Getting Started Kit:
Prevent Central Line Infections

How-to Guide

100,000 Lives Campaign

We invite you to join a Campaign to make health care safer and more effective — to ensure that hospitals achieve the best possible outcomes for all patients. The Institute for Healthcare Improvement (IHI) and other organizations that share our mission are convinced that a remarkably few proven interventions, implemented on a wide enough scale, can avoid 100,000 deaths between January 2005 and July 2006, and every year thereafter. Complete details including materials, contact information for experts, and web discussions available on the web at http://www.ihi.org/IHI/Programs/Campaign/.

Goal:

Prevent catheter-related bloodstream infections by implementing the five components of care called the central line bundle.

The Case for Preventing Catheter-Related Bloodstream Infections

- Central venous catheters (CVCs) are being used increasingly 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 catheter-related bloodstream infections (CR-BSIs) occur with CVCs.
- Mermel LA. Prevention of intravascular catheter-related infections. *Ann Intern Med*. 2000;132(5):391-402.

- Forty-eight percent of intensive care unit (ICU) patients have central venous catheters, accounting for 15 million central venous-catheter-days per year in 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 4000 U.S. patients die annually due to bloodstream infections.

- In addition, nosocomial bloodstream infections prolong hospitalization by a mean of 7 days. Estimates of attributable cost per bloodstream infection are estimated to be between $3,700 and $29,000.

- Soufir L, Timsit JF, Mahe C, Carlet J, Regnier B, Chevret S. Attributable morbidity and mortality of catheter-related septicemia in critically ill patients: a matched, risk-adjusted, cohort study. *Infect Control Hosp Epidemiol*. 1999;20(6):396-401.

The Central Line Bundle

Care bundles, in general, are groupings of best practices with respect to a disease process that individually improve care, but when applied together result in substantially greater improvement. The science supporting each bundle component is sufficiently established to be considered standard of care.

The central line bundle is a group of evidence-based interventions for patients with intravascular central catheters that, when implemented together, result in better outcomes than when implemented individually.

The key components are:

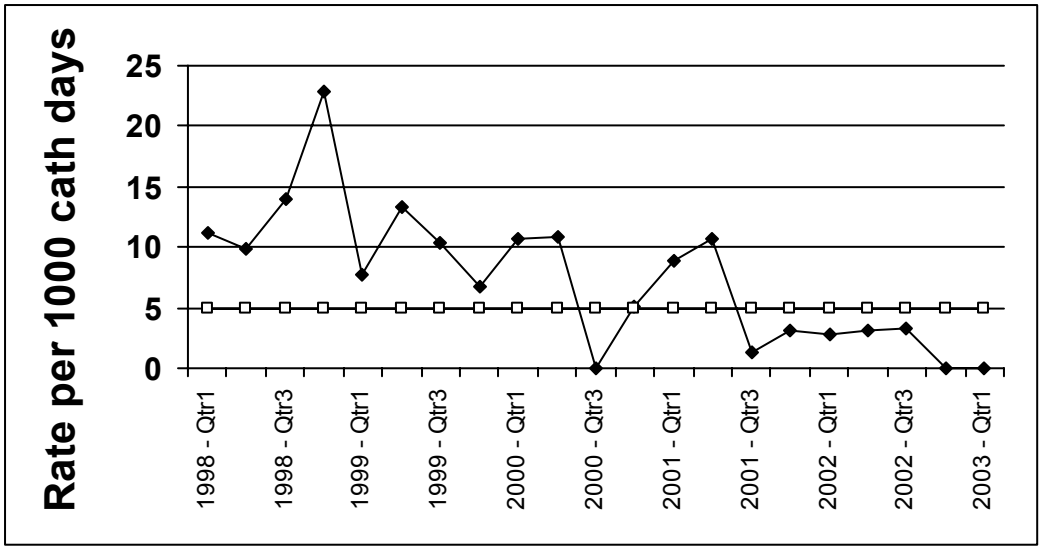
1. Hand hygiene
2. Maximal barrier precautions
3. Chlorhexidine skin antisepsis
4. Optimal catheter site selection, with subclavian vein as the preferred site for non-tunneled catheters
5. Daily review of line necessity, with prompt removal of unnecessary lines

Compliance with the central line bundle 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.

