. These practices on the selected unit are being consistently applied and monitored, showing a sustained performance at or close to goal. The team has achieved (and sustained) their aim(s) and is ready to spread to other areas.</td>
</tr>
</tbody>
</table>

The measurement methodology and recommendations regarding sampling size referenced in this GSK, is based on The Model for Improvement and is designed to accelerate the pace of improvement using the PDSA cycle; a "trial and learn" approach to improvement based on the scientific method.¹

It is not intended to provide the same rigor that might be applied in a research study, but rather offers an efficient way to help a team understand how a system is performing. When choosing a sample size for your intervention, it is important to consider the purposes and uses of the data and to acknowledge when reporting that the findings are based on an “x” sample as determined by the team.

The scope or scale² (amount of sampling, testing, or time required) of a test should be decided according to:
1. The team’s degree of belief that the change will result in improvement
2. The risks from a failed test
3. Readiness of those who will have to make the change

Please refer to the Improvement Frameworks GSK (2015) for additional information.


1.0 Central Line-Associated Primary Bloodstream Infection (BSI) Rate per 1000 Central Line-Days - Worksheet

<table>
<thead>
<tr>
<th>CL1.0 - Central Line-Associated Primary Bloodstream Infection (BSI) Rate per 1000 Central Line-Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
</tr>
</tbody>
</table>

The number of central line catheter-related bloodstream infections per 1000 central line days is the standard measure for surveillance by the CDC and JCAHO. Central line-associated primary bloodstream infections (BSIs) occur in patients in ICU or other units with a laboratory-confirmed BSI who had a central line in place within the 48-hour period before the development of the BSI by unit of attribution.

1. Identify the total number of patients this month who received care in selected units (ICU or other).
2. Subtract the total number of patients in #1 who did not have central lines in place while in the unit (ICU or other) and exclude them from patient list for calculating Central Line Rate.
3. Adult population: Subtract the total number of patients in #2 whose age was less than 18 yrs on admission to the unit (ICU or other).
4. Pediatric population: Subtract the total number of patients in #2 whose age was 18 years or more on admission to the unit (ICU or other).

**Denominator**

- **Detail worksheet (optional)**
- **Enter the total number of central line days for all patients**

**Numerator**

- **Enter the total number of laboratory confirmed bloodstream infections developing more than 48 hours following placement of the central line and within 48 hours of removal of the central line in patients in #4.**

**Your Result**

- **Numerator/Denominator x 1000**
- **Your Result**
- **Goal**: Decrease the BSI rate by 50% in one year
## 1.0 Central Line-Associated Primary Bloodstream Infection (BSI) Rate per 1000 Central Line-Days - Technical Description

**Measure:** Central Line Associated Blood Stream Infection  
**Reported as:** Cases per 1000 central line days

### CALCULATION DETAILS:

**Definition:** The number of cases with a laboratory confirmed blood stream infection associated with a central venous catheter expressed per 1000 line days

**Significance:** CLA-BSI increase morbidity, mortality and costs. It can be prevented using evidence-based interventions. This measure can be used to detect changes related to implementation or lack of adherence to these best practices.

**Derivation:**

**Cases (Numerator):**
Cases require laboratory confirmation as described below. Cultures obtained at any time following central line insertion and up to 48 hours after central line removal will be considered.

1. **Recognized pathogen cultured from one or more blood cultures and organism cultured from blood is not related to an infection at another site**

OR

2. **All 3:**
   1. at least one of the following signs or symptoms: fever (>38°C), chills, hypotension
   2. signs and symptoms and positive laboratory results are not related to an infection at another site
   3. common skin contaminant is cultured from two or more blood cultures drawn on separate occasions (i.e., diphtheroids [Corynebacterium spp.], Bacillus [not B. anthracis] spp., Propionibacterium spp., coagulase-negative staphylococci [including S. epidermidis], viridans group streptococci, Aerococcus spp., Micrococcus spp.)

OR

3. **Patient < 1 year of age has:**
   1. at least one of the following signs or symptoms: fever (>38°C core), hypothermia (<36°C core), apnea, or bradycardia
   2. signs and symptoms and positive laboratory results are not related to an infection at another site
   3. common skin contaminant (i.e., diphtheroids [Corynebacterium spp.], Bacillus [not B. anthracis] spp., Propionibacterium spp., coagulase-negative staphylococci [including S. epidermidis], viridans group streptococci, Aerococcus spp., Micrococcus spp.) is cultured from two or more blood cultures drawn on separate occasions.
Line days (Denominator):
Count each patient with one or more central lines each day of the reporting period. Usually the calculation of central line days is done at approximately the same time every day (e.g., 09:00-11:00). A patient having multiple central lines cannot contribute to more than one central line day per day.

A central line is a vascular access device that terminates at or close to the heart or one of the great vessels. Neither the location of the insertion site nor the type of device may be used solely to determine whether the line qualifies as a “central” line. Only if the location of the tip of the line meets the criteria above does the device qualify as a central line.

This includes central venous catheter sheaths through which a transvenous pacing wire might be placed. CVCs include percutaneous non-tunneled, tunneled (e.g. Hickman), peripherally inserted (PICC) and pulmonary artery catheters. Surveillance does not include totally implanted devices (e.g. Ports), arterial catheters, pacemaker leads and other non-infusion devices. Great Vessels are the superior vena and inferior vena cava, brachiocephalic veins, internal jugular veins, and subclavian veins. A catheter inserted into a femoral vein will be considered as located in a great vessel.

