



JOHNS HOPKINS

M E D I C I N E

---

QUALITY AND SAFETY  
RESEARCH GROUP

JOHNS HOPKINS QUALITY AND SAFETY RESEARCH GROUP (QSRG)

**ON THE CUSP: STOP BSI**  
**CENTRAL LINE-ASSOCIATED BLOOD STREAM INFECTION**  
**TOOLKIT**

## Table of Contents

---

How to Use This Toolkit .....	3
Engage: How does this make the world a better place? .....	3
Educate: How will we accomplish this? .....	4
Execute: What do I need to do? .....	5
Step 1: Educate staff .....	5
Step 2: Create a central line insertion cart.....	6
Step 3: Ask providers daily whether catheters can be removed .....	6
Step 4: Implement a checklist to be completed by the bedside nurse .....	7
Step 5: Empower nurses to stop procedures if guidelines are not adhered to.....	7
Evaluate: How will we know that we added value? .....	8
References .....	9

## Appendices

*The Michigan Experience (NEJM 2006; 355(26):272502732).....	Appendix A
Fact Sheet .....	Appendix B
CDC/NHSN CLABSI Definitions (Am J Infect Control 2008; 35(5):309-332) .....	Appendix C
The NHSN Manual .....	Appendix D
Central Venous Access Device Training Slides.....	Appendix E
Central Venous Access Device Quiz .....	Appendix F
*SHEA/IDSA Strategies to Prevent CLABSI in Acute Care Hospitals (Infect Control Hosp Epidemiol 2008; 29(supp 1):S22-S33).....	Appendix G
Adult Vascular Access Device: Johns Hopkins Hospital (JHH) Policy.....	Appendix H
Procedure for Changing a Central Venous Access Device: JHH Policy .....	Appendix I
Line Cart Inventory .....	Appendix J
Daily Goals Worksheet .....	Appendix K
Central Line Insertion Checklist .....	Appendix L
Annotated Bibliography.....	Appendix M

\* Included in annotated bibliography

## How to Use This Toolkit

---

The purpose of this toolkit is to support your efforts to implement evidence-based practices and eliminate Central Line Associated Blood Stream Infections (CLABSIs) in your clinical area. The strategies in this toolkit have nearly eliminated CLABSIs in participating Michigan ICUs (Appendix A). These strategies have been adopted by over 100 ICUs in large and small, academic and community hospitals that we have worked with to date. Most of these ICUs have demonstrated a significant reduction in their CLABSI rates and many have not had a CLABSI in >6 months.

Nevertheless, your leadership is needed to achieve these results in your clinical area. Most of your efforts will be working with staff that insert and assist with the insertion of central lines. We developed a model to help disseminate this, and other, interventions. This model includes 4 stages that answer the following questions:

1. **Engage:** How will this make the world a better place?
2. **Educate:** How will we do this?
3. **Execute:** What do I need to do?
4. **Evaluate:** How will we know we made a difference?

This toolkit provides details of what you should do in each of these stages. In the appendices, we provide all the tools you will need to eliminate CLABSIs in your clinical area; the rest is up to you.

### Engage: How does this make the world a better place?

---

You need to help staff understand that Central Line Associated Blood Stream Infections (CLABSIs) are associated with significant morbidity, mortality, and costs. (1-2) Patients in intensive care units (ICUs) are at an increased risk for CLABSIs because 48% of ICU patients have indwelling central venous catheters accounting for 15 million central line days per year in United States (U.S.) ICUs. (1) Assuming an average CLABSI rate of 5.3 per 1000 catheter days and an attributable mortality of 18% (0-35%), as many as 28,000 ICU patients die from CLABSIs annually in U.S. alone. (2-4) Therefore, efforts to decrease the rate of CLABSIs and improve the quality of ICU care are paramount.

To engage your colleagues, first make the problem real by telling a story of a patient who developed a CLABSI in your clinical area. Identify a patient in your clinical area that has suffered needless harm from a central line and share the patient's story with your colleagues. In our ICU, for example, we tell the story of a 46 y.o. mother of two, Jane Doe (an alias for the purpose of this toolkit) who suffered an irreversible hypoxic brain injury from sepsis due to a CLABSI. Share your story openly with your colleagues and leadership. Ask them if this is the kind of care they would like for their family, if this is care they are proud of, if this is the best your clinical area can do?

