



2.0

HOURS

Continuing Education

CLABSI Reduction Strategy

A Systematic Central Line Quality Improvement Initiative Integrating Line-Rounding Principles and a Team Approach

Kerry A. Wilder, MBA, BSN, RN; Brittany Wall, MSN, RN, NNP-BC, CPNP-PC/AC;
David Haggard, DNP, RN, NNP-BC; Tiffany Epperson, MSN, BSN, RN

ABSTRACT

Background: Central line–associated bloodstream infections (CLABSI) are the most common hospital-acquired infections costing hospitals millions of dollars annually. An evidence-based practice literature review revealed that utilizing a systematic team approach for proper line maintenance is effective in reducing CLABSI rates.

Purpose: The purpose of this quality improvement initiative was to reduce the CLABSI rate in the neonatal intensive care unit from 3.9 per 1000 line days in 2011 by at least 50% in 2014. Policies, protocols, team members utilized, competencies, and techniques were created and a formal line-rounding and dressing change competency was established. The competency included specific criteria for performing daily line rounds and a 2-person sterile technique for dressing changes.

Findings/Results: Central line–associated bloodstream infection rate was effectively reduced from 3.9 in 2011 to 0.3 per 1000 line days in 2014, with an overall 92% improvement.

Implications for Practice: Introduction of a dedicated CLABSI team has been shown to be effective in the reduction of CLABSI rates in the neonatal intensive care unit.

Implications for Research: Further research is needed to evaluate how a team approach could be used to reduce other hospital-acquired conditions; catheter-associated urinary tract infection, and hospital-acquired pressure ulcers.

Key Words: central venous line, children's hospital neonatal database, CLABSI, chlorhexidine gluconate, infiltration, interventional radiology, neonatal ICU, PICC, quality improvement, solutions for patient safety, sterile tubing change

According to the American Hospital Association, a central line–associated bloodstream infection (CLABSI) occurs when bacteria or other microorganisms enter the bloodstream through a central line and cause infection.¹ The Centers for Disease Control and Prevention (CDC) cites that in recent years, adoption and implementation of evidence-based practices, such as bundled central line interventions, have significantly decreased CLABSI rates.² “An estimated 30,100 CLABSI's occur in intensive care units of acute care facilities each year across the United States.”² While a 44% national reduction in CLABSI's occurred between 2008 and 2012, further improvement is needed. Patient harm due to hospital-acquired CLABSI's continues to take place. Medically fragile infants are at high risk for encountering CLABSI's during their stay in the neonatal intensive care unit (NICU) and are defenseless

compared with physiologically more mature newborns. Infants receiving care in the NICU have been shown to experience wide variation in clinical care and outcomes. Therefore, the utilization of line maintenance teams provides the needed standardization of care for these lifelines.

SETTING

This quality improvement project took place in a 36-bed level IV NICU affiliated with a large academic medical center located in the southwest United States. The unit is composed entirely of infants born at referral facilities. Because of our patient population, intravenous access is frequently limited because of multiple failed intravenous attempts at referring facilities. This reality can make it difficult for the nursing staff or the medical team, defined as the neonatal nurse practitioner (NNP) or the neonatologist, to place peripherally inserted central catheter (PICC) lines, and, therefore, interventional radiology (IR) and surgery were often utilized.

Central line days increased from 2300 line days in 2011 to 3880 line days in 2014, with an average of 11 central lines per day. Central line days are expected to increase with the increase in population and size, thus making meticulous standardization and quality care practices crucial as the NICU continues to grow.

Author Affiliation: Children's Health, Dallas, Texas.

We would like to thank NICU and hospital leadership for their support and guidance during this most important quality initiative: Jim Moore, MD, PhD; Lisa Mason, RN, BSN, MBA, MHA; Infection Prevention department; Hospital-wide CLABSI committee.

The authors declare no conflicts of interest.

Correspondence: Kerry A. Wilder, MBA, BSN, RN, Children's Health, 2222 Welborn Street, Dallas, TX 75219 (Kerry.wilder@childrens.com).