Data Collection Plan:
Surveillance process is required that includes monitoring patients for criteria meeting the definition up to 48 hours after removal of all central lines, including those patients who may be transferred from the intensive care unit.

A process to record and tabulate the total central line days is also required.

Considerations and Assumptions:
If a patient with a CLA-BSI was transferred from another location within 48 hours of the positive blood culture, the CLA-BSI should be attributed to the location where the central line was inserted.

Evidence exists that arterial lines can cause bloodstream infections and that similar intervention may be appropriate. When a catheter-associated blood stream infection is identified, it may not be possible to determine the source when multiple catheters are present. Rigorous blood culture methodology to determine “time to positivity” can be helpful in these situations.

Display and Interpretation:
Data will be displayed in a run chart using standard rules of interpretation.

Benchmark/Goal:
Organizations have reported elimination of CLA-BSI for extended periods of time. Zero CLA-BSI is a reasonable stretch goal.
SAMPLE GRAPH: Children’s Hospital of Eastern Ontario, Ottawa, Ontario
(CLAI BSI Rate shown is rate per 1000 line days)

CL Blood Stream Infection Rate

References:
1. CDC definition for CLA-BSI at http://www.cdc.gov/nhsn/pdfs/pscmanual/4psc_clabscurrent.pdf
# 2.0 Central Line Insertion Bundle Compliance - Worksheet

## Denominator

1. Enter the total number of patients included in this sample population for this report (adult or paediatric).

## Numerator

2. Record which of the four CL-BSI insertion bundle elements listed below have been fully implemented in your healthcare facility and would apply to this month’s sample:
   1. Hand hygiene
   2. Maximal barrier precautions
   3. Chlorhexidine skin antisepsis
   4. Optimal catheter type and site selection

3. Enter the total number of patients in #1 for whom ALL of the CL-BSI Insertion Bundle Elements listed below which have been implemented in your healthcare facility as recorded in #2, were completed at the time of the survey.

## Numerators for Compliance with individual Insertion Bundle Elements and automatic calculation

4. Enter the total number of patients in #1 that were in compliance with the Hand Hygiene bundle element.
5. Enter the total number of patients in #1 that were in compliance with the Maximal barrier precautions bundle element.
6. Enter the total number of patients in #1 that were in compliance with the Chlorhexidine skin antisepsis bundle element.
7. Enter the total number of patients in #1 that were in compliance with the Optimal catheter type and site selection bundle element.

### Your Result

8. Numerator/Denominator x 100 = %

**Goal**

55% of all patients with central lines in the included intensive care units receive all elements of the Central Line Insertion Bundle.

---

**June 2012**
2.0 Central Line Insertion Bundle Compliance - Technical Description

Intervention(s): Prevention of Central Line-Associated Primary Bloodstream Infections

Definition: The percentage of intensive care patients in the included ICUs with central lines for whom all elements of the Central Line Insertion Bundle are documented on the daily goals sheet and/or central line checklists or patient’s medical record.

Goal: To have 95% of all patients with central lines in the included intensive care units receive all elements of a Central Line Insertion Bundle. Historically, this level of reliability has been achieved by building an infrastructure using central line insertion checklists, multi-disciplinary rounds, and daily goals.

CALCULATION DETAILS:

Numerator Definition: Number of intensive care patients with central line insertions for whom all elements of the central line insertion bundle are documented and in place. The Central Line Insertion Bundle elements are:
1. Hand hygiene
2. Maximal barrier precautions
3. Chlorhexidine skin antisepsis
4. Optimal catheter type and site selection

NOTE: These are “all or nothing” indicators. If any of the elements are not documented, do not count the patient in the numerator. If a bundle element is contraindicated for a particular patient and this is documented appropriately on the checklist, then the bundle can still be considered compliant with regards to that element.

Numerator Exclusions: none

Denominator Definition: Total number of intensive care patients with observed central line insertions.

Denominator Exclusions: none

Measurement Period Length: Monthly

Summary of Procedures:

Hand Hygiene: Recommendations about hand hygiene are found in the CDC guidelines www.cdc.gov/mmwr/PDF/rr/rr5110.pdf

• When caring for central venous catheters, wash hands or use an alcohol-based waterless hand cleaner:
  o Before and after palpating catheter insertion sites
  o Before and after inserting, replacing, accessing, repairing, or dressing and intravascular catheter
Palpation of the insertion site should not be performed after the application of antiseptic, unless aseptic technique is maintained.

Wash hands if hands are obviously soiled or if contamination is suspected.

Wash hands or use an alcohol-based waterless hand cleaner between patients, after removing gloves and after using the bathroom.

Maximal barrier precautions on insertion: Include all of the following:

- For the Provider: Hand hygiene, non-sterile cap and mask, all hair under cap, mask covering nose and mouth tightly, and sterile gown and gloves

- For the Patient: Cover patient’s head and body with a large sterile drape

Chlorhexidine skin antisepsis: Includes all of the following:

- Prepare skin with antiseptic/detergent chlorhexidine 2% in 70% isopropyl alcohol by saturating the pad, pressing it against the skin, and applying chlorhexidine solution using a back-and-forth friction scrub for at least 30 seconds. Do not wipe or blot.

