

Selected Best Practices and Suggestions for Improvement

NQI 03: Neonatal Blood Stream Infection

Why focus on neonatal blood stream infection (BSI)?

- Central line-associated bloodstream infection (CLABSI) rates are higher in children than in adults, particularly in neonates.¹ Newborn infants, and especially premature newborns, are more susceptible to bloodstream infections (BSIs) because of poor skin integrity, immature immune systems, repeated invasive procedures, exposure to many caregivers, and an environment conducive to abnormal microbial colonization.
- Between 2 percent and 10 percent of all babies admitted to the neonatal intensive care unit (NICU) experience at least one episode of BSI.²
- Low-birth-weight infants with BSIs are at increased risk for chronic lung disease, periventricular leukomalacia, necrotizing enterocolitis, severe retinopathy of prematurity, poor neurodevelopmental outcomes, prolonged hospitalization, and death.³
- The mortality of BSIs in neonates has been estimated to be as high as 21 percent.⁴
- BSIs in neonates lead to significantly increased length of stay and cost, with an increased average length of stay of 23 days⁵ and excess costs of \$25,090 or more.³
- Part of this cost is likely to be shouldered by hospitals, as the Centers for Medicare & Medicaid Services will not reimburse for CLABSI for Medicaid patients unless it is present on admission.⁶
- In addition, CLABSI (in NICUs and pediatric ICUs) is one of the core set of children’s health care quality measures for voluntary public reporting by Medicaid and the Children’s Health Insurance Program.⁷
- AHRQ-funded researchers found that an intervention to implement evidence-based practices and reduce CLABSI rates (part of the Michigan Health and Hospital Association Keystone Center for Patient Safety and Quality Keystone ICU project) was successful at nearly eliminating CLABSIs in ICUs (the study included one pediatric ICU).⁸
- Studies have also shown that it is possible to reduce neonatal CLABSI rates with hospital-based interventions.^{9,10}

Recommended Practice	Details of Recommended Practice
Assess Neonatal Patients for Risk Factors	Identify the risk factors that are most common among neonates for bloodstream infection and screen patients using these criteria.
Implement Standard Infection Prevention Techniques To Prevent Neonatal Bloodstream Infections	General infection prevention practices, such as hand hygiene, along with appropriate line care may help decrease the incidence of neonatal bloodstream infections.
Prevent Early-Onset Group B Strep Bacteria	Screen all pregnant women between 35 and 37 weeks and administer antibiotics during labor for those who test positive.
Site Selection	The upper or lower extremities (or the scalp in neonates or young infants) can be used as the catheter insertion site. ¹¹

Maximal Barrier Precautions and Skin Preparation	<p>To prevent CLABSIs, providers must¹¹⁻¹⁴:</p> <ul style="list-style-type: none"> • Wash hands before and after central line insertion. • Apply maximal barrier precautions. <p>Use chlorhexidine skin prep unless contraindicated.</p>
Daily Monitoring, Assessment, and Line Access	<p>All central lines should be assessed daily for need and removed promptly if the line is no longer needed for care of the patient. Central lines should also be assessed daily for the presence of infection and to ensure that the dressing is intact.^{11,12,14}</p> <p>Disinfect hubs, needless connectors, and injection ports prior to use.¹⁵</p>

Best Processes/Systems of Care

Introduction: Essential First Steps

- Engage key procedural personnel, including nurses, physicians and other providers, technicians, and representatives from the quality improvement department, to develop evidence-based protocols for care of the neonatal patient population.
- The above team:
 - Identifies the purpose, goals, and scope and defines the target population for this guideline.
 - Analyzes problems with guideline compliance, identifies opportunities for improvement, and communicates best practices to frontline teams.
 - Establishes measures to indicate if changes are leading to improvement, identifies process and outcome metrics, and tracks performance using these metrics based on a standard performance improvement methodology (e.g., FOCUS-PDSA).
 - Determines appropriate facility resources for effective and permanent adoption of practices.