Copyright © 2016 by the National Association of Neonatal Nurses

DOI: 10.1097/ANC.0000000000000259

BACKGROUND KNOWLEDGE/LOCAL PROBLEM

In 2011, PICC dressings were managed by the NNPs assigned to the infant's care team. Assessments of when dressings required changing were found to have a lack of consistency. Dressings in need of change were often overlooked and the importance of careful maintenance and assessment was not present secondary to the urgency of other needed procedures, as well as conflicts with time due to academic rounds. Data related to dressing changes were not tracked and no specific competency tool or protocols existed for PICC and central venous line (CVL) maintenance. For example, if the bedside nurse felt that the dressing was lifting at the edges, and called the NNP to the bedside for a dressing change, the NNP may not agree with the decision, leading to a great deal of discomfort for nursing staff. On the contrary, many infants were found to have multiple dressing changes per day on the basis of variances in dressing change criteria. In addition, central line dressings were frequently changed using a 1-person technique without utilizing full sterile technique (ie, cap, mask, gown, gloves), thereby contributing to a higher likelihood of sterile field contamination, as well as increasing the frequency of inadvertently dislodging the PICC line. In addition, the IR department was utilized to place PICC lines in infants known to be difficult to access. The standard for IR during this period was to suture PICC lines as a means of line securement. This practice increased the frequency of PICC dressing changes needed, as many dressings were found to be saturated with blood after insertion, thereby suspected to contribute to an increase in the NICU CLABSI rate.

INTENDED IMPROVEMENT

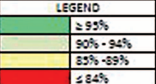
In 2011, our NICU CLABSI rate was almost triple the nationwide Children's hospital benchmark average. Therefore, a concentrated effort to design a bundled approach focusing on hand hygiene, central

line insertion checklists, scrub the hub, sterile cap/tubing change frequency, and prompt central line removal was initiated.³ However, gaps (timing of dressing changes, inadvertent removals) existed in dressing changes and line maintenance techniques. Data were extracted from an internal quality event reporting system and utilized to create our process for improvement.

The first step in planning the quality initiative was the formation of a 2-person line-rounding and PICC dressing change team to plan, develop, implement, and evaluate this process improvement project. The line maintenance model during this time frame was for each provider to evaluate and address issues for their team of patients. This led to increased variability in assessment and intervention. Recognizing the existing inconsistencies, a 2-person team (NNP team leader and NICU quality program manager) began assessing every central line dressing 5 days per week together, with the initial goal of developing a standard for what set of criteria constituted a dressing change. Daily monitoring of all central lines provided an opportunity to gather the information needed for the team to respond promptly if dressing integrity was compromised or catheter complications occurred. During this time, members of the dressing change team were keeping track of all data in a log book, which was managed by the NICU quality manager. Based on the findings, a line-rounding tool was developed with specific criteria to evaluate each PICC dressing every day. In addition, this role modeling strategy aimed at creating a culture where dressing changes became a top unit priority. This approach later became formally known as line rounding (Figure 1).

The interventions selected to mitigate these gaps were based upon initiating a focused group of highly skilled healthcare providers to assess and maintain neonatal PICCs as well as central vascular access devices. A thorough literature review demonstrated that a dedicated central line maintenance team in the NICU is essential to the improvement of CLABSI rates.⁴

FIGURE 1

NICU	INSERTION		COMPLIANCE with MAINTENANCE BUNDLE							No. of Maintenance Audits	
	Insertion	Assessed line necessity	Tubing dated and date is correct	Dressing dated and date is correct	Dressing clean, dry, and intact	Tubing up and away from potential contamination	Protective overlay (mud flap) correctly placed if needed	PICC: Securement device present & beneath dressing	AON		
Jan-13	100%	100%	100%	97%	95%	100%	88%	99%	92%	616	LEGEND 
Feb-13	100%	100%	100%	98%	93%	100%	85%	100%	91%	624	
Mar-13	No audits	100%	100%	100%	94%	100%	100%	100%	93%	464	
Apr-13											
May-13											
Jun-13											
Jul-13											
Aug-13											
Sep-13											
Oct-13											
Nov-13											
Dec-13											

Compliance with line rounding. AON, "All Or Nothing" Principle; NICU, neonatal intensive care unit central line; PICC, percutaneous inserted central catheter.