- Allow antiseptic solution time to dry completely before puncturing the site (~ two minutes).

Optimal catheter type and site selection: In adult patients, a subclavian site is preferred for infection control purposes, although other factors (e.g., the potential for mechanical complications such as pneumothorax or hemorrhage, risk for subclavian vein stenosis, and catheter-operator skill) should be considered when deciding where to place the catheter. There should be discussion regarding the number of lumens required for that patient, and consideration of antimicrobial-coated catheters if those are available in your institution.

Avoid the femoral vein in adults; subclavian preferred to minimize infection risk. Optimal catheter type and site selection in children is more complex with the internal jugular vein or femoral vein most commonly used. Site preference in children needs to be individualized.

Calculate as:

**Numerator/Denominator:** Number of patients with central line insertions for whom all elements of the central line insertion bundle are documented and in place / Total number of patients with central line insertions observed in the sample [x 100 to express as a percentage].

**Comments:** This measure is an assessment of how well the team is adhering to the central line insertion bundle. Experience has been that teams begin to demonstrate improvement in outcomes when they get the process right more frequently. Therefore, it is important to measure the compliance with the entire central line insertion bundle, not just parts of the bundle. Incorporating the elements of the central line insertion bundle into a central line insertion checklist and a daily goals form allows for easy review of bundle compliance during weekly survey. This also serves as a reminder during rounds to increase compliance with the bundle elements.
COLLECTION STRATEGY:

Use a central line insertion checklist, daily goal sheet, and/or medical record as data sources. Review for implementation of the central line insertion bundle.

The sample should include all patients with central line insertions in the intensive care unit. Only patients with all aspects of a central line insertion bundle in place are recorded as being in compliance with a central line bundle.

Sampling Plan: Conduct the sample one day per week. This is a weekly compliance measure. Rotate the days of the week and the shifts. On the day of the sample, the medical records (including daily goals sheets and central line checklists) are examined for evidence of bundle compliance in all patients in the ICU for whom central lines were placed in the ICU. The central line checklist and daily goals sheet should be used to confirm compliance with the elements that are specific to the time of initial insertion.

If even one element is missing, the case is not in compliance with the bundle. For example, if there are seven patients with central line insertions, and 6 have all four bundle elements completed, then 6/7 (86%) is the rate of compliance with the central line insertion bundle. If all seven patients had all four elements completed, compliance would be 100%. If all seven patients were missing even a single item, compliance would be 0%. This measure is always expressed as a percentage.

Sample Graph:
Winnipeg Children’s Hospital (Winnipeg, MB)
# 3.0 Central Line Care Bundle Compliance - Worksheet

## CLI 3 - Central Line Care Bundle Compliance

<table>
<thead>
<tr>
<th>Denominator</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Enter the total number of patients included in this sample population for this report (adult or pediatric).</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Numerator</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Record which of the four CL-BSI Care bundle elements listed below which have been fully implemented in your healthcare facility and would apply to this month’s sample.</td>
<td></td>
</tr>
<tr>
<td>3. Enter the total number of patients in #1 for whom ALL of the CL-BSI Care Bundle Elements listed below which have been implemented in your healthcare facility as recorded in #2, were completed at the time of the survey:</td>
<td></td>
</tr>
</tbody>
</table>

### Numerators for Compliance with individual Care Bundle Elements and automatic calculation

<table>
<thead>
<tr>
<th>Numerator</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Enter the total number of patients in #1 that were in compliance with the Daily review of necessity for line with prompt removal of unnecessary lines bundle element.</td>
<td></td>
</tr>
<tr>
<td>5. Enter the total number of patients in #1 that were in compliance with the Dedicated lumen for Total Parenteral Nutrition (TPN) bundle element (DISCONTINUED).</td>
<td></td>
</tr>
<tr>
<td>6. Enter the total number of patients in #1 that were in compliance with the Accessing the lumens aseptically bundle element.</td>
<td></td>
</tr>
<tr>
<td>7. Enter the total number of patients in #1 that were in compliance with the Checking entry site for inflammation with every change of dressing bundle element (DISCONTINUED).</td>
<td></td>
</tr>
<tr>
<td>8. Enter the total number of patients in #1 that were in compliance with the Catheter site and tubing care bundle element.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th></th>
</tr>
</thead>
</table>

### Your Result

9. Numerator/Denominator x 100 = %

Your Result:  |

Goal: 95% of all patients with central lines in the included intensive care units receive all elements of the Central Line Care Bundle.
3.0 Central Line Care Bundle Compliance -Technical Description

**Intervention(s):** Prevention of Central Line-Associated Primary Bloodstream Infections

**Definition:** The percentage of intensive care patients in the included ICUs with central lines for whom all elements of the Central Line Care Bundle are documented on the daily goals sheet or patient’s medical record.

**Goal:** 95% of all patients with central lines in the included intensive care units receive all elements of the Central Line Care Bundle. Historically, this level of reliability has been achieved by building an infrastructure using multi-disciplinary rounds and daily goals.

**CALCULATION DETAILS:**

**Numerator Definition:** Number of intensive care patients with central lines for whom all elements of the central line care bundle are documented and in place. The Central Line Care Bundle elements are:
- Daily review of line necessity, with prompt removal of unnecessary lines
- Aseptic lumen access
- Catheter site and tubing care

**NOTE:** These are “all or nothing” indicators. If any of the elements are not documented, do not count the patient in the numerator. If a bundle element is contraindicated for a particular patient and this is documented appropriately on the checklist, then the bundle can still be considered compliant with regards to that element.