Potential Impact of the Central Line Bundle

Application of the central line bundle has demonstrated striking reductions in the rate of central line infections in many hospitals. Berenholtz et al. demonstrated that ICUs that have implemented multifaceted interventions similar to the central-line bundle have nearly eliminated CR-BSIs.

Berenholtz SM, Pronovost PJ, Lipset PA, et al. Eliminating catheter-related bloodstream infection in the intensive care unit. *Critical Care Medicine*. 2004;32:2014-2020.



The success of these interventions is perhaps due to a combination of the mindfulness that develops when regularly applying the elements of the bundle 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.

Author/date	Design	Catheter	Odds Ratio for infection w/o MBR
Mermel 1991	Prospective Cross-sectional	Swan Ganz	2.2 ($p<0.03$)
Raad 1994	Prospective Randomized	Central	6.3 ($p<0.03$)

Mermel et al. demonstrated that the odds ratio was 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.

Mermel LA, McCormick RD, Springman SR, Maki DG. The pathogenesis and epidemiology of catheter-related infection with pulmonary artery Swan-Ganz catheters: a prospective study utilizing molecular subtyping. *Am J Med*. 1991;91(3B):197S-205S.

Raad, II, Hohn DC, Gilbreath BJ, et al. Prevention of central venous catheter-related infections by using maximal sterile barrier precautions during insertion. *Infect Control Hosp Epidemiol*. 1994;15(4 Pt 1):231-238.

Reducing Central Line-Associated Bloodstream Infections – Five Components of Care

1. Hand hygiene

One way to decrease the likelihood of central line infections is to use proper hand hygiene. Washing hands or using an alcohol-based waterless hand cleaner helps prevent contamination of central line sites and resultant bloodstream infections.

O'Grady NP, Alexander M, Dellinger EP, et al. Guidelines for the prevention of intravascular catheter-related infections. Centers for Disease Control and Prevention. *MMWR Recomm Rep.* Aug 9 2002;51(RR-10):1-29. www.cdc.gov/mmwr/PDF/rr/rr5110.pdf

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 and after invasive procedures
- Between patients
- Before donning and after removing gloves
- After using the bathroom

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

Hospital teams across the United States have developed and tested process changes that allowed them to improve performance on hand hygiene. These changes, taken together, support the implementation of the central line 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, only available near hand sanitation equipment.
- Post signs at the entry and exits to the patient room as reminders.
- Initiate a campaign using posters including photos of celebrated hospital doctors/employees recommending hand hygiene.
- Create an environment where reminding each other about hand hygiene is encouraged.

Reducing Central Line-Associated Bloodstream Infections – Five Components of Care

2. Maximal barrier precautions

A key change to decrease the likelihood of central line infections is to apply maximal barrier precautions in preparation for line insertion.

For the operator placing the central line and for those assisting in the procedure, maximal barrier precautions means strict compliance with hand hygiene, wearing a cap, mask, sterile gown, and gloves. The cap should cover all hair and the mask should cover the nose and mouth tightly. These precautions are the same as for any other surgical procedure that carries a risk of infection.

For the patient, applying maximal barrier precautions means covering the patient from head to toe with a sterile drape, with a small opening for the site of insertion.

In two studies, the odds of developing a central line infection increased if maximal barrier precautions were not used. For pulmonary artery catheters, the odds ratio for developing infection was more than two times greater for placement without maximal barrier precautions. A study of similar design found that this rate was six times higher for placement of central line catheters.

Mermel LA, McCormick RD, Springman SR, Maki DG. The pathogenesis and epidemiology of catheter-related infection with pulmonary artery Swan-Ganz catheters: a prospective study utilizing molecular subtyping. *Am J Med.* Sep 16 1991;91(3B):197S-205S.

Raad, II, Hohn DC, Gilbreath BJ, et al. Prevention of central venous catheter-related infections by using maximal sterile barrier precautions during insertion. *Infect Control Hosp Epidemiol*. Apr 1994;15(4 Pt 1):231-238.

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

Hospital teams across the United States 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 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 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.