Second, post the number of people who developed a CLABSI each month in your clinical area and the total number of CLABSIs for the previous year in your clinical area. To keep staff engaged, post a trend line so nurses and physicians can see at a glance your CLABSI rate and how it is changing over time. Post the number of days (weeks or months) since your last CLABSI. Use formal and

informal opportunities to talk about the intervention and about unit specific infection rates. Make a point of recognizing providers who appropriately follow the protocol. Invite your hospital infection control professional or epidemiologist to become an active part of your clinical area's improvement team and draw on their expertise to help with your specific challenges. The goal should be that no patient suffers harm from a preventable complication while in our clinical area.

Third, using baseline data on CLABSI rates in your clinical area, calculate the potential opportunity to improve for the number of preventable CLABSIs, preventable deaths, excess hospital days and costs per year. We have provided an Opportunity Calculator to help you calculate this for your clinical area (Appendix B). Share this information openly with your colleagues.

Finally, make sure your staff recognizes that benchmarking your performance against similar clinical areas and striving for the 50<sup>th</sup> percentile is unacceptable for preventable complications. Our goal should be that no patient suffers harm from a preventable complication while under our care. You can eliminate infections and any infection should be viewed as a defect.

### Educate: How will we accomplish this?

---

Make sure your staff understands how they can reduce CLABSIs. Numerous interventions have reduced the incidence of CLABSI and the ensuing morbidity, mortality and costs. (5-8) In addition, the Centers for Disease Control (CDC), [http://www.cdc.gov/ncidod/dhqp/nhsn\\_members.html](http://www.cdc.gov/ncidod/dhqp/nhsn_members.html), the Society of Critical Care Medicine (SCCM), the Society of Healthcare Epidemiologists of America (SHEA), the Infectious Disease Society of America (IDSA) and several other societies have developed evidence graded guidelines for the prevention of catheter-related infections. (9) Several of the guideline recommendations are supported by well-done clinical trials or systematic reviews and include the appropriate use of hand hygiene, chlorhexidine skin preparation, full-barrier precautions during central venous catheter insertion, avoiding the femoral site when possible and maintaining a sterile field while inserting the line. (1) Improving compliance with these evidence-based practices will result in dramatic reductions in CLABSI rates in your clinical area.

We strongly recommend that you identify who the hospital epidemiologist or infection control practitioner is for your hospital/unit and partner with them to reduce CLABSIs in your clinical area. You can work with them to:

- Ensure you are using NHSN definitions for CLABSI (Appendix C & D)
- Educate staff about how to reduce CLABSI
- Ensure you have chlorhexidine in your central line kits
- Publicly post the number of people infected per month and your quarterly infection rates

Using baseline data on CLABSI rates in your clinical area, you can easily calculate the number of preventable CLABSIs, preventable deaths, excess hospital days and costs per year. Again, we will provide you with an Opportunity Calculator to help you calculate this for your clinical area but providers often want to know how these calculations are derived. If your CLABSI rate is 5.3 per 1000 catheter days and your s has 2500 catheter days per year, you have 13 preventable CLABSIs every year. The calculation is:  $5.3/1000 \times 2500$ . If we assume that the mortality associated with a CLABSI is 18%, then there will be 2 preventable deaths (13 preventable CLABSIs x 0.18) per year in your clinical area. If we assume that patients stay in the hospital for an additional 13 days if they

develop a CLABSI, then 13 CLABSIs leads to 169 excess hospital days per year (13 preventable CLABSIs x 13 hospital days). If we assume the cost of each CLABSI is \$45,254, then your CLABSIs translated into an extra \$588,302 per year (13 preventable CLABSIs x \$45,254). Actual estimates of mortality, LOS and costs of care vary by clinical area but these estimates are consistent with those published in the literature. (10) Share this information openly with your colleagues.

## Execute: What do I need to do?

---

There are 5 steps in the CLABSI toolkit:

Educate staff by distributing a FACT SHEET and hold in-services for bedside providers.

Reduce complexity by creating a line insertion cart.

Ask providers daily whether catheters could be removed.

Implement a checklist during catheter insertion to ensure adherence to evidence-based guidelines for preventing CLABSIs.

Empower staff to stop the catheter insertion procedure if a violation of the guidelines is observed.

### Step 1: Educate staff

---

The biggest barrier to compliance with evidence-base practice is not that providers disagree with the evidence but rather that providers don't know the evidence exists or don't know what they should be doing. To educate providers about the evidence-based practices we have developed a one page FACT SHEET (Appendix B). We recommend that you distribute the FACT SHEET to all staff members. We have also provided a PowerPoint presentation that you may use for education (Appendix E). Consider staff in-services to review the presentation, review the FACT SHEET and allow providers to have their questions answered. Consider using a quiz (Appendix F) to test the provider's knowledge after the in-service and requiring providers to pass the quiz prior to being allowed to insert central lines in your clinical area.