Following the development of dressing change guidelines, the NICU PICC line policy was updated and a new PICC line maintenance competency as well as central line maintenance record was developed. The PICC maintenance team was selected by a multidisciplinary committee (quality, NNP, nursing clinical manager) based on interest, verbalized commitment, skill level such as being an experienced NICU nurse (minimum of 3-5 years), history of demonstrating attention to detail, flexibility, and evaluation by peers to be team players. Standardization was the goal in an effort to decrease line-rounding subjectivity/variability as the PICC maintenance team expanded. Our long-term goal was to provide 24/7, 7 days per week line-rounding coverage.

A line-rounding audit tool was also developed to track the number of daily central lines, reasons for dressing change recommendations, and plans for central line removal. To measure compliance with the said interventions, direct observation audits were performed with each central line dressing change, with the expectation that the auditors interrupt practice when they witnessed a breach in sterile technique. "Quality Improvement (QI) programs are an integral component of a hospital's PICC program. Data gathered through this process guide decision making to positively affect patient care."⁵

To familiarize staff with the new Neonatal PICC and CVL team, bedside education was implemented and barriers (workflow changes, time commitments, individual vs team ownership, and lack of leadership) were addressed through a multidisciplinary leadership team approach comprising medical director, nursing/NNP management, and quality manager. The team met on a weekly basis to discuss and

determine the root cause(s) of issues identified. Based on the findings, a line-rounding audit tool was developed by the quality manager and NNP team leader with specific dressing change criteria for evaluation. Families were also educated and invited to partner with the NICU PICC team by letting the bedside nurse know when they visualized dressing issue(s) such as transparent occlusive dressing edges peeling up. According to a review by Westergaard et al,⁶ continual education of healthcare workers and parents has been shown to decrease the incidence of CLABSI in CVLs.

METHODS OF EVALUATION

Data were obtained from direct observation during our internal daily line-rounding process. Specific objective criteria were developed on the basis of the literature and our own findings to standardize the dressing change process. Recommendations included

- blood/drainage pooled around the insertion site >0.5 cm
- blood tracking up the catheter >25% of the line
- edges of the tegaderm peeling up/tenting and close to the insertion site or securement device within 0.5 cm in diameter
- measuring tape used for accuracy
- exposed catheter wings
- insertion site erythematous
- Biopatch soiled and/or 7 days old
- length of external line noted in electronic health record
- Two weeks since last PICC dressing change
- dressing labeled with initials and date (Figure 2)

FIGURE 2

- Tip of wing exposed
- Perform dressing change per protocol



Before and after dressing.

- Line with appropriate dressing per protocol



A 2-person PICC dressing change technique was implemented, and ongoing communication throughout the dressing change between participants was strongly encouraged. Neonatal nurse practitioners were identified as super user/resource for dressing changes. Training for the NNPs, consisted of each NNP participating as an observer for 2 dressing changes and then moving into the role of assistant. Each NNP was asked to complete 5 successful dressing changes under the direct supervision of a dressing change team member. Competencies (ie, checklist) were utilized to track progress of all dressing changes.

Two-Person PICC Dressing Change Procedure

All dressing changes were done using sterile technique with those involved wearing sterile gloves, sterile gown, mask, and hat. There were enough personnel to provide comfort to the infant during the procedure and allow for one individual to stabilize the catheter (secondary person) while the other performed the dressing change (primary person).

Prior to the procedure performed, members of the PICC maintenance team verified the correct patient by matching the infant's name with medical record number and patient identification band before beginning.