Recommended Practice: Assess neonatal patients for risk factors

- Assess all neonatal NICU patients for BSI. Risk factors for neonatal BSI include²⁻⁵:
 - Gestational age at birth <32 weeks or birth weight \leq 1,500 g
 - Low Apgar scores (i.e., \leq 7 at 1 minute)
 - Presence of specific comorbidities (e.g., respiratory distress syndrome, bronchopulmonary dysphasia)
 - History of maternal premature rupture of membranes
 - Necrotizing enterocolitis
 - Mechanical ventilation
 - Central venous catheter (including umbilical catheters)
 - High NICU space and staffing ratios
 - Transfer from an outside hospital

Recommended Practice: Implement standard infection prevention techniques to prevent neonatal bloodstream infections

- Implement general infection prevention practices:
 - General infection prevention practices, such as hand hygiene and appropriate glove use, along with appropriate line care may help decrease the incidence of neonatal BSIs.^{3, 4}
 - Although there is limited evidence that shows hand hygiene directly leads to a statistically significant reduction in BSI rates, it still remains an important foundation in infection prevention techniques.
 - Implement and continually monitor and educate staff on the importance and proper techniques of hand hygiene.
- Develop insertion checklist:
 - The multidisciplinary team defined in the introduction section must develop the central line insertion checklist. The checklist should have all of the following¹²⁻¹⁴:
 - Date, start time, end time, hands washed prior to insertion, sterile gloves, sterile gown, cap, mask, full-body sterile drape, chlorhexidine skin prep unless contraindicated, insertion site, type of catheter, circumstances for insertion, dressing type, followup chest x-ray complete, person inserting, cart used, and procedure note.
 - A central line insertion cart should include all the components and equipment needed to insert a central line. The cart should be available on all units/areas where central lines are inserted and should be brought into the room. The central line cart, at a minimum, should include all of the following^{13,14}:
 - Supplies for maximal barrier precautions: sterile gloves, masks, sterile gowns, and caps for any provider inserting or assisting in the insertion of a central line. For the patient, a full-length sterile drape. (if Pyxis is used, replenish cart and charge patient).
 - Chlorhexidine for skin prep, if not contraindicated.
 - Central venous catheter insertion kit.
 - Central venous catheters (triple lumens, Swan-Ganz catheters, peripherally inserted central catheters, umbilical catheters, etc.).
 - Supplies to dress the catheter site (sterile, transparent, semipermeable dressings are preferred but if the site is bleeding or oozing or the patient is diaphoretic, a gauze dressing is preferred).
 - Central line insertion checklist.
- Follow protocol for insertion:
 - The time-sequenced protocol includes the following for all insertions of central venous catheters:
 - Identify indications for catheter insertion and use. Patients must meet criteria for insertion, set by institution.¹²

- Define competency criteria to identify staff eligible to insert central lines and remove central lines within the institution. These procedures should be done by a nurse, physician, or other health care professional who has received appropriate education to ensure that the proper procedures are followed.¹³
- Start by first bringing the central line cart into the patient's room or within proximity of patient's room.
- The clinician assisting the procedure starts with the checklist. The health care professional assisting with the insertion completes the checklist and is empowered to stop the procedure if the central line protocol is not followed.¹²
- Obtain informed consent from patient and/or patient's caregiver(s) to insert the central line and put the consent in the medical record.
- Educate the patient, if appropriate, and caregivers about CLABSIs.¹³
- Ensure that the person inserting and anyone assisting wash their hands with antiseptic soap and water or use an alcohol-based hand rub prior to starting to prep the patient (the use of gloves does not obviate hand hygiene).¹⁴

Recommended Practice: Site Selection

- Select appropriate site for insertion of central line^{11,13,14}:
 - The upper or lower extremities or the scalp (in neonates or young infants) can be used as an insertion site.¹¹
 - The risks and benefits of a particular site must always be considered on an individual basis and clinician discretion should be used.
 - Providers (including any assistants) should wash their hands before and after palpating catheter insertion sites (palpation of the insertion site should not be performed after the application of antiseptic, unless performed with sterile gloves).

