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Sustained Reduction in Bloodstream Infections in Infants at a Large Tertiary Care Neonatal Intensive Care Unit

Sara Neill, RN, MSN, NNP¹, Sarah Haithcock, RN², P. Brian Smith, MD, MPH, MHS^{3,4}, Ronald Goldberg, MD³, Margarita Bidegain, MD³, David Tanaka, MD³, Charlene Carriker, RN, CIC², and Jessica E. Ericson, MD^{3,4}

¹Department of Advanced Practice Nursing, Duke University, Durham, NC

²Department of Nursing, Duke University, Durham, NC, USA

³Department of Pediatrics, Duke University, Durham, NC, USA

⁴Duke Clinical Research Institute, Durham, NC, USA

Abstract

Purpose—Reduction of bloodstream infections (BSI) has emerged as an important patient safety goal. Implementation of central line insertion bundles, standardized line care protocols, and health care provider education programs have reduced BSI in neonatal intensive care units (NICUs) around the country. The ability of large tertiary care centers to decrease nosocomial infections, including BSI, has been demonstrated. However, long-term BSI reductions in infants are not well documented. We sought to demonstrate that a low incidence of BSI can be maintained over time in a tertiary care NICU.

Subjects—6,790 infants admitted to a large, tertiary care NICU between 2005 and 2013.

Design—Retrospective intervention study.

Methods—A staged, multifaceted infection prevention plan was implemented beginning in October 2007 under nursing leadership. The incidence of BSI was determined annually for 2005–2013.

Results—Baseline BSI incidence for infants admitted to the NICU was 5.15 and 6.08 episodes per 1,000 infant-days in 2005 and 2006, respectively. After protocol implementation, the incidence of BSI decreased to 2.14/1,000 infant-days and 2.44/1,000 infant-days in 2008 and 2009, respectively. Yearly incidence remained low over the next 4 years and decreased even further to 0.20–0.45 infections/1,000 infant days. This represents a 92% decrease in BSI over a period of >5 years.

Conclusions—Implementation of a nursing-led comprehensive infection control initiative can effectively produce and maintain a reduction in the incidence of BSI in infants at a large tertiary care NICU.

Corresponding Author: Jessica E. Ericson, MD, Duke Clinical Research Institute, Durham, NC, USA. Phone: 919-668-7817; jessica.ericson@dm.duke.edu.

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What this study adds—Long term reductions in neonatal BSI are possible with implementation of a multidisciplinary team approach and strong nursing leadership.

Keywords

neonatal sepsis; bacteremia; central-line associated bloodstream infection

Bloodstream infections (BSI) cause significant morbidity and mortality for infants admitted to neonatal intensive care units (NICUs). Infants with BSI have increased incidence of cerebral palsy, vision and hearing impairment, and chronic lung disease.^{1,2} As many as 69% of BSI occurring after 7 days of life may be related to the presence of a central venous catheter, suggesting that interventions focused on reducing catheter-related infections may be effective in reducing the overall incidence of BSI.³ Premature infants are at greatest risk due to an immature host defense system and the need for prolonged invasive life-sustaining equipment and parenteral nutrition.^{4,5}

Several centers and multicenter state collaboratives have successfully implemented quality improvement initiatives in their NICUs with subsequent reductions in infections.^{3,6-9} One center was able to reduce the incidence of line-related BSI from 6.3 infections per 1,000 central line days to 1.3 infections per 1,000 central line days after instituting changes to hand hygiene and line care practices.⁶ A multicenter collaborative in Ohio used multidisciplinary teams to implement evidence-based catheter care, achieving a 20% decrease in the incidence of BSI for infants born at 22-29 weeks gestation.³ In New York, use of standardized central venous line insertion and maintenance bundles aided by checklists decreased central line-associated BSI by 40%.⁷ A North Carolina collaborative was able to reduce central line-associated BSI by 71% using a multidisciplinary team.⁹ A toolkit and workshops were used by a collaborative in California to reduce the odds of acquiring a nosocomial infection, OR: 0.81.¹⁰ Common successful strategies reported by both single centers and state collaboratives include the use of central line insertion and maintenance bundles, standardization of central-line care practices, improved hand hygiene and staff education.^{7,11-13} Although reductions in the incidence of BSI have been seen immediately following these interventions, prolonged improvements have not yet been well described.