Supplies

- PICC line dressing change kit
- Three swabs of chlorhexidine gluconate 2%
- Occlusive dressing (if a larger one is needed, then what is provided in the kit)
- Securement device (if an appropriate type is available for the catheter inserted)
- Two pairs of sterile gloves
- Masks
- Hats (surgical caps)
- Two sterile gowns
- Two sterile towel packages
- Suture removal kit

Procedure

- Patient was positioned and curtain or door to the patient's room was closed.
- The team donned their hat and mask.
- Opened both packages of sterile gowns. Opened and dropped a sterile glove package onto each gown.
- Percutaneous inserted central catheter dressing change kit was opened using sterile technique on a covered procedure cart to provide a sterile field. The suture removal kit was set aside for use in removing the old dressing. Bedside staff registered nurse (RN) watched the sterile field while PICC maintenance team left to scrub.
- Team performed hand hygiene with a 3-minute surgical scrub from fingertips to elbows.

Primary Role

- Donned sterile gowns and gloves. The primary person put on a second pair of sterile gloves (provided in the PICC dressing change kit) over the first pair of gloves. These were considered "dirty" and were used in removal of the old dressing.
- The primary person placed 1 drape under limb and line. The secondary person placed a sterile drape over the remaining exposed infant, including the face.
- The primary person removed the old dressing. The dressing was lifted off the skin by stretching it outward and pulling toward the insertion site.

Secondary Role

- The secondary person was responsible for holding the catheter at the insertion site as the dressing was lifted to ensure that the line did not migrate out.
- The primary nurse placed a sterile drape underneath the limb and line to create a sterile field.
 - The infant's limb was lifted off the drape and a second drape was placed over the limb. The third person assistant (bedside nurse or patient care technician) removed the remaining "dirty" glove.
 - The primary person removed the securement device while the secondary person held the insertion site (Figure 3)

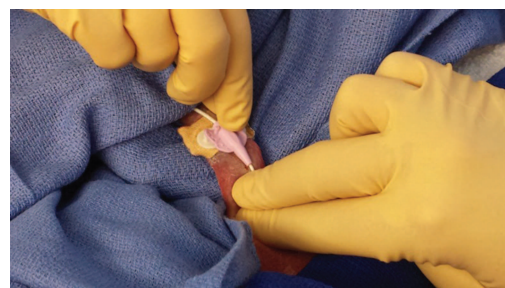
The central line site was assessed for the following:

- External length of the catheter to determine whether the external length of the catheter has changed.
- Swelling, redness, or exudate.

Support Services

- Support services were utilized when the PICC maintenance team identified active infants who may be difficult to manage during dressing changes.

FIGURE 3



Securement device removal.

Skin Preparation

Using friction, the team cleansed the area under the dressing with chlorhexidine gluconate 2% under the following recommendations:

- Three swabs of chlorhexidine gluconate 2% were utilized
- Cleaned for 30 seconds using friction
- No wiping or blotting
- Allowed chlorhexidine gluconate time to dry completely
 - If neonate did not meet criteria for chlorhexidine gluconate 2%, 3 betadine swabs were used. After betadine dried (2 minutes), sterile saline wipes were used to remove betadine from skin.³
- Catheter was positioned so not to overlap on itself. The catheter was anchored with a sterile steristrip across the hub and/or by a securement device. A securement device shall be utilized at all times, if the appropriate catheter-specific type is available.⁷

A transparent occlusive dressing was placed over the insertion site, covering the site and hub of catheter (Figure 4). If a securement device was used, we ensured the dressing was completely covered by the transparent dressing.

The team did not remove any protective personal equipment until insertion site and securement device were completely covered by the occlusive dressing.

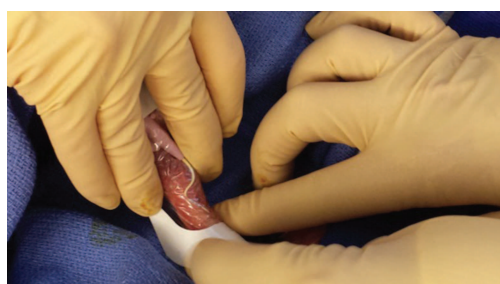
Chevron Technique for Securement

- A steristrip (adhesive side up) was placed under the catheter via chevron technique as close as possible to the transparent dressing in an effort to provide extra securement.
- The team labeled the dressing with the date and initials of both the primary and secondary persons.