Reducing Central Line-Associated Bloodstream Infections – Five Components of Care

3. Chlorhexidine skin antisepsis

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

The technique, for most kits, is as follows:

- Prepare skin with antiseptic/detergent chlorhexidine 2% in 70% isopropyl alcohol.
- Pinch wings on the chlorhexidine applicator to break open the ampule. Hold the applicator down to allow the solution to saturate the pad.
- Press sponge against skin, 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 (~ 2 minutes).

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

Hospital teams across the United States have developed and tested process and changes that allowed them to improve performance on chlorhexidine skin antisepsis. These measures, taken together, support the implementation of the central line 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 are executed for each line placement.
- Include chlorhexidine antisepsis as part of your checklist for central line placement.
- Include chorhexidine antisepsis kits in carts or grab bags storing central line equipment. Many prepared central line kits include povodine-iodine kits and these must be avoided.
- Ensure that solution dries completely before attempting to insert the central line.

Reducing Central Line-Associated Bloodstream Infections – Five Components of Care

4. Optimal catheter site selection, with subclavian vein as the preferred site for non-tunneled catheters in adults

Percutaneously inserted catheters are the most commonly used central catheters. Several risk factors have been identified, however, that are associated with bloodstream infections. These include the site of placement.

Mermel et al. were able to demonstrate that the great majority of infections develop at the insertion site. Other risk factors included use of the jugular insertion site over the subclavian site. In addition, for use of total parenteral nutrition, McCarthy demonstrated a similar effect.

Mermel LA, McCormick RD, Springman SR, Maki DG. The pathogenesis and epidemiology of catheter-related infection with pulmonary artery Swan-Ganz catheters: a prospective study utilizing molecular subtyping. *Am J Med.* Sep 16 1991;91(3B):197S-205S.

McCarthy MC, Shives JK, Robison RJ, Broadie TA. Prospective evaluation of single and triple lumen catheters in total parenteral nutrition. *J Parenter Enteral Nutr.* 1987 May-Jun;11(3):259-262.

Whenever possible, and not contraindicated, the subclavian line site should be preferred over the jugular and femoral sites for non-tunneled catheters in adult patients.

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

Hospital teams across the United States 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 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 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.

Reducing Central Line-Associated Bloodstream Infections – Five Components of Care

5. Daily review of central line necessity with prompt removal of unnecessary lines

Daily review of central 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.

The CDC guidelines state that "catheter replacement at scheduled time intervals as a method to reduce CR-BSI has not lowered rates of infection." Additionally, routine replacement is "not necessary for catheters that are functioning and have no evidence of causing local or systemic complications." The guidelines further note that "replacement of temporary catheters over a guidewire in the presence of bacteremia is not an acceptable replacement strategy, because the source of infection is usually colonization of the skin tract from the insertion site to the vein."

O'Grady NP, Alexander M, Dellinger EP, et al. Guidelines for the prevention of intravascular catheter-related infections. Centers for Disease Control and Prevention. *MMWR Recomm Rep.* Aug 9 2002;51(RR-10):10. www.cdc.gov/mmwr/PDF/rr/rr5110.pdf

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

Hospital teams across the United States have developed and tested process changes that allowed them to improve performance on daily review of necessity. These measures, taken together, support the implementation of the central line 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.

Forming the Team

IHI recommends a multidisciplinary team approach to patient care in the ICU. Improvement teams should be heterogeneous in make-up, 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.

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 therapists 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; finding champions within the hospital who are of sufficiently high profile and visibility to lend the effort immediate credibility; and working with those who want to work on the project rather than trying to convince those that do not.

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 in the ICU 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-BSI’s by 50% in one year.”

Teams are more successful when they have unambiguous, focused aims. Setting 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, IHI recommends 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 health care organizations to improve many different health care 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, test medication reconciliation on admissions first.

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 on www.IHI.org

Getting Started

Hospitals will not successfully implement the central line bundle overnight. If you do, chances are that you are doing something sub-optimally. A successful program involves careful planning, testing to determine if the process is successful, making modifications as needed, re-testing, 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 taken presently 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 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.
- Introduce the central line bundle to the staff.

First Test of Change

Once a team has prepared the way for change by studying the current process and educated the affected parties, of the next step is to begin testing the central line bundle 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.

Measurement

See measurement information forms for specific information regarding the recommended process and outcomes measures for preventing central line infections. (See Appendix C).