Methods

Infection Prevention Program

The Duke University Medical Center NICU is an urban, tertiary academic medical center in North Carolina with approximately 800 admissions each year. Early in 2007, the incidence of BSI in our NICU exceeded 5 infections/1000 infant-days. This was greater than the national average and indicated a need for aggressive infection-reduction measures. A BSI was defined as a positive blood culture obtained after 2 days of age. All positive blood cultures growing the same organism within a 21 day period were considered to be part of the same BSI episode. For coagulase negative staphylococci, a positive blood culture was considered to represent an infection if it met the following criteria: 2 positive blood cultures within 4 days, 3 positive within 7 days, or 4 within 10 days.¹⁴ We excluded the following

organisms as they are commonly considered to represent contamination: *Bacillus* species, *Diphtheroids*, *Neisseria* species, viridans group *Streptococci*.

In 2007, a unit-based multidisciplinary team was formed to develop and implement an intervention with the goal of reducing BSI. The team was co-chaired by a neonatal nurse practitioner (NNP) and a staff nurse. Other multidisciplinary members included neonatologists, nurse managers, nurse practitioners, staff nurses, respiratory therapists, pharmacists, and a hospital infection control nurse.

A unit-based comprehensive infection control program was chosen as the intervention tool. Areas identified by other centers as effective targets of intervention were chosen as focus issues.¹³ These were (1) cleanliness of the patient environment, including caregiver hygiene; (2) vascular access; (3) nutrition; (4) antibiotic exposure; and (5) caregiver culture. The intervention program was implemented in 2 phases.

Phase 1 focused on staff education regarding the 5 areas identified for improvement and implementation of a root cause analysis process to identify opportunities to prevent future BSI (Table 1). This occurred from October 2007 to December 2009. Specific expectations for staff included cleaning the entire patient area including equipment at the beginning of each nurse's shift, use of alcohol hand wash before touching any patient, and use of a central line insertion check list. Insertion and line maintenance bundles were implemented and reinforced (Table 2). Bundles included a change to 2% aqueous chlorhexidine gluconate for skin preparation in December 2007 and placement of a silver alginate patch on all central line insertion sites beginning in November 2008.^{15,16} Educational activities for unit staff focused on accountability and the responsibility that each individual has in preventing BSI. BSI that did occur were treated as sentinel events with a corresponding root cause analysis.

Phase 2 of implementation began in January 2010. During this phase, line care best practices were emphasized with development of a "safe zone" protocol, a change to 2% chlorhexidine gluconate with 70% isopropyl alcohol for line hub anti-sepsis and skin preparation in infants >28 weeks gestational age, implementation of a closed umbilical artery catheter blood sampling system, and development of a strict central line change procedure. The "safe zone" during central line dressing, fluid, and line changes required that curtains be pulled around the patient bedspace and that everyone inside of the curtains wear a hat and mask for the entire procedure. Prior to this initiative only providers performing line care were required to wear barrier protection. A hat, mask, and clean gloves were required for the priming of tubing, and sterile gloves and towels were required for connecting the tubing to the line.

A zero tolerance policy was adopted for both line care and hand hygiene initiatives. All float staff and consultants were educated on the unit policies and expected to comply. Patient families were also involved in infection prevention efforts. Parents were provided educational materials on the initiative and encouraged to be attentive to both their own and health care provider compliance with hand washing and line care policies. A family focused "germ school" was held every 2-4 weeks to reinforce the importance of good hand hygiene. These sessions also served to encourage parents to advocate for optimal practices for their own infants. Mothers were also encouraged to provide colostrum during this phase.

Available maternal colostrum was applied to the buccal mucosa of the infants in 0.1 mL aliquots every 4 hours as previously described.¹⁷ Since that time, no new components have been introduced; rather, the emphasis has shifted to maintaining the early gains seen as a result of these efforts.