Documentation in the Electronic Medical Record

- Length of external catheter
- Site appearance (including what sutures look like if present)

FIGURE 4



Tegaderm placement.

- What was used for site cleansing (betadine, chlorhexidine, etc)
- Removal of sutures and/or biopatch
- Patient's tolerance of procedure

Education

- Provide parent/legal guardian education, as appropriate.

Throughout this process, RNs were also educated and became “super users” on the dressing change team. The intent was to include a small number of RNs and NNPs who would be trained to utilize a standardized approach in order to limit the total number of participants and thereby mitigate differences in practice. A secondary anecdotal finding of this collaboration was that the nurse and NNP relationships underwent a shift in their dynamics. With the added time working together to ensure dressing changes were conducted in an appropriate manner, the RN and NNP staff fostered better working relationships. During this time, fourth quarter 2012—first quarter 2013, the team expanded quickly and once again subjectivity existed among team members, thus contributing to several CLABSIs over a 7-month period. Upon reviewing the data, it was clear that a permanent line maintenance team was needed to ensure a top-quality standard. According to the 2015 Neonatal Association of Neonatal Nurses PICC guidelines, using a dedicated team significantly improves patient's safety, outcomes, and infection rates.^{5,8}

After much discussion, a 3-person CLABSI team model was created to provide the desired coverage. Interested candidates were interviewed and selected by a multidisciplinary team consisting of an NNP, RN, clinical manager, and quality manager. Roles and responsibilities, orientation program, and scheduling processes were formalized. The team was dedicated to CLABSI reduction, out of staffing numbers on a 6-hour per day basis, 7 days per week (Table 1).

The team also provided bedside staff education for all of the CLABSI bundle elements to standardize practices and decrease variation. The team also instituted positive rewards when staff followed protocols. The bloodstream infection Beat newsletter was created and implemented to share process improvement cycles, CLABSI days since last infection, and monthly reminders with bedside staff. An end of shift report checklist was sent by the team to include the quality manager, clinical manager/team leader, and the chief quality officer as a way to ensure continuity of hand off communication.

Central line-associated bloodstream infection bundle elements were addressed during this phase of education. Neutral caps were instituted at our organization in 2012. Cap change frequency and sterile cap change technique was followed according to our

TABLE 1. CLABSI Maintenance Team Cost

Bedside RN	Average Pay	Hours	CLABSI Maintenance Team Hours	Weeks/Year	Total Team Cost
RN × 3	\$35.75/h	3 RNs × (2) 6-h shifts per week per RN	(6) 6-h shifts = 36 h/wk	52	\$66,924

Abbreviations: CLABSI, central line–associated bloodstream infection; RN, registered nurse.

hospital policy. During this time, the NICU systematically expanded from 14 to 36 operational beds over 18 months. Every 96-hour cap change frequency, as identified as best practice by the Centers for Disease Control and Prevention, was difficult for bedside staff to maintain compliance.³ Gaps in documentation, use of float staff, and traveling nurses were key factors contributing to the lack of compliance. After a review of the literature, it was noted that an every Monday/Thursday cap change methodology could be considered as an accepted variation in practice.⁸ After approval from the hospital infection prevention team, the change was implemented.

As part of a national multicenter Neonatal Children's Hospital Collaborative (2011-2013), our NICU implemented a sterile tubing change methodology. Through a direct observation and use of a 2-person sterile tubing change process, every line entry was audited and strict compliance was followed. If a breach in sterile technique was noted, the process was stopped and staff were provided with real-time education.⁹

Chlorhexidine gluconate (3.15%) was implemented in fourth quarter 2013 for scrubbing the hub before accessing central lines. Authors from the *Journal of Pediatric Surgery*, 2011, acknowledge that the use of chlorhexidine for hub care may assist in the prevention of infection via the CVL route by improving sterility when the line is accessed to draw blood or administer total parental nutrition.¹⁰