Recommended Practice: Maximal Barrier Precautions and Skin Preparation

- Prepare skin:
 - Prepare skin with chlorhexidine skin antiseptic, if not contraindicated, by first breaking the central core. Let the solution saturate the pad.
 - Apply with a back and forth motion for at least 30 seconds. Do not wipe or blot.¹²
 - Allow antiseptic solution to dry completely before puncturing the site.^{11,12}
 - If patient is allergic to chlorhexidine or contraindicated, apply substitute antiseptic (tincture of iodine, an iodophor, or 70% alcohol can be used as a substitute).
 - For an umbilical insertion site, avoid tincture of iodine because of the potential effect on the neonatal thyroid. Other iodine-containing products (e.g., povidone iodine) can be used.¹¹
 - Apply maximal barrier precautions.¹¹⁻¹⁴
 - The clinician and anyone assisting with insertion should wear a cap, mask, sterile gown, and sterile gloves.
 - The patient should be covered from head to toe with a sterile drape, leaving a small opening for the insertion site.

- Perform time-out to verify the patient ID x2, announce procedure to be performed, and verify that all medication and syringes are labeled.
- Clinician assisting is empowered to stop procedure if central line protocol is not followed.¹¹
- Select appropriate catheter for insertion. Use the minimum number of ports or lumens essential for management of patient.
- Insert central line:
 - Consider placing central line via guided ultrasound if available.¹¹
 - Place caps on lumens.
 - Suture in place or use sutureless securement device.
- Dress central line insertion site with a sterile, transparent, semipermeable dressing to cover the catheter site. If the site is bleeding or oozing or the patient is diaphoretic, a gauze dressing is preferred. Consider use of a chlorhexidine-impregnated sponge dressing for patients > 2 months old.^{11,13}
 - Date and time the dressing.
 - Do not routinely apply prophylactic topical antimicrobial or antiseptic ointment or cream to the insertion site of peripheral venous catheters.
- After inserting and dressing the catheter site, remove gown and gloves and then wash hands.
 - Confirm catheter placement via x-ray after placement.
 - Clinician inserting central line should complete progress note on checklist, sign, and put in chart.

Recommended Practice: Daily Monitoring, Assessment, and Line Access

- Review necessity of central line daily:¹¹⁻¹³
 - During multidisciplinary rounds, review necessity of line and record date and time of line placement. If the patient has a long-term CVC (tunneled or totally implantable), determine a timeframe to review necessity, such as weekly.
 - Remove promptly if line is unnecessary. Ideally, umbilical artery catheters should not stay in place for more than 5 days and umbilical venous catheters for more than 14 days.¹¹
 - Inspect central line site daily for signs of infection.
 - Do not replace catheters:
 - At scheduled time intervals.
 - Over a guide wire if the patient is suspected of having catheter-related infection.
 - Remove and do not replace umbilical artery catheters if any signs of Catheter-Related Bloodstream Infection (CRBSI), vascular insufficiency in the lower extremities, or thrombosis are present.¹¹

- Remove and do not replace umbilical venous catheters if any signs of CRBSI or thrombosis are present.
- Follow appropriate dressing assessment and replacement according to best practices specific to the age of the child, type of central line, and other patient-related factors, such as skin condition.
 - In younger pediatric patients, the risk of dislodging the catheter may outweigh the benefit of changing the dressing.¹¹
- Clean all injection ports with 70% alcohol or an iodophor before accessing the system. Also cap all stopcocks when not in use.
- Ensure patency of central line by flushing after every central line use.
- When removing central lines, follow these steps:
 - Assess developmental status of the child to determine need for restraint or sedation
 - Explain procedure to patient/caregiver (as appropriate)
 - Position patient.
 - Perform hand hygiene and put on clean gloves.
 - Remove the dressing and discard along with gloves.
 - Repeat hand hygiene and don sterile gloves.
 - Remove sutures.
 - Ask the patient to take a deep breath, hold it, and bear down (if applicable).
 - Pull the catheter slowly and gently while covering the site with sterile gauze to prevent air embolism. Stop if there is any resistance.
 - Once catheter is removed, hold pressure until bleeding stops and apply a sterile occlusive dressing.
 - Inspect the integrity of the central line to make sure it did not break off inside the vein.
- Establish standing order sets for inserting central lines, to include chest x-ray to confirm placement, type of dressing to be used, dressing changes, and daily monitoring. Mandate the use of these standing orders anytime a central line is placed.
- Assign responsibility for appropriate placement of standing orders on units (decisions based on accessibility via electronic medical record versus paper).