Measurement is the only way to know whether a change represents an improvement. There are two measures of interest for central line catheter-related bloodstream infections.

1. Central line catheter-related 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 3 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.

$$\frac{\text{Total no. of CR-BSI cases}}{\text{No. of catheter days}} \times 1000 = \textit{CR-BSI rate per 1000 catheter days}$$

2. Central Line Bundle Compliance

The second measure is an assessment of how well the team is adhering to the central line bundle. Our experience has been that teams begin to demonstrate improvement in outcomes when they get the process right more frequently. Therefore, we choose to measure the compliance with the entire central line bundle, not just parts of the bundle.

On a given day, select all the patients with central lines and assess them for compliance with the central line bundle. If even one element is missing, the case is not in compliance with the bundle. For example, if there are 7 patients with central lines, and 6 have all 5 bundle elements completed than 6/7 (86%) is the compliance with the central line bundle. If all 7 had all 5 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.

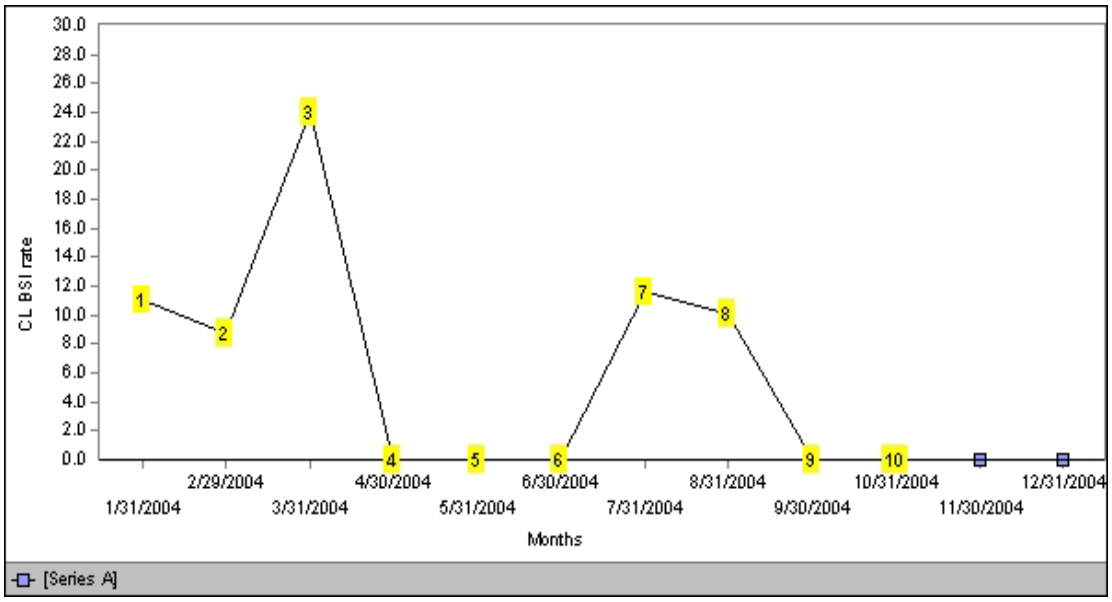
$$\frac{\text{No. with ALL 5 elements of central line bundle}}{\text{No. with CVCs on the day of the sample}} = \textit{reliability of bundle compliance}$$

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.

Example: Our Lady of Lourdes Hospital



The reductions here are clearly visible over time. During the course of one year the rate of CR-BSIs decreased three-fold.

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.

Work To Achieve a High Level of Compliance

The experience of the hospitals that have used the central line bundle thus far has been that the greater the level of compliance with *all* of the items in the bundle, the better the reduction in the CR-BSI rate.

Of course, compliance is only as good as the element that is 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:

Intervention:	**Compliance**:
Hand hygiene	62%
Chlorhexidine antiseptic at the procedure site	100%
Draped the entire patient in a sterile fashion	85%
Used a hat, mask, and sterile gown	92%
Used sterile gloves	100%
Sterile dressing applied	100%

Berenholtz SM, Pronovost PJ, Lipsett PA, et al. Eliminating catheter-related bloodstream infections in the intensive care unit. *Crit Care Med.* Oct 2004;32(10):2014-2020.