**Numerator Exclusions:** none

**Denominator Definition:** Total number of intensive care patients with central lines on day of the week of the sample.

**Denominator Exclusions:** none

**Measurement Period Length:** Monthly

**Summary of Procedures:**
- **Daily review of line necessity with prompt removal of unnecessary lines:** The ICU patient with a central line will be reviewed daily, with a notation on the daily goals sheet or medical record indicating the continued need for the central line. Routine replacement should be avoided, and all lines should be removed as early as possible.

- **Aseptic lumen access**
  - Providers should ensure lines are accessed aseptically by following hand washing guidelines and swabbing the port with a chlorhexidine antiseptic swab (for a description of these, see technical description for Central Line Insertion Bundle Compliance).
- **Catheter site and tubing care**
  - Use either sterile gauze or sterile, transparent, semipermeable dressing to cover the catheter site (Level IA). Do not use topical antibiotic ointment or creams on insertion sites, except for dialysis catheters. Use a chlorhexidine-impregnated sponge dressing for temporary short-term catheters if the CLABSI rate is not decreasing despite adherence to basic prevention measures.
  - In patients not receiving blood, blood products or fat emulsions, replace administration sets that are continuously used, including secondary sets and add-on devices, no more frequently than at 96-hour intervals, but at least every 7 days. If the tubing is used to administer blood, blood products, or fat emulsions (those combined with aa and glucose in a 3-in-1 admixture or infused separately), it should be replaced within 24 hours of initiating the infusion. Needleless system components should be changed at same frequency as tubing.
  - For patients with central lines, providers should check dressing for soiling, excessive moisture for inflammation when changing a dressing.

**Calculate as:** Number of patients with central lines for whom all elements of the central line care bundle are documented and in place / Total number of patients with central lines on day of the week of the sample [x 100 to express as a percentage].

**Comments:** This measure is an assessment of how well the team is adhering to the central line care bundle. IHI’s experience has been that teams begin to demonstrate improvement in outcomes when they get the process right more frequently. Therefore, it is important to measure the compliance with the entire central line care bundle, not just parts of the bundle. Incorporating the elements of the central line care bundle into a daily goals form, and reviewing lines daily during multidisciplinary rounds, allows for easy review of bundle compliance during weekly survey. This also serves as a reminder during rounds to increase compliance with the bundle elements.

**COLLECTION STRATEGY:**

Use a daily goal sheet and/or medical record as data sources. Review for implementation of the central line care bundle.

The sample should include all patients with central lines in the intensive care unit. Only patients with all aspects of a central line care bundle in place are recorded as being in compliance with the bundle.

**Sampling Plan:** Conduct the sample one day per week. This is a weekly compliance measure. Rotate the days of the week and the shifts. On the day of the sample, the medical records (including daily goals sheets) are used to confirm compliance with the four components of the bundle, for all patients in the ICU for whom central lines were in place. A patient who remains in the ICU with a central line for more than one week may be included in more than one weekly compliance measure, although the compliance with the initial care bundle elements will remain the same.
If even one element is missing, the case is not in compliance with the bundle. For example, if there are seven patients with central lines, and six have all three bundle elements completed, then $6/7$ (86%) is the rate of compliance with the central line care bundle. If all seven patients had all four elements completed, compliance would be 100%. If all seven patients were missing even a single item, compliance would be 0%. This measure is always expressed as a percentage.

**SAMPLE GRAPH:**

Winnipeg Children’s Hospital (Winnipeg, MB)
Appendix B: Sample Central Line Insertion Checklist

BC CHILDREN’S HOSPITAL ICU/TCU VASCULAR ACCESS DEVICE INSERTION CHECKLIST

Purpose: To work as a team to decrease patient harm from catheter-related bloodstream infections
When: During all central venous line, central line re-wire or PIC insertions
By whom: Bedside nurse

1. Today’s date: __________/________/________

2. Procedure: □ PIC line □ New central line □ Line rewire

3. Is the procedure: □ Elective □ Urgent

4. Before the procedure, did the physician:
   Remove jewelry? Yes □ No □ Don’t Know □
   Apply eye protection? □ □ □
   Wash hands using 2% chlorhexidine soap (pump soap at sinks in ICU/TCU) □ □ □
   Use hat, mask and sterile gown? □ □ □
   Use sterile gloves? □ □ □
   Disinfect procedure site using 2% chlorhexidine with 70% alcohol. □ □ □
   Drape entire patient in a sterile fashion. □ □ □

5. Did the physician maintain a sterile field during the procedure? □ □ □

6. Was a sterile dressing applied to the site? □ □ □

7. Was the procedure documented in the chart? □ □ □

8. Was the procedure aborted and restarted for break in technique? □ □ □

9. Was ultrasound used to visualize the vessel? □ □ □

10. How many line attempts were made? __________

11. Line site (e.g., R fem vein) __________

PLEASE RETURN COMPLETED SHEET TO CVC BINDER ON LINE CART

W:/CRBSI Collaborative/Insertion Bundle/Insertion Checklist Aug 2005

[For information purposes only.]
Appendix C: Sample Daily Goals

ICU Daily Goals

Patient Name __________________
Room Number _________________ Date____/____/______