After the intensive CLABSI bundle standardization and education by the PICC maintenance team, we noticed that PICC lines inserted by IR and surgery often times still required dressings changes 24 to 48 hours postinsertion. We were using different products to assist us; however, we found that we used only small portions of these products and were wasting the majority. From a cost perspective, we researched other options and located a commercially sold hemostatic product. This product was said to "cause rapid dehydration of blood, absorption of exudate and creation of a seal at the site that does not depend on the body's natural clotting mechanism to form a seal."¹¹ Furthermore, this product was utilized in both powder and disc form whereby the seal "created a hostile environment for bacteria via a low pH on the distal side of the seal, near the insertion site."¹¹ Once piloted, this product

eliminated the need for 24- to 48-hour postinsertion dressing changes. We also utilized this product proactively with central lines found to be in close proximity to a tracheostomy, ostomy site(s), or in groin area(s).

ANALYSIS

Creating a small dedicated team, who took ownership of every aspect of the CLABSI reduction program, and keeping the bedside staff abreast of the number of days between infections, our Level IV NICU was able to decrease the CLABSI rate by 92%, equaling a reduction of 7 CLABSI infections over 3 years.

In addition, the quality improvement initiative saved the hospital \$327,238.34 (cost of care—team cost) while decreasing the length of stay by approximately 17.6 days.

OPPORTUNITY CALCULATOR/PROJECT FINDINGS

The Opportunity Calculator, as defined by Health Research and Education Trust,¹² 2009, proposed a way to highlight cost savings, mortality, and length of stay by assigning a value for each of the following per CLABSI: (a) ~\$45,000, (b) 18% mortality, and (c) length of stay extended by 13 inpatient days⁵ (Table 2)

Multidisciplinary collaboration was necessary for success of this quality improvement initiative. Staffing the CLABSI maintenance team required creative reorganization utilizing the following internal methodology:

- 3 Full Time Equivalents:
 - Bedside shifts per week
 - ⊗ (9) 12-hour shifts reduced to (6) 12-hour shifts
 - Created a total of 36 hours out of staffing per week
 - Lost only (3) 12-hour shifts per week
 - CLABSI maintenance team shifts per week
 - ⊗ (3) 12 hour bedside shifts were reallocated to (6) 6 hour CLABSI Team shifts per week
 - Created 36 hours per week dedicated to the CLABSI reduction program (Table 1)

TABLE 2. Opportunity Calculator

Year	CLABSI Rate	Total CLABSI Infections	Central Line Days/Year	Mortality Rate (~18%)	Preventable CLABSI Infections	Excess Hospital Days (~13)	Cost of Care (~\$45,254 per CLABSI)
2011	3.9/1000	8	2300	18%	1.6	21	\$405,928.38
2012	1.5/1000	5	3313	18%	0.9	11.7	\$40,728.60
2013	1.4/1000	5	3679	18%	0.94	12.2	\$42,538.76
2014	0.26/1000	1	3880	18%	0.18	3.4	\$11,766.04
							Cost of care savings: \$405,928.38-\$11,766.04 = \$394,162.34

Abbreviation: CLABSI, central line-associated bloodstream infection.
^aCLABSI rate × Central line days × Mortality rate = Preventable, CLABSI infections.
^bPreventable infections × Excess hospital days × Cost per CLABSI infection = Total cost of care.