For John's Hopkins Hospital, compliance cannot be higher than 62%, given the score obtained for hand-washing. Aiming for a high level of compliance will improve outcomes and prevent infections.

Tips for Gathering Data

Implementing a central line 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 A.)

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 B.) This form can be completed during daily rounds on the patient. Many organizations implement the central line bundle in tandem with the ventilator bundle to improve systematic care to patients in ICUs. (For information on the ventilator bundle, see the Getting Started Kit for “Prevent Ventilator-Associated Pneumonia.”)

Appendix A: Central Line Insertion Checklist (Virginia Mason Medical Center)

Central Line Insertion Standard Work and Safety Checklist
Date: ____/____/____ **Start time**: _____
Location:_____
Catheter Type: ☐ Dialysis ☐ Central Venous ☐ PICC ☐ Pulmonary Artery
Number of Lumens: ☐ 1 ☐ 2 ☐ 3 ☐ 4
Insertion Site: **Jugular:** ☐ R ☐ L **Upper Arm:**☐ R ☐ L
Subclavian: ☐ R ☐ L **Femoral:** ☐ R ☐ L
Reason for Insertion: ☐ New Indication ☐ Elective ☐ Emergent ☐ Replace Malfunctioning Catheter
Procedure Provider:_____**ProcedureAssistant:**_____
☐ Attending MD ☐ Housestaff ☐ IV Therapist ☐ IV Therapist ☐ RN

Standard Work Before, During, and After Procedure		**YES Or True**	***YES*** *(After Reminder)*	NA
PROCEDURE PREP	➢ ***Patient has NO allergy to Heparin***	☐		
	➢ ***Patient's latex allergy assessed & procedure plan modified PRN***	☐		
	➢ ***Consent form completed & in chart*** *(exception Code 4)*	☐		
	➢ ***Perform Procedural Pause*** *Perform patient ID X 2*	☐	☐	
	Announce the procedure to be performed	☐	☐	
	Mark / assess site	☐	☐	
	Position patient correctly for procedure	☐	☐	
	Assemble equipment/verify supplies (including ultrasound, unless insertion is subclavian)	☐	☐	
	Verify all medication & syringes are labeled	☐	☐	
	➢ ***Confirm that all persons in room cleanse hands?*** (ASK, if unsure)	☐	☐	
	➢ ***Central line cart utilized?***	☐	☐	
	➢ ***Prep Procedure site*** *Chloraprep 10.5 ml applicator used*	☐	☐	
	Dry: 30 second scrub + 30 second dry time ***OR***	☐	☐	☐
	Wet: 2 minute scrub + 1 minute dry time	☐	☐	☐
	➢ ***Used large drape to cover patient?***	☐	☐	
	➢ ***Transducer set-up for all jugular and subclavian line insertions***	☐	☐	☐
DURING	➢ **Wear sterile gloves, hat, mask with eyeshield, and sterile gown? (all** must be worn**)**			
	Procedure provider	☐	☐	
	Procedure assistant	☐	☐	
	➢ ***Did patient and all other persons in the room wear a mask?***	☐	☐	
	➢ ***Maintain sterile field?***	☐	☐	
	➢ ***Was ultrasound guidance used for all jugular & femoral insertions?***	☐	☐	☐ subclavian
	➢ ***Venous placement confirmation via:***			
	pressure transducer w/ monitor ***OR***	☐	☐	☐
	manometry	☐	☐	☐
	➢ ***Type of solution used to flush/dosage:*** _____			
	➢ ***Catheter caps placed on lumens?***	☐	☐	
	➢ ***Catheter sutured in place?***	☐	☐	
	➢ ***Position confirmation*** *Fluoroscopy* ***OR***	☐	☐	☐
	Chest X-ray ordered	☐	☐	☐ femoral

A F T E R	➢ ***Was sterile technique maintained when applying dressing?***	☐	☐	
	➢ ***Was dressing dated?***	☐	☐	
	➢ ***Catheter position confirmed by:***			
	Already confirmed during procedure via fluoroscopy (see above), **OR**	☐	☐	☐
	Chest X-ray findings	☐	☐	☐ femoral

RN Procedure Note:

MD Procedure Note:

PATIENT Label

VIRGINIA MASON MEDICAL CENTER
Central Line Insertion Standard Work and Safety Checklist

Feedback on Pilot Form

1. How easy was this form to use?

2. Are there any important elements that should be added (please specify)?

3. Are there elements of the form that you think should be excluded (please specify)?

4. Other suggestions for improvements:

5. Other comments

Name:_____

Appendix B

Daily Goals

Patient Name _____ Room Number_____ Date_____/_____/_____

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

GOAL	NOTES	0700-1500	1500-2300	2300-0700
What needs to be done for the patient to be discharged from the ICU?				
What is this patient's greatest safety risk?				
Pulmonary/Ventilator: HOB 30 degrees or greater				
Sedation Vacation and Assessment of Readiness to Extubate				
PUD Prophylaxis				
DVT Prophylaxis				
Cardiac Rhythm, Hemodynamics				
Volume Status, net goal for 12 MN				
Neuro/Pain Mgt/Sedation				
GI/ Nutrition/Bowel Regimen				
Mobilization/OOB				
ID, Cultures, Drug levels				
Medication changes (Can any be discontinued?)				
Tests/Procedures Today				
Review scheduled labs. Can any be discontinued?				
Morning labs and PCXR				
Consultations				
Can central lines or other catheters/tubes be DC'd?				
Attending up to date?				
Family Updated?				
Any social issues to address?				
Emotional/spiritual issues addressed?				
Skin Care Addressed?				
Code Status Addressed?				
Advanced Directive in place?				
Parameters for calling MD				

Appendix C

Measure Information Form:
Central Line-Associated Primary Bloodstream Infection (BSI) Rate per 1000 Central Line-Days

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

Definition: 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. (The specific surveillance criteria are outlined in the CDC Guideline - *MMWR* Aug. 9, 2002/51(RR 10) and JCAHO core measures.)

Goal: The rate of CR-BSI will decrease by 50% in one year using the central line bundle. Once a hospital has gone more than 60 days between central line catheter-related bloodstream infections, the goal is for 150 or more days between central line infections.

Matches Existing Measures:

- JCAHO ICU-4
- CDC guidelines

CALCULATION DETAILS:

Numerator Definition: Number of central line-associated primary bloodstream infections (BSIs), in ICU patients with a laboratory confirmed BSI who had central line in place within the 48-hour period before the development of the BSI, by unit of attribution

Numerator Exclusions: Secondary bloodstream infections, BSI present or incubating on admission to the ICU, clinical sepsis

Denominator Definition: Number of central line-days, for patients who have a central line in place and are receiving care in intensive care units, by type of unit

Denominator Exclusions :

- Patients in non-ICU areas
- Patients who do not have central lines in place while in the ICU
- Patients less than 18 years of age at the date of ICU admission

Measurement Period Length: Monthly

Definition of Terms:

- **Primary Catheter-Associated BSI** (from Appendix A of CDC Guideline MMWR Aug. 9, 2002/51(RR 10); 27-28 and the JCAHO Core Measures Glossary): The major site of infection is a bloodstream infection and the specific site is either laboratory confirmed BSI or clinical sepsis. For example, a patient with leukemia with a vascular catheter has two positive blood cultures with coagulase-negative staphylococci. Even if there are clinical signs and symptoms of localized infection at the vascular access site, but no other infection can be found, the infection is considered a primary bloodstream infection. Also, when a vascular access device is present and no other infection site is evident, then the BSI is considered a primary BSI regardless of whether there are localized signs of infection at the vascular access site (JCAHO). BSI is considered to be associated with a central line if the line was in use during the 48-hour period before development of the BSI. If the time interval between onset of infection and device use is >48 hours, there should be compelling evidence that the infection is related to the central line (CDC).