Recommended Practice: Prevent early-onset Group B Strep (GBS) disease

- Screen pregnant women with vaginal-rectal screening for GBS colonization at 35-37 weeks.¹⁶
- Give intrapartum antibiotic prophylaxis for¹⁶:
 - Women who delivered a previous infant with GBS disease.
 - Women with GBS bacteriuria in the current pregnancy.
 - Women with a GBS-positive screening result in the current pregnancy.
 - Women with unknown GBS status who deliver at less than 37 weeks' gestation, have an intrapartum temperature of 100.4° F or greater, or have rupture of membranes for 18 hours or longer.

- Penicillin remains the preferred agent, with ampicillin an acceptable alternative.¹⁶

Educational Recommendation

- Plan and provide education on protocols to physicians and other providers, nursing, and all other staff involved in procedural cases. Education should occur upon hire, annually, and when this protocol is added to job responsibilities.⁴

Effectiveness of Action Items

- Track compliance with elements of established protocol by using checklists, appropriate documentation, etc.
- Evaluate effectiveness of new processes, determine gaps, modify processes as needed, and reimplement practices.
- Mandate that all personnel follow the safety protocols developed by the team to prevent BSI and develop a plan of action for staff in noncompliance.
- Provide feedback to all stakeholders (physicians and other providers, nursing, and ancillary staff; senior medical staff; and executive leadership) on the level of compliance with process.⁴
- Conduct surveillance and determine prevalence to evaluate outcomes of new process.
- Monitor and evaluate performance regularly to sustain improvements achieved.⁴

Additional Resources

Systems/Processes

- CDC Group B Strep Web site
<http://www.cdc.gov/groupbstrep/about/index.html>

Policies/Protocols

- Montana State Hospital Policy and Procedure-Handwashing
http://dphhs.mt.gov/Portals/85/amdd/documents/MSH/volumeii/infectioncontrol/handwashing_1.pdf
- Policy for the Care of Patient With Short Term Central Venous Catheter. Johns Hopkins Hospital
https://cdn.community360.net/app/jh/csts/elabsi/JHH_VAD_Appendix_F_Care_Shortterm_Cath.pdf
- Policies & Procedures. Central Venous Catheters Insertion – Assisting. Saskatoon Health Region
<https://www.saskatoonhealthregion.ca/about/NursingManual/1073.pdf>

Tools

- Central Line Insertion Care Team Checklist. Johns Hopkins Health System
https://cdn.community360.net/app/jh/csts/elabsi/JHH_VAD_Appendix_C_Central_Line_Checklist.pdf
- Reducing Central Venous Catheter-associated Bloodstream Infections, CHANGE PACKAGE. CHCA Clinical Improvement Collaborative

<http://iphi.nonprofitoffice.com/vertical/Sites/%7B00CFF503-04BE-4895-B1A4-FF765B2CE512%7D/uploads/%7BA8536386-10B4-4983-A868-57FD85E3D911%7D.PDF>

Staff Required

- Physicians and other providers (in neonatology, pediatrics, infectious diseases)
- NICU registered nurses
- Laboratory staff

Equipment

- Antibacterial soap or alcohol-based hand rub
- Chlorhexidine skin antiseptic
- Maximal barrier precautions
- Central line catheters

Communication

- Education on policy/protocol of monitoring and treatment of BSIs

Authority/Accountability

- Senior leaders such as chief/chairs of surgery and medicine, nursing leadership, and unit managers