Once a week for two consecutive weeks, determine the number of providers that have received the FACT SHEET and/or completed the quiz. If <90% of providers received the FACT SHEET and/or completed the quiz, plan a meeting with your team to evaluate additional opportunities to increase knowledge among providers.

We have also provided a copy of the SHEA/IDSA Strategies to Prevent Central Line-Associated Bloodstream Infections in Acute Care Hospitals (Appendix G), our vascular access device policy (Appendix H), and our policy for changing a central venous access device dressing (Appendix I) that you may find useful as additional resources. The procedures detailed in our vascular access device policy include the standard requirements for training, VAD site selection, insertion, site assessment, dressing change requirements, documentation requirements, appropriate flushing procedures, tubing replacement and central catheter removal and/or replacement requirements. These are examples that you may find helpful as you revise or develop your own protocols. As you make this project your own you will also have a chance to share protocols developed by other teams in the collaborative.

## Step 2: Create a central line insertion cart

---

We identified that a potential barrier to compliance with the evidence-based practices in our ICU was that physicians had to go to several different places to collect the equipment needed to comply with the CDC guidelines. If this is also true in your clinical area, simplify the process by establishing a central line insertion cart that contains the equipment and supplies needed and thereby reduce the number of steps required.

Gain consensus on what supplies should be included and how the central line cart should be organized in your clinical area. We use an A-Smart Standard Cart from Armstrong medical ([www.armstrongmedical.com](http://www.armstrongmedical.com)) that can be rolled to the patient's room. We have the 4-drawer variety but can be ordered with customized drawer space. Our current supply list for the line cart is provided in Appendix J. Adjust the cart content and organization to accommodate providers in your unit.

The use of 2% chlorhexidine for skin antisepsis before catheter insertion and during dressing changes is the preferred agent, unless the patient is allergic to chlorhexidine. This is a Category IA CDC recommendation (Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies). You should meet with your hospital's epidemiologist, infection control practitioner or senior leadership to ensure you have 2% chlorhexidine available.

Determine how often the cart needs to be stocked in your clinical area. Our support associate stocks the cart every four hours from the ICU supply room and signs off on the checklist located on top of the cart. Other clinical areas may be able to stock the cart less frequently depending on the number of lines placed each day. Adjust the frequency as needed to ensure it is stocked at all times.

## Step 3: Ask providers daily whether catheters can be removed

---

One of the most effective strategies for preventing CLABSIs is to eliminate, or at least reduce, exposure to central venous catheters. The decision regarding the need for a catheter is complex and therefore difficult to standardize into a practice guideline. Nonetheless, to reduce exposure to central venous catheters, we should have a systematic approach to ask providers daily whether any catheters or tubes could be removed.

Develop a strategy to ensure that providers are asked whether any catheters or tubes could be removed. To ensure that this question was asked, we added it to the rounding form, called the Daily Goals form (Appendix K) which is used to develop daily care plans for patients in our ICU. In addition, you could add this question to existing reporting mechanisms in your clinical area (nurse to nurse report forms, charge nurse report forms, for example). You should also develop a strategy to place tunneled catheters if central access will be required for a prolonged period of time to decrease the risk for infection.

Consider recording the number of central line days or the number of times per week that a central venous catheter was discontinued. Graph results over time using a run- chart. Make the results known to providers. If central venous catheters are not being discontinued, discuss with appropriate

leadership and providers whether there may be an opportunity to decrease the number of central venous catheters used in your clinical area.

#### Step 4: Implement a checklist to be completed by the bedside nurse

---

Creating independent redundancies, through the use of a checklist, is an effective technique to monitor whether patients receive the care processes they should. Checklists are used extensively in aviation to create independent redundancies for key steps in a process. In addition, using a checklist allows nurses to serve as an independent, redundant check to encourage physician adherence to evidence-based practices.

We developed a checklist that you can adapt to your clinical area (Appendix L). We require the bedside nurse to be present during all central line insertions and they complete the checklist during every central venous catheter insertion. Pilot test the checklist in your unit for one week and interview several nurses regarding the clarity of the form, burden of data collection and the need for modification.

In our experience, a powerful strategy to demonstrate the opportunity for improvement in your clinical area is to establish baseline compliance with the evidence-based practices. Consider implementing a two week observation only phase where nursing staff observes the physicians during catheter placement and completes the checklist for each procedure. Physicians would not be aware that they were being observed during the observation only phase. You could then calculate the percent of central line insertions where providers were compliant with evidence-based practices and share these results openly with your staff.

Audit the percentage of central venous catheter insertions that had the checklist completed. Based on feedback, modify the form and provide in-services to the nursing staff.