- **Central Line:** A vascular access device that terminates at or close to the heart or one of the great vessels. An umbilical artery or vein catheter is considered a central line. **Note: 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.** (CDC: http://www.cdc.gov/mmwr/PDF/rr/rr5110.pdf and JCAHO)

- **Central Line Day**: Any day that a patient has a central line in place at the time the count is made. A patient with multiple central lines in a particular day should be counted as having only one central line day. Central line days should be counted in a consistent manner (e.g., at the same time each day). Central line days as the denominator include the total number of days of exposure to central venous catheters by all patients in the selected population during the selected time period. (JCAHO)

- **Great Vessels:** Aorta, superior vena and inferior vena cava, brachiocephalic veins, internal jugular veins, and subclavian veins (JCAHO)

- **Laboratory-Confirmed BSI:** Must meet at least one of the following criteria:

Criterion 1: Patient has a recognized pathogen cultured from one or more blood cultures, and the pathogen cultured from the blood is not related to an infection at another site.
Criterion 2: Patient has at least one of the following signs or symptoms: fever (100.4 [38C]), chills, or hypotension, and signs and symptoms and positive laboratory results are not related to an infection at another site, and at least one of the following:

1. Common skin contaminant [e.g., Corynebacterium sp. (formerly diphtheroids), Bacillus sp., Propionibacterium sp., coagulase-negative staphylococci, or micrococci] cultured from two or more blood cultures drawn on separate occasions.
2. Common skin contaminant [e.g. Corynebacterium sp. (formerly diphtheroids), Bacillus sp., Propionibacterium sp., coagulase-negative staphylococci, or micrococci] is cultured from at least one blood culture from a patient with an intravascular line, and the physician institutes appropriate antimicrobial therapy.
3. Positive antigen test on blood (e.g., H. influenzae, S. pneumoniae, N. meningitidis, or Group B streptococcus).

- **Secondary BSI:** A culture-confirmed bloodstream infection related to infection at another site. For example, a patient has pneumonia with Pseudomonas aeruginosa and grows the same pathogen in his blood cultures. The pneumonia is considered the primary infection site and the BSI is secondary to it. Another example is a leukemic patient who appears septic and the blood cultures grow E. coli. The patient has a vascular catheter and also has signs and symptoms of a urinary tract infection, but no urine culture is ordered. The patient's primary infection is a symptomatic UTI complicated by a secondary bloodstream infection. Secondary BSIs are not included in this measure (JCAHO).

Calculate as: Number of central line-associated bloodstream infections / Number of central line-days [x 1,000]

Comments: See CDC guidelines and JCAHO Core Measure ICU-4 for more specific information.

COLLECTION STRATEGY:

Data Collection Approach: Report the monthly CR-BSI rate for the last several months (preferably the last three to six months). This will serve as your baseline. Continue to track the measure monthly. If possible, track the rate in an annotated run chart, with notes reflecting any interventions you made to improve.

If your organization's infection control practitioner reports data quarterly, we recommend that you disaggregate the data and track by month. It is recommended that both the numerator and denominator data elements be collected concurrently.

Data Accuracy: Data accuracy is enhanced when all definitions are used without modification and denominator data are collected in a consistent manner (e.g., at the same time each day). It is recommended that an infection control practitioner (ICP) collect the

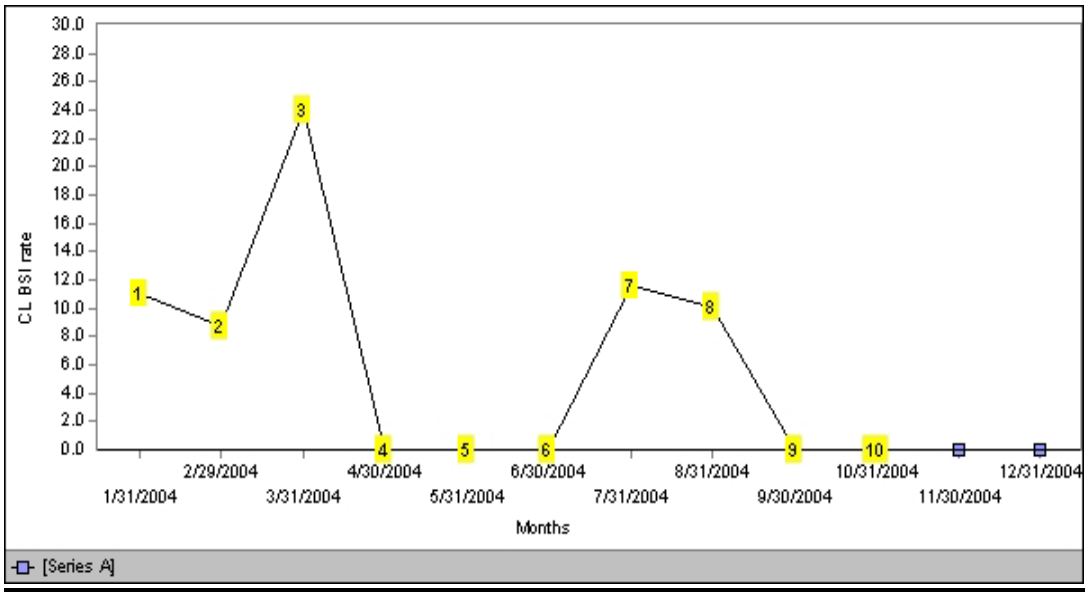
data for this measure, as some interpretation will be required. The patient is followed for evidence of infection for 48 hours after the removal of the central line, whether in the ICU or discharged from the ICU.

