CE 2.3 HOURS Continuing Education

Central Line "Attention" Is Their Best Prevention

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ABSTRACT

Central line associated blood stream infections (CLABIs) are associated with an increase in length of stay, morbidity, hospital costs, and mortality. In 2009, CLABIs were on the increase at Covenant Healthcare's 55 bed Level III neonatal intensive care unit (NICU). Prior to this practice initiative, there were no standardized central line management practices in the NICU. We retrospectively reviewed the incidence CLABIs for the six months prior to the initiation of the standardization of central line management and then 3 months following the implementation of the new practice policy. Specific outcomes measured were the number of CLABIs, length of stay related to CLABIs, and adherence to the policies and procedures. The project was implemented in four phases: 1) hand hygiene, 2) "scrub the hub", 3) central line tubing changes, 4) central line insertion, removal, and dressing changes. Although there were no statistically significant changes in the outcome measures, there were clinically significant differences between length of stay and risk for central line infection, incidence of CLABIs, and an increase in adherence to the central line practice change policies. The study showed for every week that is added to the patient stay, the patient was 7 times more likely to have a CLABIs. The rate of central line infection was decreased from 15.6 percent per 1000 line days to zero in 2010.

Key Words: central line associated infections (CLABIs), central line(s), neonatal intensive care unit, practice change

Every year 250 000 central line–associated blood stream infections (CLABIs) occur in the hospital setting.[1] Patients hospitalized in any type of intensive care unit are estimated to have between 48 600 and 80 000 CLABIs.[2] These CLABIs not only put the patient at risk for mortality and morbidity but also increase the length of hospital stay and increase the cost of the hospitalization.[3] It is estimated that the approximate cost for each hospital CLABIs is $25 000.[1]

Newborns are disproportionally affected with CLABIs because of their immature immune system, frequent need for central venous access, frequency of handling, and of blood sampling from central lines.[4-10] Each time a central line is accessed, the risk for contamination and subsequent infection is increased.[11] It is believed that 10% to 20% of patients who acquire a CLABIs will die.[12] The benefits of reducing the incidence of CLABIs for the neonatal intensive care unit (NICU) population are significant and include decreases in length of stay (LOS), costs, mortality, and morbidity.[2-6,8-10,12,13]

In the NICU at Covenant Healthcare in Saginaw, Michigan, there were no evidence-based policies for central line management. The incidence of CLABIs for 2009 was 15.6 per 1000 line days. Many hospitals have implemented policies regarding insertion, removal, maintenance, and central line "bundles of care."[14,15] A central line care bundle is combining all the known best practices related to central line management and combining them to improve outcomes.[16] There is a growing body of evidence that supports the implementation of care bundles specifically targeted at reducing CLABIs. Care bundles have been introduced and popularized by the Institute for Healthcare Improvement (IHI). Care bundles are well established and now considered standard of care.[16] The components of the IHI care bundle include the following: hand hygiene, maximal barrier precautions for central line insertion,

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chlorhexidine solution for site preparation and access, daily review of line and prompt removal.[16] There are also several studies that address the care of the needleless adaptor. These studies discuss the use of 70% alcohol or chlorhexidine preparation for care; not only the solution used for cleaning but also the length of time spent on cleaning. The studies recommend at least 15 seconds using friction. This is commonly referred to as "scrub the hub."[17-19]

There are also several guidelines that help assist with the implementation of the practice change related to central line management. There were 4 specific guidelines reviewed that related to central line management. One guideline specifically addresses dressing changes related to peripherally inserted venous catheters. The other 3 guidelines refer to the establishment of central line bundles to reduce CLABIs in NICUs.[20-22]

In reviewing the specific guidelines recommended by Sharpe related to peripherally inserted central catheters, Schulman and colleagues, the National Health Safety Network, and the IHI guidelines for preventing CLABIs common themes emerged.[20-22] The first is hand hygiene, which includes hand washing, as well as the use of hand sanitizer. The use of hand sanitizers (waterless alcohol products) has been proven to be a very effective aseptic technique.[23] Hand hygiene is the first step in preventing CLABIs and other nosocomial infections.[23] Hand Hygiene is also the first step of care bundles. This speaks to the importance of this critical first step in the practice change of reducing CLABIs at Covenant Healthcare.