---Initial as goals are reviewed ----

<table>
<thead>
<tr>
<th>GOAL</th>
<th>NOTES</th>
<th>0700 - 1500</th>
<th>1500 - 2300</th>
<th>2300 - 0700</th>
</tr>
</thead>
<tbody>
<tr>
<td>What needs to be done for the patient to be discharged from the ICU?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is this patient’s greatest safety risk?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central line insertion bundle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Hand hygiene</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Maximal barrier precautions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Chlorhexidine skin antisepsis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Optimal catheter site selection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central line care bundle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Daily review of line necessity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Accessic lumen access</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Catheter site and tubing care</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac Rhythm, Hemodynamics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume Status, net goal for next 8 - 12 hrs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuro: Pain Mgt/Sedation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GI: Nutrition /Bowel Regimen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GOAL</td>
<td>NOTES</td>
<td>0700 - 1500</td>
<td>1500 - 2300</td>
<td>2300 - 0700</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
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<td><strong>Parameters for calling MD</strong></td>
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*Adapted from the Johns Hopkins University Quality & Safety Research Group Tool Kit

[For information purposes only.]
Appendix D: Central Line Infection Tips and Tricks

Many hospitals across Canada and the US have been working to reduce Central Line Infections. Here are some of the "tips and tricks" for successful testing and implementing of each intervention.

- **Customize the program.**
  Making this initiative fit into the patterns and habits at your institution is essential. Teams will be most effective if they engage doctors, nurses, and other staff to work with them to develop key aspects of implementation. For example, it is critical that teams make the review of daily necessity a part of the daily goal sheets. In order to know if a line is truly necessary, the best-performing teams will develop their own standard criteria and work to apply this routinely to all cases in their institution. Once this has been established, all stakeholders will share a common understanding of exactly when a line is truly necessary or simply a convenience. Similar arrangements and customizations can be made for other aspects of the bundle, such as criteria for optimal site selection.

- **Measure, but do not become pre-occupied with measurement.**
  Working on preventing central line infections (or any clinical performance program) requires measurement, but measurement should not become the pre-occupation of the teams engaging in the work. While feedback on performance and compliance may drive further efforts forward, if teams become too focused on measurement details it can hinder the overall program. It is best to design rules that assist your team in making your plans work; for example, assign credit for completion of bundle elements in cases where your team has determined there are true contraindications to bundle elements. Undue attention to unusual cases or special circumstances will impede success. Plan for the majority.

- **Decide early about the method of data collection you will use.**
  Some teams have preferred to use a sampling approach to assess compliance with the central line bundle; for example, some teams use spot checks of compliance three times per week, whereas other teams have chosen daily assessments of compliance at designated times. Regardless of the method, be sure to maintain the standard over time for accurate results.

- **Emphasize compliance with all elements of the bundle.**
  Approach this work with the knowledge that “picking and choosing” bundle elements will not work. Discourage the tendency to select interventions that seem easy at the expense of more difficult options also included in the bundle. Your aim is 100% compliance with every bundle element for every patient - partial compliance is the equivalent of noncompliance.

- **Post updates to results regularly and prominently.**
  Enthusiasm for the project will wane over time if clinical staff perceive that the leadership’s enthusiasm has diminished. It is essential to update all involved staff on the work on the monthly level of compliance and the monthly change in central line infection rates. Not only will this show dedication to the project, but when momentum becomes apparent, clinical staff will be aware of the progress.

- **Apply the bundle elements in a way that makes sense.**
The goal of the bundle is not to force a clinician to do anything that may be clinically inappropriate or cause harm in a unique situation. The elements apply to most patients, but there will always be exceptions. Deal with these in a way that makes sense. For example, if a patient is claustrophobic and panics about being under drapes, then modify the placement of drapes so that the patient is at ease and the site is protected; it’s not beneficial to the patient to induce a panic attack. When exceptional situations arise, the key is for the team to discuss the elements, devise a sensible plan, and document it accordingly. Give credit for meeting the bundle element in such cases.
Appendix E: Frequently Asked Questions

Frequently Asked Questions: Central Line Infection

Can I implement most of the central line bundle but exclude some items?
While this is possible, it is not recommended. In fact, the goal of bundling therapies together aims to create a linkage between practices that makes the overall process more effective. Certainly, in terms of monitoring compliance with the central line bundle, “picking and choosing” items would be unwise.

The definition of a primary central line infection is confusing. What is the standard definition?
The definition used in the rate measure is well described in the Measurement Technical Description included in this document. The key to the numerator is to track primary catheter-associated bloodstream infections. Bloodstream infections are considered to be associated with a central catheter if the line was in use during the 48-hour period before development of the bloodstream infection. These catheter-associated bloodstream infections must be either laboratory confirmed or the patient must meet criteria for clinical sepsis. Clinical sepsis can be defined as a site of suspected infection and two or more generalized signs and symptoms of infection (formerly known as SIRS criteria). Clinical sepsis can be distinguished from the syndrome “severe sepsis,” which adds organ dysfunction, such as hypotension or onset of renal failure. In general, the threshold to establish clinical sepsis is lower than that for severe sepsis.