When we first introduced the CLABSI checklist at Hopkins, staff expressed concern. Barriers identified included: 1) the nurses perception that their job was not to police physicians and 2) the physicians perception that credibility and authority would be challenged if they were critiqued or corrected by nursing staff. Our unit leadership met with nursing and physician staff to emphasize the focus on patient safety and teamwork. It would be analogous to watching anyone on the healthcare team enter a patient room and intentionally inflict patient harm. While we would never tolerate intentional harm, and this extreme scenario may never happen, that is in fact what we are doing when we allow providers to violate evidence-based infection control practices. When presented in this light, physicians and nurses in our ICU understood that they needed to work together to keep patients safe.

#### Step 5: Empower nurses to stop procedures if guidelines are not adhered to

---

While efforts to improve interpersonal communication have resulted in improved aviation safety, the same is not yet true in healthcare where the culture is still typically hierarchical. Successful implementation of the checklist requires effective interpersonal communication skills and provides a means to learn teamwork skills experientially.

Require the bedside nurse to complete the checklist during central venous catheter placement. Inform the physician staff that the checklist is being implemented if an observation only phase was implemented. Empower nurses to stop the procedure, absent an emergency, if they observe a violation in compliance with the evidence-based practices. Indicate if the procedure was stopped on the checklist. Develop a support system for the bedside nurse to minimize the risk of an undesirable encounter. For example, we instructed the nurse to page the unit director 24/7 if the physician, after the nurse identified a violation, failed to correct the violation. You should develop a strategy in your clinical area to support the bedside nurse.

Audit the percentage of central venous catheter insertions that had the checklist completed. Calculate compliance with evidence-based practice and the number of corrections required. Make the results known to providers.

### Evaluate: How will we know that we added value?

---

The first step is to collect baseline rates of CLABSI in your clinical area for the past 12 months. To accomplish this, you will use the web-based data form. The second step is to track CLABSI rates over time in your clinical area. To accomplish this, you will continue to use the web-based data form. Your hospital's infection control staff should have the information needed to complete these forms.

While we encourage all clinical areas to adopt standardized definitions for CLABSI provided by the Centers for Disease Control (CDC) (Appendix C), we recognize that the definitions may vary among hospitals. We will identify whether your hospital uses a standard definition provided by the CDC. If your hospital uses definitions other than those provided by the CDC, you can submit data though we will not be able to benchmark your clinical areas performance against other hospitals. However, as long as your definition of an infection remains constant, you can evaluate trends over time in infection rates. We encourage the team leader to discuss these issues with the director of hospital epidemiology or infection control.

## References

---

- \*Mermel LA. Prevention of intravascular catheter-related infections. *Annals of Internal Medicine*. 2000; 132(5):391-402.
- \*Pittet D, Tarara D, Wenzel RP. Nosocomial bloodstream infection in critically ill patients. Excess length of stay, extra costs, and attributable mortality. *Journal of the American Medical Association*. 1994; 271(20):1598-1601.
- CDC. National nosocomial infections surveillance (NNIS) System report, data summary from October 1986-April 1998, issued June 1998. *American Journal of Infection Control*. 1998; 26:522-533.
- Heiselman D. Nosocomial bloodstream infections in the critically ill. *Journal of the American Medical Association*. 1994; 272:1819-1820.
- \*Goetz AM, Wagener MM, Miller JM, Muder RR. Risk of infection due to central venous catheters: effect of site of placement and catheter type. *Infection Control Hospital Epidemiology*. 1998; 19(11):842-845.
- \*Raad II, Hohn DC, Gilbreath BJ, et al. Prevention of central venous catheter-related infections by using maximal sterile barrier precautions during insertion. *Infection Control Hospital Epidemiology*. 1994; 15(4 Pt 1):231-238.
- 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. *American Journal of Medicine*. 1991; 91(3B):197S-205S.
- \*Maki DG, Ringer M, Alvarado CJ. Prospective randomised trial of povidone-iodine, alcohol, and chlorhexidine for prevention of infection associated with central venous and arterial catheters. *Lancet*. 1991; 338(8763):339-343.
- \*Mermel LA, Farr BM, Sherertz RJ, Raad II, O'Grady N, Harris JS et al. Guidelines for the management of intravascular catheter-related infections. *Infection Control Hospital Epidemiology*. 2001; 22(4):222-242.
- \*O'Grady NP, Alexander M, Dellinger P, et al. 2002 Guidelines for the prevention of intravascular catheter-related infections. *Infection Control and Hospital Epidemiology*. 2002; 23(12):759-769.

\*Included in annotated bibliography