Maintenance of program goals has occurred through ongoing education and continuous review of policies and caregiver behaviors. The multidisciplinary team continues to be active and meets formally periodically. Program directors meet informally monthly to monitor gains and reinforce practice. Running tallies of infection-free days and hand hygiene compliance rates are posted and easily visible by staff. Educational activities continue to occur to emphasize the effectiveness of initiative compliance in reducing BSI. All staff are required to repeat a hospital-wide training every year and a NICU-focused infection prevention training every 2 years; and new staff complete training modules prior to beginning work in the unit.

Effectiveness Analysis

The incidence of BSI was determined per 1,000 infant-days. The incidence before the intervention (2005-2007) was compared with the incidence during program implementation (2007-2009) and the incidence after completion of the intervention (2010-2013).

Results

We identified 6,790 infants admitted to the Duke University Medical Center NICU between 2005 and 2013. Infants were of similar gestational age, birth weight, race, and gender distributions throughout the study period (Table 3).

The pre-intervention quarterly incidence of BSI ranged from 2.04 to 12.38 episodes per 1,000 infant-days with a mean of 5.62 BSI per 1000 infant-days. During the implementation phase, there was a decline in the incidence of BSI to 2.14 BSI per 1,000 infant-days in 2008 and 2.44 BSI per 1,000 infant-days in 2009 (Figure 1). With additional interventions in 2010, the incidence of BSI decreased to 0.27 episodes per 1,000 infant-days in 2010, 0.20 episodes per 1,000 infant-days in 2011, 0.45 episodes per 1,000 infant-days in 2012, and 0.25 episodes per 1,000 infant-days in 2013.

Since 2010, there have been 6 quarters with no BSI. Three of these were consecutive quarters immediately following the implementation of phase 2 in 2010. The BSI incidence has decreased 92% from the pre-intervention period (2005-2007) to the post-intervention period. Incremental improvements were seen during implementation.

Root cause analyses performed on incident bloodstream infection cases revealed that ELBW infants require additional measures to prevent bloodstream infections (Table 4).

Discussion

This phased nursing-driven infection prevention initiative resulted in sustained decreases in the incidence of BSI in infants admitted to a tertiary care NICU. Improvements were seen within a few months of introducing the first phase of the intervention. Further dramatic

decreases occurred with the expansion of efforts to include parental involvement and the change from ethanol to chlorhexidine line hub antiseptics. The initial improvements have been now been sustained for 7 years, and the mean annual incidence of BSI has been <1 per 1,000 infant-days for 4 years.

The prevention of nosocomial infections has been established as a priority by many professional health care organizations and the Centers for Disease Control and Prevention.¹⁸ Premature infants are at increased risk of infection because of immature immune function,⁴ invasive procedures including placement and subsequent use of central venous lines,¹⁹ mechanical ventilation, and parenteral nutrition. A point prevalence analysis found that 11% of NICU patients had a nosocomial infection, and 50% of those were BSI.²⁰ BSI are particularly important because they typically have systemic manifestations and are associated with increased mortality.²¹ Additionally, premature infants with BSI are at greater risk for chronic lung disease,^{1,22} intraventricular hemorrhage,²³ periventricular leukomalacia,²⁴ and cerebral palsy or other neurodevelopmental impairments.²⁵⁻²⁸

In addition to the significant consequences of a BSI for the individual patient, the associated economic burden is also substantial. A recent analysis in adults found a cost savings of over \$3,000 for each episode of BSI that was successfully prevented.²⁹ A BSI episode in very low birth weight (<1500 g) infants has direct costs closer to \$10,000.³⁰ Overall costs can be expected to be even greater for infections occurring in infants because of the costs associated with long-term complications such as chronic lung disease^{31,32} and neurodevelopmental impairment³³⁻³⁵. The 10-fold decrease in annual BSI incidence seen in our NICU would be expected to be associated with significant cost savings.