What is a central line?
Typically, most experts and improvement teams have relied upon the definitions provided by the National Nosocomial Infections Surveillance System (NNIS) devised by the Centers for Disease Control (CDC). This program has been replaced recently by a new initiative, the National Healthcare Safety Network (NHSN). NHSN has defined a central line as a catheter whose tip terminates in a great vessel. The great vessels include the aorta, pulmonary artery, superior vena cava, inferior vena cava, brachiocephalic veins, internal jugular veins, subclavian veins, external iliac veins, and common femoral veins. Neither the type of line alone nor the site of insertion can determine if a line is a central line. If the line terminates in a great vessel, it is a central line.

Are femoral lines central lines? Are they included in the bundle?
Yes. Femoral lines qualify as central lines because they terminate in a great vessel as defined by NHSN. Their placement should be guided by the parameters of the central line bundle. See above.
Are PICC lines central lines? Are they included in the bundle?
Peripheral inserted central catheters (PICC) lines terminate in a great vessel. Because neither the site of insertion nor the type of line alone can determine whether a catheter is a central line, the peripheral site of insertion does not exempt the line from the central line bundle.

Are PICC lines preferred over subclavian or internal jugular central venous catheters?
Data is still lacking on infection rates for PICC lines in acute care settings as opposed to chronic or home care settings. The existing evidence suggests that infection rates rival those of subclavian or internal jugular catheters placed in the acute care setting. In addition, PICCs are vulnerable to thrombosis. No direct comparison has yet been done to make a definitive conclusion.17 18

Does everyone in the room need to gown and glove when a central line is placed, or just the nurse assisting the procedure directly and dropping items onto the sterile field?
The best advice is that the placement of a central line should be considered analogous to a surgical procedure. In the operating room, anyone who comes into contact with the sterile field wears maximal barrier precautions. This includes any assistants in direct contact with the field and most certainly the scrub nurse directly assisting in the procedure. To that end, any assistant in direct contact with or dropping items onto the field should be similarly gowned, gloved, etc., as in a surgical situation.

Why is a full-size drape essential for maximal barrier precautions?
Studies that demonstrate the effectiveness of maximal barrier precautions have employed a full-size drape. These studies show dramatic reductions in risk when maximal barrier precautions are used. It is not possible to clearly parse out the effect of a full-size drape from these trials versus the other components of maximal barrier precautions such as gowns, gloves, eyewear, etc. In the absence of such information and given striking results of interventions that include a full-size drape, not using the larger drape could only add an unnecessary element of risk to an otherwise simple procedure. Using the analogy to surgery as cited immediately above, it would be unimaginable for a patient to undergo any surgical procedure in the operating room without a full-size drape in place.

I read that the central line bundle as written is designed to apply only to patients in the ICU. I want to include patients in the emergency room and the PACU. Why do you advise to use the bundle only in the ICU?
The reason for recommending application of the central line bundle first in the ICU has more to do with improvement methods and less to do with the utility of the intervention. It was originally tested with ICU teams working to improve teamwork and communication for improved outcomes. It was hoped that by starting in the ICU hospitals would become expert in application of the bundle in one location, develop the skill and manpower to translate the practice to other areas of the hospital, and ultimately do so. In general, it is recommended to start small and spread changes to larger domains over time. There is no reason not to apply the central line bundle in all areas that central lines are placed and where you can gain the cooperation of staff. However, it may be wiser to perfect the practice in one location than to launch an overly broad initiative that might fail before it begins. Be sure to check for guidelines from clinical expert panels related to other locations before spreading.
**How can you compare central line infection rates between institutions?**
The practice of comparing rates of disease entities or patterns of therapy across institutions is commonly known as “benchmarking.” Benchmarking, while presently utilized by many oversight agencies to track performance, may not be a valid method to compare performance between facilities because of differences in patient population, resource availability, or severity of illness.

Fortunately, none of the work required to improve the care of patients receiving central lines requires a comparison of rates between institutions. As long as you establish methods in your institution to determine the patterns and methods of your regular data collection, your results will be consistent over time with respect to your own performance and your own improvement, which is our primary interest. Presumably, any improvements you make would be reflected in any benchmarking work that you do for other agencies.

Remember to benchmark based on improvement, rather than just by comparing rates. If you learn of a hospital that has significantly improved, based on data and using the same measure over time, then learn from their work! Even if they are using a different definition from your hospital or treat some different populations, there will still be value in finding out what practices and changes they used to achieve their results.

**What are the inclusion and exclusion criteria for application of the central line bundle? For the individual bundle elements?**
No specific exclusion criteria exist, but good clinical judgment should be exercised in conjunction with a close reading of the evidence cited in the How-to Guide. Likewise, no specific inclusion criteria are available. Instead, teams interested in improving their performance should develop these standards in conjunction with their clinical staff and apply them uniformly over time. In so doing, teams will have an accurate standard whereby they can measure their own progress in comparison to the only standard that is truly meaningful: their own data.

As an example, some institutions have decided that the central line bundle cannot be applied in emergent settings such as the ER. Accordingly, they have created policies and procedures to re-site those lines if a patient is subsequently admitted to a critical care unit. Policies such as this are best left to the discretion of the individual institutions.

Workable inclusion criteria, exclusion criteria, measurement systems, and protocols all require customization at the local level to be effective. The only key factor in all of these decisions is that the standards, once decided, are adhered to over time.
References


Bibliography - Prevent Central Line Infections

The references included in this Bibliography are those contained in the bibliography for IHI’s 100K Lives Campaign, with additional references identified by Safer Healthcare Now!