Hospitals may wish to implement periodic audits to monitor and ensure data accuracy.

Sampling: No sampling option available for this measure.

SAMPLE GRAPH:

Our Lady of Lourdes, Binghamton, NY
(CL BSI Rate shown is rate per 1000 line days)



Measure Information Form:
Central Line Bundle Compliance

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 five elements of the central line "bundle" are documented on the daily goals sheet and/or central line checklist or patient's medical record.

Goal: 95% of all patients with central lines in the included intensive care units receive all five elements of the central line bundle. Historically, this level of reliability has been achieved by building an infrastructure using central line insertion check lists, multi-disciplinary rounds, and daily goals.

Matches Existing Measures: None.

CALCULATION DETAILS:

Numerator Definition: Number of intensive care patients with central lines for whom all elements of the central line bundle are documented and in place. The central line bundle elements include:

- Hand hygiene
- Maximal barrier precautions upon insertion
- Chlorhexidine skin antisepsis
- Optimal catheter site selection, with subclavian vein as the preferred site for non-tunneled catheters in patients 18 years and older
- Daily review of line necessity with prompt removal of unnecessary lines

NOTE: This is an "all or nothing" indicator. 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: Same as denominator exclusions

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

Denominator Exclusions:

- Patients outside the intensive care unit and patients whose lines were not placed in the intensive care unit
- Patients less then 18 years of age at the date of ICU admission

Measurement Period: Monthly

Definition of Terms:

- **Central Line Bundle:** A group of interventions related to patients with intravascular central catheters that, when implemented together, result in better outcomes than when implemented individually. When implemented with a higher level of reliability, basic structural changes are required on unit to maintain compliance.

- **Central Line:** A vascular access device that terminates at or close to the heart or one of the great vessels. An umbilical artery or vein catheter is considered a central line. **Note: 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.** http://www.cdc.gov/mmwr/PDF/rr/rr5110.pdf and JCAHO
- **Great Vessels:** Aorta, superior vena and inferior vena cava, brachiocephalic veins, internal jugular veins, and subclavian veins (JCAHO)

- **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:
        - Before and after palpating catheter insertion sites
        - 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 (~ 2 minutes).
- **Optimal catheter 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. (CDC Guidelines).
- **Daily review for necessity and 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.

Calculate as: Number of intensive care patients with central lines for whom all elements of the central line bundle are documented and in place / Total number of intensive care patients with central lines on day of week of 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 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 bundle, not just parts of the bundle. Incorporating the five elements of the central line bundle into a central line insertion checklist and 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 central line insertion checklist, daily goal sheet, and/or medical record as data sources. Review for implementation of the central line bundle.

The sample should include all patients with central lines in the intensive care unit. Only patients with all five aspects of central line bundle in place are recorded as being in compliance with the 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 should be used to confirm compliance with the elements that are specific to the time of initial insertion and the daily goals sheet can be used to confirm compliance for that day with the element of "daily review of line

necessity with prompt removal of unnecessary lines." A patient who remains in the ICU with a central line for more than one week will be included in more than one weekly compliance measure, although the compliance with the initial insertion 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 7 patients with central lines, and 6 have all 5 bundle elements completed, then 6/7 (86%) is the rate of compliance with the central line bundle. If all 7 had all 5 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.

SAMPLE GRAPH:

Our Lady of Lourdes, Binghamton, NY
(began work with central line bundle in March, 2004)