The reviewed guidelines also stress the importance of maintaining sterile technique at all times. This includes maintaining sterility during the insertion, dressing change, or central line tubing change. The reviewed guidelines support strongly that this process of maintaining sterile technique greatly reduces the incidence of CLABIs.[20-22]

Not only is maintaining sterile technique a key component, but having a check system in place is also important. A check system is when anyone, at any time, can inform the person they have broken sterile technique. This does not just apply during critical points in the dressing change or insertion, but also during routine care in the NICU. This strategy is aimed at creating a culture change where it is acceptable to stop someone and redirect his or her behavior.

Another area addressed by all guidelines is monitoring the integrity of the dressings of central lines. Every day the central line dressing needs to be evaluated. It can then be determined whether it needs to be changed. Not only do the guidelines address the dressing change but also evaluate the need for the central line daily. Every infant that has a central line needs to be evaluated everyday and discussed during rounds to determine whether the central line is needed. Prompt removal of central lines when they are no longer needed is mentioned in all the guidelines to reduce the incidence of CLABIs.[20-22] These guidelines combined with the studies related to care bundles help to support the central line policy practice change implemented at Covenant Healthcare.

This retrospective study was aimed at establishing a baseline comparison for the introduction of a policy change to reduce the incidence of CLABIs and increase staff compliance with policy change. It was believed that the incidence of CLABIs would decrease related to the evidence-based practice changes implemented and the strong emphasis placed on the importance of this project and potential clinical significance.

Methods

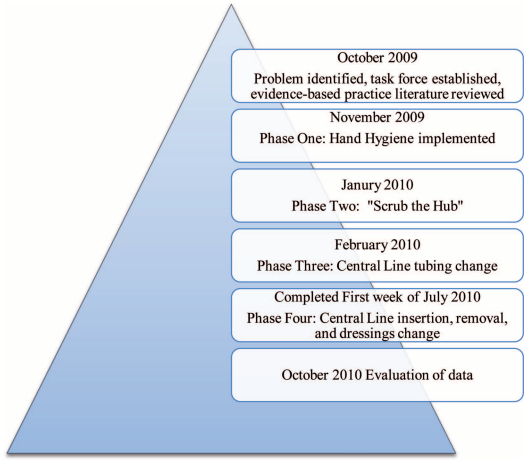
This study was approved by the institutional review board at both Covenant Healthcare and Duke Medical Center. The study design was a comparison retrospective study. The study was conducted in a 55-bed level III NICU in a community-based hospital in Saginaw, Michigan. The budgeted LOS is 17.75 days for 2010. The average daily census was 36 neonates in 2009 and 32 neonates in 2010. The sample population for this study consisted of infants requiring a central line, who were born between May and October 2009, which was a minimum of 6 months before the initiation of the care bundle, and those born between July and September 2010, which corresponded to the first 3 months after the care bundle was completely initiated. The project was implemented using 4 phases that are described in more detail further in this article.

The Centers for Disease Control and Prevention (CDC) defines *blood stream infections* (BSI) as infections that are confirmed by the laboratory and not related to any other definition criteria for infection by the CDC.[24] The CDC further explains there is no minimum time frame a central line needs to be in place for the BSI to be associated with the central line, and if the central line has been removed within a 48-hour time frame, the infection may still be associated with the central line that was removed.[24] Per recommendation by the CDC and hospital policy, the process of drawing a blood culture to determine an infection was drawn from both the peripheral and central site. The blood cultures were drawn 15 minutes apart from separate sites. Each specimen was specifically labeled to differentiate which site it was obtained from. The presence of a central line infection was determined by hospital infection control after reviewing the blood culture reports.

Description of Innovation

In neonates requiring central venous catheterization, the question was posed: Can the rates of CLABIs in the neonatal population cared for in the NICU be

FIGURE 1.



Details the timeline of implementation for the process improvement project.

reduced by standardizing the guidelines for insertion, maintenance, and removal of central lines? The first step was a formation of a committee to address, plan, develop, implement, and evaluate this process-improvement project. The committee was chaired by the medical director and consisted of neonatal nurse practitioners (NNPs), a second neonatologist, the nurse managers, nurses from all shifts, and the hospital's infection control nurse. The committee met (and still continues to meet) on a weekly basis. To increase enthusiasm for the project, the committee organized a contest among the staff to come up with a name for the project. The acronym FBI (fighting BSIs) was selected. The 4 phases of the evidence-based practice–supported initiative to prevent CLABIs at Covenant Healthcare's NICU are outlined later. Figure 1 depicts the timeline of implementation for the project.

In Phase 1, the committee reviewed the data on CLABIs for the unit and agreed that the infection rates exceeded the national norms and therefore a practice change was indicated. Thereafter, the committee reviewed the available literature on the care of central lines in the neonatal population and decided to adopt the care bundle that is outlined in Table 1.