Prospective cohort study involving all patients with a central venous catheter in a surgical ICU, in which a quality improvement team implemented five interventions: staff education, use of a catheter insertion cart, asking providers daily whether lines could be removed, implementing a checklist to ensure adherence to evidence-based guidelines, and empowering nurses to stop the catheter insertion procedure if a violation of the guidelines was observed. The rate of catheter-related bloodstream infections fell from 11.3 per 1,000 catheter-days to zero after implementation of these interventions.


A meta-analysis of randomized clinical trials comparing any type of Chlorhexidine gluconate with povidine-iodine antiseptic solutions for vascular catheter site care. The primary outcome of interest was catheter related bloodstream infection which the authors defined as isolation of the same organism from a peripheral blood culture and a semiquantitative or quantitative culture of a catheter segment. The article summarizes data from 8 randomized trials. Their analysis demonstrated a risk ratio of 0.49 [95% CI, 0.28 to 0.88] when using Chlorhexidine antiseptic solutions.


Controlled trial in adult ICU patients requiring central venous or pulmonary artery catheters for more than three days. Patients were randomized to replacement every three days by
insertion at a new site, replacement every three days over a guide wire, replacement when clinically indicated at a new site, or replacement when clinically indicated over a guide wire. Guide wire exchange was associated with an increased risk of bloodstream infection. Reinsertion at a new site was associated with an increased risk of mechanical complications. Replacement at three days did not reduce the risk of infection.

The authors conducted a quantitative systematic review to: a) compare guidewire exchange with new-site replacement with regard to the frequency of colonization, catheter exit site infection, catheter-related bacteremia, and mechanical complications; and b) compare scheduled catheter management with as-needed catheter management with regard to these outcomes. 12 relevant randomized studies were chosen from a pool of 151 randomized controlled trials on central venous catheter management. Catheter exchange over a wire was associated with a trend towards more infectious complications, although there was also a trend towards reduced mechanical complications with the use of guidewire exchange. The authors were unable to find any evidence to support routine replacement of catheters in order to reduce the incidence of catheter related bloodstream infections.

This systematic review of the literature focuses on differences in children compared to adults regarding CVC use. CVC-related complications in pediatric patients are closely linked to age, body size, and age-related immune status. In older children, many complications are similar to those encountered in adult patients. Because of ongoing growth and body changes, a cutoff point beyond which children can be regarded as "young adults" is difficult to define; many of our recommendations are therefore age-related. More frequently than in adults, an implanted port may be the first choice in pediatric patients when long indwelling times are expected.

The optimal site of insertion also depends on factors such as the patients' age as well as the need for sedation and analgesia during the insertion procedure. In contrast to guidelines in adult patients, we recommend that a radiograph always be made following CVC insertion to check the position of the catheter. Regarding prevention of infectious complications, we recommend full sterile barrier precautions during CVC insertion and strict protocols for catheter care. CVCs should be removed as soon as possible when they are no longer needed, but there is no place for elective CVC replacement on a routine basis. New developments such as the use of impregnated catheters might help reduce infection rates; however, additional research will be required to provide more evidence of benefit in the pediatric population.

A recent review describing the epidemiology, impact, pathogenesis and risk factors, treatment and prevention of catheter related blood stream infections.


This prospective cohort study looked at total and direct medical costs of PICU and hospital stay for patients with and without nosocomial primary BSI. The PICU studied had a high baseline rate of catheter related BSI of 13.8 per 1000 central venous line days. After controlling for age, severity of illness, underlying disease and ventilator days, the direct cost of PICU attributable for nosocomial primary BSI was estimated to be $39,219USD. The savings through the elimination or reduction in these and other nosocomial infections are considerable.


Prospective observational study or the risk factors for colonization of catheters and of catheter-related bloodstream infection over 28 months of all non-tunnelled central venous catheters on medical-surgical wards of a VA hospital. Emergent insertion and choice of the femoral vein for insertion were associated with catheter contamination, and there was a trend for an association between femoral placement and catheter-related bloodstream infection.


This study does not have a comparison group but reported a 7% stenosis or occlusion rate in outpatients with PICCs.


A prospective observational study was conducted to evaluate infectious morbidity associated with long-term use of venous access devices. Quantitative microbiologic tests were used to identify device-related bacteremia and fungemia, catheter tunnel infection, pocket infection in implantable port devices, and site infections; number of days the device remained in situ and time until infectious morbidity; vessel or device thrombosis and device breakage. The incidence of infections per device-day was 12 times greater with catheters than with ports. Patients with solid tumors were the least likely to have device-related infectious morbidity compared with those with hematologic cancers. The authors speculate that the reasons for the difference in infectious complications is uncertain but may be attributable to type of disease, intensity of therapy, frequency with which devices are accessed, or duration of neutropenia.

Review of seven studies published between 1977 and 1995 that examined the relationship between handwashing and hospital-acquired infection. The review concluded that there was a clear causal relationship between hand hygiene and reduced transmission of infections. Recommended practices included use of waterless alcohol-based products rather than detergent-based antiseptics to reduce skin damage.


A detailed literature review, performed by the University of California at San Francisco (UCSF)-Stanford University Evidence-Based Practice Center, of published research on practices to improve handwashing compliance. The chapter starts with a brief review of the well-accepted evidence that handwashing is the most important single intervention to reduce transmission of infections in hospitals.