Nationally, the incidence of bacteremia in premature infants has been unchanged for decades, with 20-36% of very low birth weight infants having at least one BSI.^{36,37} Recent studies have demonstrated that changes in practice patterns can be successful in reducing BSI.^{3,6,7,12} As an example, BSI due to *Candida* have decreased due to decreased use of broad-spectrum antibiotics and judicious use of fluconazole prophylaxis.³⁸ The use of lactoferrin, a key protein found in colostrum, has also been associated with decreased incidence of late onset bacterial and fungal sepsis.^{39,40} Using methods that had been successful at other institutions, we were able to develop an effective, evidence-based intervention. Many of these techniques are best practices in the prevention of central line-associated BSI in the NICU.¹¹

Implementation of practice changes can be difficult because of differences in perspective between those who develop and those who implement protocols.⁴¹ Unit initiatives may not achieve their goals due to conflicting priorities among administration, medical staff, and nurses. The success of this infection prevention initiative was largely due to its development by a multidisciplinary team and the leadership of an NNP and bedside nurse. The NNP functioned closely with both medical providers and nursing staff, and served as a facilitator between the 2 groups of caregivers. Other centers have noted success in BSI reduction through team-based approaches.⁴¹ Additionally, involvement of bedside nurses allowed for an accurate review of practice change implementation. The pairing of an NNP and a clinical nurse allowed change to occur in a collaborative manner.⁴²

BSI in infants have significant long term sequelae and are associated with increased health care costs. The American Academy of Pediatrics report on the prevention of nosocomial infections in the NICU notes that “the goal of all infection-control programs should be to reduce the rate of central line-associated BSI to zero.”¹¹ Multifaceted approaches can lead to dramatic declines in infection rates, and periods of no BSI episodes can be attained. This study represents the longest duration of BSI improvement following a targeted intervention. A multidisciplinary, nursing-led team can successfully implement a staged initiative leading to prolonged success in BSI reduction.

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References

1. Liljedahl M, Bodin L, Schollin J. Coagulase-negative staphylococcal sepsis as a predictor of bronchopulmonary dysplasia. *Acta paediatrica*. 2004; 93:211–5. [PubMed: 15046276]
2. Alshaikh B, Yusuf K, Sauve R. Neurodevelopmental outcomes of very low birth weight infants with neonatal sepsis: systematic review and meta-analysis. *Journal of perinatology : official journal of the California Perinatal Association*. 2013; 33:558–64. [PubMed: 23328927]
3. Kaplan HC, Lannon C, Walsh MC, Donovan EF, Ohio Perinatal Quality C. Ohio statewide quality-improvement collaborative to reduce late-onset sepsis in preterm infants. *Pediatrics*. 2011; 127:427–35. [PubMed: 21339274]
4. Melville JM, Moss TJ. The immune consequences of preterm birth. *Frontiers in neuroscience*. 2013; 7:79. [PubMed: 23734091]
5. Stoll BJ, Hansen N. Infections in VLBW infants: studies from the NICHD Neonatal Research Network. *Seminars in perinatology*. 2003; 27:293–301. [PubMed: 14510320]
6. Cooley K, Grady S. Minimizing catheter-related bloodstream infections: one unit's approach. *Advances in neonatal care : official journal of the National Association of Neonatal Nurses*. 2009; 9:209–26. quiz 27-8. [PubMed: 19823131]
7. Schulman J, Stricof R, Stevens TP, et al. Statewide NICU central-line-associated bloodstream infection rates decline after bundles and checklists. *Pediatrics*. 2011; 127:436–44. [PubMed: 21339265]
8. Schulman J, Stricof RL, Stevens TP, et al. Development of a statewide collaborative to decrease NICU central line-associated bloodstream infections. *Journal of perinatology : official journal of the California Perinatal Association*. 2009; 29:591–9. [PubMed: 19262569]
9. Fisher D, Cochran KM, Provost LP, et al. Reducing central line-associated bloodstream infections in North Carolina NICUs. *Pediatrics*. 2013; 132:e1664–71. [PubMed: 24249819]
10. Wirtschafter DD, Powers RJ, Pettit JS, et al. Nosocomial infection reduction in VLBW infants with a statewide quality-improvement model. *Pediatrics*. 2011; 127:419–26. [PubMed: 21339273]