References

1. The Joint Commission. CLABSI Toolkit – Preventing Central-Line Associated Bloodstream Infections: Useful Tools, An International Perspective. http://www.jointcommission.org/topics/clabsi_toolkit.aspx. Accessed May 17, 2016.
2. Leighton P, Cortina-Borja M, Millar M, et al. A toolkit for monitoring hospital-acquired bloodstream infection in neonatal intensive care. *Infect Contr Hosp Epidemiol* 2012;33(8):831-6.
3. Helder O, van den Hoogen A, de Boer C, et al. Effectiveness of non-pharmacological interventions for the prevention of bloodstream infections in infants admitted to a neonatal intensive care unit: a systematic review. *Int J Nurs Stud* 2013;50(6):819-31.
4. Apostolopoulou E, Lambridou M, Lambadaridis I. Infection control. Nosocomial bloodstream infections in a neonatal intensive care unit. *Br J Nurs* 2004;13(13):806.
5. Verstraete E, Boelens J, Blot S, et al. Healthcare-associated bloodstream infections in a neonatal intensive care unit over a 20-year period (1992-2011): trends in incidence, pathogens, and mortality. *Infect Contr Hosp Epidemiol* 2014;35(5):511-8.
6. Centers for Medicare & Medicaid Services. Hospital-Acquired Conditions (Present on Admission Indicator). http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HospitalAcqCond/index.html?redirect=/hospitalacqcond/06_hospital-acquired_conditions.asp. Accessed May 17, 2016.
7. State Reporting of the Central Line-Associated Blood Stream Infection (CLABSI) Measure: Summary of Workgroup Findings and Recommendations. Children’s Health Care Quality Measures Technical Assistance and Analytic Support Program, sponsored by the Centers for Medicare & Medicaid Services. May 2012. <http://www.medicare.gov/Medicare-CHIP->

[Program-Information/By-Topics/Quality-of-Care/Downloads/CLABSI-Workgroup-Report.pdf](#). Accessed May 17, 2016.

8. Pronovost P, Needham D, Berenholtz S, et al. An intervention to decrease catheter-related bloodstream infections in the ICU. *New Engl J Med* 2006;355(26):2725-32.
9. Wirtschafter DD, Pettit J, Kurtin P, et al. A statewide quality improvement collaborative to reduce neonatal central line-associated blood stream infections. *J Perinatolog* 2009;30(3):170-81.
10. Bizzarro MJ, Noonan M, Bonfiglio MP, et al., and Central Venous Catheter Initiative Committee. A quality improvement initiative to reduce central line-associated bloodstream infections in a neonatal intensive care unit. *Infect Contr Hosp Epidemiol* 2010;31(3):241-8.
11. O’Grady NP, Alexander M, Burns LA, et al. Guidelines for the prevention of intravascular catheter-related infections, 2011. Atlanta, GA: Centers for Disease Control and Prevention; 2011. www.cdc.gov/hicpac/pdf/guidelines/bsi-guidelines-2011.pdf. Accessed May 17, 2016.
12. How-to Guide: Prevent Central Line-Associated Bloodstream Infections. Cambridge, MA: Institute for Healthcare Improvement; 2012. <http://www.ihl.org/resources/pages/tools/howtoguidepreventcentrallineassociatedbloodstreaminfection.aspx>. Accessed May 17, 2016.
13. Marschall J, Mermel L, Yokoe D, et al. Strategies to prevent central line-associated bloodstream infections in acute care hospitals. *Infect Contr Hosp Epidemiol* 2008 Oct;29 Suppl 1:S22-S30.
14. Hospital: 2016 National Patient Safety Goals. Oakbrook Terrace, IL: The Joint Commission; 2016. http://www.jointcommission.org/standards_information/npsgs.aspx. Accessed May 17, 2016.
15. Chopra V, Krein SL, Olmsted RN, et al. Prevention of central line-associated bloodstream infections: brief update review. In: Shekelle PG, Wachter RM, Pronovost PJ, et al. Making Health Care Safer II: An Updated Critical Analysis of the Evidence for Patient Safety Practices. Comparative Effectiveness Review No. 211. (Prepared by the Southern California RAND Evidence-based Practice Center under Contract No. 290-2007-10062-I.) Rockville, MD: Agency for Healthcare Research and Quality; March 2013. AHRQ Publication No. 13-E001-EF. p. 88-109. www.ahrq.gov/research/findings/evidence-based-reports/ptsafetyuptp.html. Accessed May 17, 2016.
16. Group B Strep, Overview of 2010 Guidelines. Centers for Disease Control and Prevention Web site. <http://www.cdc.gov/groupbstrep/guidelines/new-differences.html>. Accessed May 17, 2016.