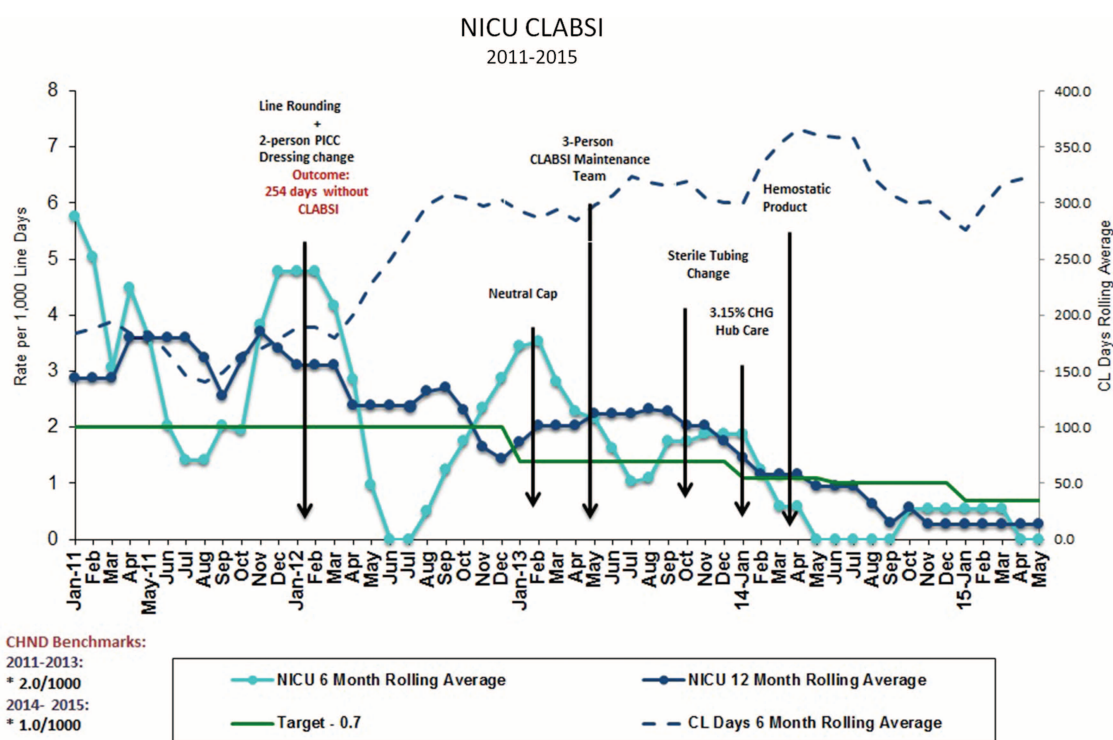
CONCLUSION

By utilizing a dedicated central line maintenance team, collaborating with key operational leaders, and implementing a central line awareness and safety-first culture to optimize quality care, our NICU demonstrated a significant reduction in CLABSI rate as well as cost savings to the organization. The NICU remains committed to providing the best in quality care. As a result of the success (both financial and quality outcome), the leadership team

has committed resources to the development of a permanent team to continue optimizing CLABSI results. Our ultimate goal is to create a system that promotes the best clinical standards and ensures the highest quality of patient care through transparency and accountability.

In addition, as a solution for patient safety organization, it is our long-term goal to eliminate preventable patient harm. Our local NICU CLABSI team will change its name (2015) from a central line maintenance team to a safety and quality team, reflecting

FIGURE 5



Neonatal intensive care unit central line-associated bloodstream infection, 2011-2015. CHG, chlorhexidine gluconate; CLABSI, central line-associated bloodstream infection; NICU, neonatal intensive care unit; PICC, percutaneous inserted central catheter.

Summary of Recommendations for Practice and Research

What we know:	<ul style="list-style-type: none"> • Multidisciplinary team approach improves CLABSI quality outcomes • CLABSI infections are costly, delay the discharge process, and negatively impact the patient/family experience
What needs to be studied:	<ul style="list-style-type: none"> • Evaluation of how a multidisciplinary team approach could be used to improve other hospital acquired infections (CAUTI, HAPU, PIVIE) and future patient safety initiatives
What we can do today:	<ul style="list-style-type: none"> • Standardize care • Be creative in reorganizing resources • Use a multidisciplinary team approach by including frontline nursing staff and quality managers in those operational decisions that impact quality outcomes • Track costs and cost savings in an effort to highlight the value of top quality standards across your organization

the work they do as their role expands. The 2015 safety and quality team will include 12 hours of coverage, 7 days per week to address more global health-care-associated conditions—catheter-associated urinary tract infections (CAUTI), health-care-associated pressure ulcers (HAPU), and peripheral intravenous infiltrations (PIVIE) (Figure 5).