11. Polin RA, Denson S, Brady MT. Committee on F, Newborn, Committee on Infectious D. Strategies for prevention of health care-associated infections in the NICU. *Pediatrics*. 2012; 129:e1085–93. [PubMed: 22451712]
12. Holzmann-Pazgal G, Kubanda A, Davis K, Khan AM, Brumley K, Denson SE. Utilizing a line maintenance team to reduce central-line-associated bloodstream infections in a neonatal intensive care unit. *Journal of perinatology : official journal of the California Perinatal Association*. 2012; 32:281–6. [PubMed: 22011970]
13. Schelonka RL, Scruggs S, Nichols K, Dimmitt RA, Carlo WA. Sustained reductions in neonatal nosocomial infection rates following a comprehensive infection control intervention. *Journal of perinatology : official journal of the California Perinatal Association*. 2006; 26:176–9. [PubMed: 16341027]
14. Jean-Baptiste N, Benjamin DK Jr, Cohen-Wolkowicz M, et al. Coagulase-negative staphylococcal infections in the neonatal intensive care unit. *Infection control and hospital epidemiology : the official journal of the Society of Hospital Epidemiologists of America*. 2011; 32:679–86.
15. Hill ML, Baldwin L, Slaughter JC, Walsh WF, Weitkamp JH. A silver-alginate-coated dressing to reduce peripherally inserted central catheter (PICC) infections in NICU patients: a pilot randomized controlled trial. *Journal of perinatology : official journal of the California Perinatal Association*. 2010; 30:469–73. [PubMed: 20010613]
16. Khattak AZ, Ross R, Ngo T, Shoemaker CT. A randomized controlled evaluation of absorption of silver with the use of silver alginate (Algidex) patches in very low birth weight (VLBW) infants with central lines. *Journal of perinatology : official journal of the California Perinatal Association*. 2010; 30:337–42. [PubMed: 19940856]
17. Seigel JK, Smith PB, Ashley PL, et al. Early administration of oropharyngeal colostrum to extremely low birth weight infants. *Breastfeeding medicine : the official journal of the Academy of Breastfeeding Medicine*. 2013; 8:491–5. [PubMed: 23805944]
18. Cardo D, Denney PH, Halverson P, et al. Moving toward elimination of healthcare-associated infections: a call to action. *American journal of infection control*. 2010; 38:671–5. [PubMed: 21058460]
19. Romanelli RM, Anchieta LM, Mourao MV, et al. Risk factors and lethality of laboratory-confirmed bloodstream infection caused by non-skin contaminant pathogens in neonates. *Jornal de pediatria*. 2013; 89:189–96. [PubMed: 23642430]
20. Sohn AH, Garrett DO, Sinkowitz-Cochran RL, et al. Prevalence of nosocomial infections in neonatal intensive care unit patients: Results from the first national point-prevalence survey. *The Journal of pediatrics*. 2001; 139:821–7. [PubMed: 11743507]
21. Pereira CA, Marra AR, Camargo LF, et al. Nosocomial bloodstream infections in Brazilian pediatric patients: microbiology, epidemiology, and clinical features. *PLoS One*. 2013; 8:e68144. [PubMed: 23861860]
22. Marshall DD, Kotelchuck M, Young TE, Bose CL, Kruyer L, O'Shea TM. Risk factors for chronic lung disease in the surfactant era: a North Carolina population-based study of very low birth weight infants. *North Carolina Neonatologists Association. Pediatrics*. 1999; 104:1345–50. [PubMed: 10585987]
23. Mularoni A, Madrid M, Azpeitia A, Valls ISA. The Role of Coagulase-Negative Staphylococci in Early-Onset Sepsis in a Large European Cohort of Very Low Birth Weight Infants. *The Pediatric infectious disease journal*. 2013
24. Silveira RC, Procianoy RS, Dill JC, da Costa CS. Periventricular leukomalacia in very low birth weight preterm neonates with high risk for neonatal sepsis. *Jornal de pediatria*. 2008; 84:211–6. [PubMed: 18425215]
25. Bassler D, Stoll BJ, Schmidt B, et al. Using a count of neonatal morbidities to predict poor outcome in extremely low birth weight infants: added role of neonatal infection. *Pediatrics*. 2009; 123:313–8. [PubMed: 19117897]
26. Msall ME, Buck GM, Rogers BT, Duffy LC, Mallen SR, Catanzaro NL. Predictors of mortality, morbidity, and disability in a cohort of infants < or = 28 weeks' gestation. *Clinical pediatrics*. 1993; 32:521–7. [PubMed: 8258204]