A prospective study of the bacteria present in the physical environment in a 56-year-old hospital building which was then repeated when the University of Wisconsin moved into a new building complete with air filters, much improved ventilation, and isolation rooms with separate ventilation. Despite major differences in the environmental contamination between the two sites, the rate of hospital-acquired infection remained the same. There was a significant increase in environmental contamination after the new facility was occupied. These findings suggest that the organisms in the inanimate physical hospital environment are not a major contributor to infection - and that most infections are transmitted by hospital staff.


Randomized controlled trial on a surgical ICU in which 668 catheters were placed with either 10% povidone-iodine, 70% alcohol, or 2% aqueous chlorhexidine disinfection of the site prior to insertion and every other day thereafter. Use of chlorhexidine was associated with the lowest risk or local and bloodstream catheter-related infections.


This review is complementary to the CDC guidelines. It provides higher level change concepts that have been demonstrated to be effective for prevention of CLA-BSI.

Detailed narrative review of the causes and prevention of infections in ICUs, including the properties of specific bacteria that enable them to cause hospital-acquired infection, reservoirs of infection, patient-related factors, and the importance of handwashing, including a summary of several reports of epidemics of infection on ICUs.


This prospective study was performed to examine the complications associated with the use of these catheters in patients receiving long-term total parenteral nutrition (TPN). The two groups were comparable with respect to concomitant infections, treatment with antibiotics, and need for intensive care. However, after five days of catheterization, there was a marked increase in the number of TLC removed because of skin entry site infections. SLC were more likely to be used for the full duration of TPN administration.


Prospective observational study of Swan-Ganz catheters, showing that the great majority of infections come from the insertion site. Other risk factors were use of the jugular insertion site, duration of catheter dwell for more than three days, and lack of full barrier precautions during insertion.


Narrative review that summarizes data on the epidemiology, costs, attributable mortality, and prevention of bloodstream infections caused by ventral venous catheters.


Randomized controlled trial in 289 adults requiring a first central venous catheter, randomized to femoral or subclavian site. The femoral site was associated with a higher risk of infectious and thrombotic complications.


Catheter-related bloodstream infections (CRBSIs) are a significant complication for children treated in the pediatric intensive care unit (PICU). This review seeks to identify the epidemiology, risk factors, treatment, and prevention strategies for CRBSIs in the PICU. Factors such as catheter type, insertion site, number of lumens, indwelling time, and medications delivered all can influence the rate of CRBSIs. Prevention strategies include use of full-barrier techniques during insertion, use of chlorhexidine cleaning solutions during insertion and dressing change, strict adherence to catheter-care protocols, and removal of catheters as soon as possible after conclusion of therapy.

This is a comprehensive, systematic review of the literature that covers most aspects related to prevention of infections associated with central venous catheters and arterial catheters.


Quality improvement project led by medicine house staff in a large university-affiliated veterans hospital that resulted in a marked reduction in “idle catheter episodes,” defined as periods when peripheral IV catheters were not being used.


Case-control study in a surgical ICU over two years. Patients who developed bloodstream infection during their ICU stay were matched for primary diagnosis, age, gender, length of stay up to the day of infection, and total number of discharge diagnoses with patients who did not develop bloodstream infection (“controls”). The mortality was 50% in patients who developed bloodstream infection compared to 15 amongst controls, giving an estimated attributable mortality of 35%. Of those who survived the bloodstream infection, median hospital stay was 45 days, compared to 30 days in controls. The extra cost attributed to the infection averaged $40,000 per survivor.


Review of the reasons for poor compliance with handwashing amongst hospital staff. Easy access to handwashing facilities and ready availability of skincare lotion are imperative to ensure improved compliance. A multimodal, multidisciplinary approach at the individual, group, and institutional level is recommended.


Randomized controlled trial of maximum barrier precautions vs. use of sterile gloves and small drape during insertion of non-tunnelled central venous catheters for cancer chemotherapy. Maximal barrier precautions markedly reduced the early infection rate.


Narrative review of over 100 published articles on intravascular catheter-related infection, focusing on new diagnostic techniques, novel preventive techniques, and optimal management of infections.

There is limited data on the infection rates with PICCs. This study is a retrospective analysis of data from two prospective trial and reports an infection rate in seriously ill hospitalized patients that is similar to that seen with subclavian or internal jugular catheters.


A detailed literature review, performed by the University of California at San Francisco (UCSF)-Stanford University Evidence-Based Practice Center, of published research on prevention of intravascular catheter-associated infections, sponsored by AHRQ and published in July 2001.


A matched, risk-adjusted cohort study to determine the attributable risk of death due to catheter-related septicemia (CRS) in critically ill patients when taking into account severity of illness during the ICU stay but before CRS. The study concludes that CRS is associated with subsequent morbidity and mortality in the ICU, even when adjusted on severity factors at ICU admission. However, after adjustment on severity factors during the ICU stay and before the event, there was only a trend toward CRS-attributable mortality. The authors conclude that the evolution of patient severity should be taken into account when evaluating excess mortality induced by nosocomial events in ICU patients.


This is a prospective study on TPN related infections in 100 consecutive adult patients receiving TPN using semi-quantitative culture methods. The only risk factor found to be associated with the development of nutrition related infection was violation of the nutrition line, such as CVP measurement and administration of medications.