References

1. AHA. Central line associated blood stream infections. <http://www.cdc.gov/HAI/bsi/CLABSI-resources.html>. Published 2013. Accessed August, 2015.
2. Centers for Disease Control and Prevention. *Central Line Blood Stream Infections*. Atlanta, GA: Centers for Disease Control and Prevention; 2015.
3. O'Grady N, Alexander M, Burns L, et al. Guidelines for prevention of intravascular catheter-related infections. In *Guidelines for the Prevention of Intravascular Catheter-Related Infections*. Atlanta, GA: Centers for Disease Control and Prevention; 2011:84-88.
4. Harnage S. Seven years of zero central-line-associated bloodstream infections. *Br J Nurs*. 2012;21(21):S6-S12.
5. Neonatal Association of Neonatal Nurses. *Neonatal PICC Line Standards*. Chicago, IL: Neonatal Association of Neonatal Nurses; 2014.
6. Westergaard B, Classen V, Walther-Larsen S. Peripherally inserted central catheters in infants and children—indications, techniques, complications and clinical recommendations. *Acta Anaesthesiol Scand*. 2012;57:278-287.
7. Lippincott Williams White. Infusion Nurses Society Practice Criteria. *INS*. 2011; 34 (S49).
8. Taylor T, Massaro A, Williams L, et al. Effect of a dedicated percutaneously inserted central catheter team on neonatal catheter-related bloodstream infections. *Adv Neo Care*. 2011;11(2):122-128.
9. Pallotto E, Piazza A, Chuo J, et al. *Children's Hospital NICU's Lower CLABSI Rates Through Planned Experimentation*. CHND; 2013. Children's Hospital Association.
10. Bishay M, Retrosi G, Horn V, et al. Chlorhexidine antiseptic significantly reduces the incidence of sepsis and septicemia during parental nutrition in surgical infants. *J Pediatr Surg*. 2011;46:1064-1069.
11. Blough L, Hinson K, Hen J. The science of a seal for PICC line management: bio seal CVC powder. *J VAS Access*. 2010;15(2): 66-73.
12. Health Research & Educational Trust. Central line associated blood stream infection toolkit. <http://www.ahrq.gov/professionals/education/curriculum-tools/clabsitools/index.html>. Accessed May, 2013.

For more than 104 additional continuing education articles related to neonatal care, go to NursingCenter.com/CE.

CE Test Instructions:

- Read the article. The test for this CE activity can only be taken online at www.nursingcenter.com/ce/ANC. Tests can no longer be mailed or faxed. You will need to create (its free!) and login to your personal CE Planner account before taking online tests. Your planner will keep track of all your Lippincott Williams & Wilkins online CE activities for you.
- There is only one correct answer for each question. A passing score for this test is 13 correct answers. If you pass, you can print your certificate of earned contact hours and access the answer key. If you fail, you have the option of taking the test again at no additional cost.
- For questions, contact Lippincott Williams & Wilkins: 1-800-787-8985.

Registration Deadline: May 31, 2018

Disclosure Statement: The authors and planners have disclosed that they have no financial relationships related to this article.

Provider Accreditation:

Lippincott Williams & Wilkins, publisher of *Advances in Neonatal Care*, will award 2.0 contact hours for this continuing nursing education activity.

Lippincott Williams & Wilkins is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

This activity is also provider approved by the California Board of Registered Nursing, Provider

Number ANC0516 for 2.0 contact hours.

Lippincott Williams & Wilkins is also an approved provider of continuing nursing education by the District of Columbia and Florida, CE Broker #50-1223. Your certificate is valid in all states.

This article has been approved by the National Association for Neonatal Nurses Certification Board for Category B credit toward recertification as an NNP.

Payment:

The registration fee for this test is \$13.95 for NANN members and \$21.95 for nonmembers.

DOI: 10.1097/ANC.0000000000000311