27. Adams-Chapman I, Bann CM, Das A, et al. Neurodevelopmental outcome of extremely low birth weight infants with Candida infection. *The Journal of pediatrics*. 2013; 163:961–7 e3. [PubMed: 23726546]
28. Stoll BJ, Hansen NI, Adams-Chapman I, et al. Neurodevelopmental and growth impairment among extremely low-birth-weight infants with neonatal infection. *JAMA : the journal of the American Medical Association*. 2004; 292:2357–65. [PubMed: 15547163]
29. Cooper K, Frampton G, Harris P, et al. Are educational interventions to prevent catheter-related bloodstream infections in intensive care unit cost-effective? *The Journal of hospital infection*. 2014; 86:47–52. [PubMed: 24262140]
30. Johnson TJ, Patel AL, Jegier BJ, Engstrom JL, Meier PP. Cost of morbidities in very low birth weight infants. *The Journal of pediatrics*. 2013; 162:243–49 e1. [PubMed: 22910099]
31. Landry JS, Croitoru D, Jin Y, Schwartzman K, Benedetti A, Menzies D. Health care utilization by preterm infants with respiratory complications in Quebec. *Can Respir J*. 2012; 19:255–60. [PubMed: 22891185]
32. Miller RJ, Sullivan MC, Hawes K, Marks AK. The effects of perinatal morbidity and environmental factors on health status of preterm children at age 12. *J Pediatr Nurs*. 2009; 24:101–14. [PubMed: 19268232]
33. Petrou S, Abangma G, Johnson S, Wolke D, Marlow N. Costs and health utilities associated with extremely preterm birth: evidence from the EPICure study. *Value Health*. 2009; 12:1124–34. [PubMed: 19659702]
34. Roggero P, Gianni ML, Garbarino F, Mosca F. Consequences of prematurity on adult morbidities. *Eur J Intern Med*. 2013; 24:624–6. [PubMed: 23385012]
35. Kancherla V, Amendah DD, Grosse SD, Yeargin-Allsopp M, Van Naarden Braun K. Medical expenditures attributable to cerebral palsy and intellectual disability among Medicaid-enrolled children. *Res Dev Disabil*. 2012; 33:832–40. [PubMed: 22245730]
36. Fanaroff AA, Stoll BJ, Wright LL, et al. Trends in neonatal morbidity and mortality for very low birthweight infants. *American journal of obstetrics and gynecology*. 2007; 196:147 e1–8. [PubMed: 17306659]
37. Stoll BJ, Hansen NI, Bell EF, et al. Neonatal outcomes of extremely preterm infants from the NICHD Neonatal Research Network. *Pediatrics*. 2010; 126:443–56. [PubMed: 20732945]
38. Aliaga S, Clark RH, Laughon M, et al. Changes in the incidence of candidiasis in neonatal intensive care units. *Pediatrics*. 2014; 133:236–42. [PubMed: 24446441]
39. Ronayne de Ferrer PA, Baroni A, Sambucetti ME, Lopez NE, Ceriani Cernadas JM. Lactoferrin levels in term and preterm milk. *Journal of the American College of Nutrition*. 2000; 19:370–3. [PubMed: 10872899]
40. Manzoni P, Rinaldi M, Cattani S, et al. Bovine lactoferrin supplementation for prevention of late-onset sepsis in very low-birth-weight neonates: a randomized trial. *JAMA : the journal of the American Medical Association*. 2009; 302:1421–8. [PubMed: 19809023]
41. Stevens TP, Schulman J. Evidence-based approach to preventing central line-associated bloodstream infection in the NICU. *Acta Paediatr Suppl*. 2012; 101:11–6. [PubMed: 22404886]
42. DeVries, J.; Neill, S. National Association of Neonatal Nurses. Austin, Tx: 2009 Sep 23. Success of advanced practice nursing driven initiatives. 20092009

What we know

- Bloodstream infections are an important cause of morbidity and mortality in premature infants.
- Multidisciplinary teams can effectively reduce the incidence of bloodstream infections in the hospital setting.
- Nursing led initiatives can be effective in changing clinical practice.

What needs to be studied

- The role of family involvement in an infection prevention strategy needs to be better defined.
- We do not know if these practices can also be used to reduce the incidence of other types of nosocomial infections.

What we can do today

- Encourage nurses to take an active role in practice changes, including infection prevention.
- Consider novel strategies to improve patient care.

STOP the LINE

CENTRAL LINE CATHETER INSERTION OBSERVATION SHEET

Patient Name: _____	Inserter: RN NNP Resident
Date/Time: _____	Fellow Attending Surgeon _____
Name of Observer: _____	Assistant: RN NNP Resident
Usually bedside RN	Fellow Attending Surgical team

Time out:	YES	NO	Why not?
Line Cart used?	YES	NO	Why not?

PROCEDURE

UAC, UVC, PICC, Broviac OHER: _____

HANDWASHING

Was appropriate hand scrub with hospital approved cleansing agent performed by all personnel involved prior to insertion for 1 minutes? YES NO

STERILE BARRIER PRECAUTIONS

All individuals actively participating in line placement at bedside:

Wearing mask?	YES	NO	Why not?
Have cap on with all hair under cap?	YES	NO	Why not?
Wearing sterile gown?	YES	NO	Why not?
Wearing sterile glove?	YES	NO	Why not?

SITE PREPERATION

Was appropriate site prepping agent applied and allowed to dry completely prior to line insertion? YES NO Why not? _____

PROCESS

Was procedure performed without delay between hand scrub, donning of sterile attire and insertion? YES NO

If a delay was noted, did individual(s) rescrub? YES NO

SITE DRESSING

Appropriate sterile dressing applied immediately after procedure (if applicable)? YES NO

INSERTION SHEET

Was this form filled out at the time of insertion (real time) or after the fact?

REAL TIME LATER WHY?

Did the observer INTERVENE during procedure? (Stop the procedure to ensure compliance)

YES what happened? _____

NO Any reason should have? _____

OTHER COMMENTS: _____

LINE DETAILS

Was line placement successful? UAC YES NO UVC YES NO PICC YES NO

OTHER YES NO

UVC PICC #Lumens: 1 2

How many total attempts? _____ How many total sites attempted? _____

Figure 1.
Central line insertion checklist.

The Importance of Colostrum and Mother's Own Milk for Your Baby

Dear Moms,

The Nursery's at Duke University Health System want to give your baby the best possible care. We and the American Academy of Pediatrics, strongly encourage the use of mothers own milk as the gold standard of nutrition for all newborns. Mother's own milk contains powerful substances that help prevent infection and disease that infant formulas cannot provide.

Mother's first milk, known as colostrum, is especially important and can be given to your baby's mouth even when they may be too sick to eat. Your colostrum and milk decreases infections and bowel disease while providing numerous other benefits. Colostrum is important medicine only you can provide for your baby

Infection is a problem that can affect all babies because a baby's immune system is not mature. A premature baby's immune system is even less mature than a full term baby. Mothers own milk decreases the number of infections in babies.

Premature infants are at risk for a bowel disease called necrotizing enterocolitis (NEC). NEC can cause a baby to stay in the hospital longer and can cause learning problems as a child. Most importantly, for babies who get NEC and need surgery, the risk of dying is 50%. Mother's own milk greatly decreases the chance of NEC in babies.

We cannot promise you that your baby won't get an infection or NEC if fed mother's own milk. We can tell you that giving your baby your colostrum and milk gives them the best possible start in life. Mother's own milk benefits also include decreased number of sudden infant deaths, childhood cancers, childhood diabetes, childhood obesity and ear infections. Mother's own milk also improves IQ scores.

There may be a time where mother's own milk cannot be used and we will discuss the next best choice of nutrition for your baby with you.

Our goal is to assist you with providing colostrum to your baby and with all of your breastfeeding needs. Our team of experts is ready to help you provide this important "medicine" for your baby.

Thank you
Duke Intensive Care Nurseries

Figure 2.

Letter to mothers encouraging use of colostrum and mother's own milk.

Figure 3. Number of bloodstream infection episodes per 1,000 infant days for each quarter; A: Pre-intervention period (2005-2006), B: Phase 1 (2007-2009), C: Phase 2 (2010-2013).

Table 1
Practice Changes Implemented

Phase 1 (2007-2009)
Increased staff education on infection prevention
Hand washing initiative
Cleaning of patient areas every shift
Implementation of central line insertion checklist
Clean gloves for all central line manipulations
Silver alginate patch for central line insertion sites
2% chlorhexidine gluconate soap for skin preparation
Root cause analysis of all bloodstream infections
Dedicated PICC team
Phase 2 (2010-2013)
Safe zone for line manipulations
Line change for clear fluids increased to every 96 hours
2% chlorhexidine gluconate with 70% isopropyl alcohol for line hub anti-sepsis
2% chlorhexidine gluconate with 70% isopropyl alcohol as skin preparation agents for infants > 28 weeks gestation
“Zero tolerance” for hand hygiene and line care deviations
Increased family involvement via “germ school” and written materials
Colostrum for infants <1000 g birth weight
Closed umbilical artery catheter sampling system

Note. PICC, peripherally inserted central catheter.

Table 2

Post-insertion central line care practice changes.

Dressing changes descheduled, changed only when integrity disrupted
Dressing changes performed with 2 caregivers
Silver alginate patch changed with dressing changes
Lines directed up and away from diaper area and ostomies when dressing placed
Gloves required for all central line manipulations
Hat, mask and bedside curtains closed for all fluid changes
Hat, mask, sterile gloves, sterile towels and bedside curtains closed for all tubing changes
Line change for clear fluids increased to every 96 hours
2% chlorhexidine gluconate with 70% isopropyl alcohol for line hub anti-sepsis

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Table 3

Post-insertion central line care practice changes.

Characteristic	No. (%) of patients		
	2005-2007	2008-2010	2011-2013
	N=2,186	N=2,311	N=2,293
Gestational age, weeks			
<26	185 (8)	170 (7)	168 (7)
26-28	209 (10)	172 (7)	174 (8)
29-32	413 (19)	428 (19)	340 (15)
33-36	643 (29)	733 (31)	701 (31)
37	736 (34)	808 (35)	910 (40)
Birth weight, g			
<1,000	325 (15)	292 (13)	303 (13)
1,000-1,499	274 (13)	265 (12)	238 (10)
1,500-2,499	710 (33)	799 (35)	717 (31)
2,500-3,499	593 (28)	658 (28)	653 (29)
3,500	273 (13)	291 (13)	372 (16)
Race/ethnicity			
Caucasian	884 (40)	1004 (43)	920 (40)
African-American	894 (41)	912 (39)	899 (39)
Hispanic	209 (10)	242 (10)	254 (11)
Other	199 (9)	153 (7)	220 (10)
Male	1204 (55)	1263 (55)	1257 (55)
Died	162 (7)	152 (7)	122 (5)

Table 4

Additional practice changes following root cause analyses conducted for incident BSI.

Problem identified	Changes Made
PICC lines migrating in and out of insertion site in ELBW infants	Increased training on cutting and securing lines at proper length
Central line dressings coming loose due to humidity and gelatinous skin	Delayed PICC placement until 3-5 days old in ELBW infants (previously placed on days 2-3)
Poor skin integrity in ELBW infants	All ELBW infants receive skin team consult at admission
Stool contamination of central lines	Staff education on importance of line placement as far from ostomy sites as possible; lines anchored away from ostomy and diaper areas during line changes

PICC: peripherally inserted central catheter, ELBW: extremely low birth weight (<1000g)