Current practices that deviated from the proposed standardized procedure for caring for central lines were identified. This first phase of the process improvement focused on hand hygiene. Hand hygiene audits were done for the month of October 2009 to establish baseline data prior to any practice change. The audits were reviewed and the results showed that staff was compliant with hand hygiene 74% of the time before patient care, 67% of the time during patient care, and 66% of the time after patient care. A survey was also sent out to the nurses to determine perception of hand hygiene. Surprisingly, only 85% of respondents thought there was a correlation between good hand hygiene and decreased infection. The current hand hygiene policy was reviewed and

TABLE 1. Description of Previous Practices and Practice Changes Implemented

	Previous Practice	Practice Change
Phase 1: Hand hygiene	General knowledge of hand hygiene	Education regarding importance of hand hygiene
	Hand sanitizer on two walls in each nursery	Hand sanitizer at every bedside
	No observation of hand hygiene compliance	Continued audits
	Long sleeves, wedding bands worn	Policy changed nothing worn below the elbows, and no rings
Phase 2: Scrub the hub	Needleless connector cleaned with 70% alcohol wipes	Chlorhexidine 2% solution used, with friction 10-15 seconds
Phase 3: Central line tubing change policy	Clean technique, sterile at insertion point to central line	Completely sterile technique for central line tubing change
	No audits to evaluate compliance	Continued audits to evaluate compliance
Phase 4: Central line insertion, removal, and dressing change	No standardized procedure for insertion of central lines	Standardized procedure for insertion of central lines
	Necessity of line, not addressed daily	Central Line addressed daily during patient rounds
	No standardized approach to central line dressing changes	Standardized approach to central line dressing changes

modified to include no rings (including wedding bands), nail polish, artificial nails, or long sleeves. The policy was posted for the staff to review on the education Web site. The staff were encouraged to stop and remind any individual who was not following the hand hygiene policy. All staff, physicians, surgeons, and ancillary staff were made aware of our initiative. Everyone was informed that they would be reminded if there were a breach in compliance. The goal was to create a culture where, regardless of position, anyone would be stopped if there were a breach of the policy. The motto for the use of hand sanitizer was "gel in, gel out" for all encounters with the neonate. Hand hygiene audits continued to monitor compliance with the new policy.

Phase 2 began January 2010 and focused on using friction (scrubbing) to clean the line needleless connector with 2% chlorhexidine solution for at least 10 to 15 seconds. The "scrub the hub" phase was a change in process. Prior to this, the needleless connector was cleaned with a 70% alcohol solution. The staff were provided literature about "scrub the hub" and also laminated reminders were posted in the nursery.

Phase 3 was focused on the central line tubing changes. This phase began in February 2010. A sterile central line change policy was created and reviewed by the FBI committee. Prior to the policy change, the tubing changes were done using a clean technique and only using sterility at the actual connection for the tubing and the central line port. Team leaders were identified and trained first to properly change the lines. These individuals were then designated as the "experts" and could then were charged with providing demonstrations and training the staff. Education was completed with all the staff, including a return demonstration of the sterile central line change. This phase was completed in approximately 2 months.

Phase 4, the final phase, addressed insertion of central lines, dressing change, and removal of central lines. Specific guidelines were established for central line insertion. Central lines were typically inserted by neonatologists, NNPs, and a select group of transport nurses (the transport nurses only insert umbilical venous catheters). Specific guidelines were also established for dressing changes. Everyday, a neonate with a central line is evaluated to determine whether central line was still necessary and inspect the integrity of the dressing. A goal for removal was once feedings were established at 120 mL/kg/d the central line would be discontinued. Central line dressings were also evaluated on a daily basis to determine whether the dressing was still occlusive. If the dressing were soiled, or no longer occlusive, then the neonatologist or NNP would perform a sterile dressing change. A procedural checklist was also developed and given to all nurses to fill out after a central line is inserted to evaluate compliance with the insertion procedure. The checklist also evaluated sterile technique used by the inserter, number of attempts for the line, success of the procedure, and length of time until the radiography was done. This phase was completed the first week of July 2010.

Follow-up for evaluating adherence to the new policies was based on audits for hand hygiene compliance and central line–tubing changes. Tracking of CLABIs continued throughout the entire project. Every positive blood culture reported immediately triggered a detailed investigation by the NNP on call. A root cause analysis form had been adapted by the committee for investigation. The final determination of a positive CLABI was done by the hospital's infection control department by using the guidelines from the CDC.

This project was evaluated 6 months before the initiative, and the first 3 months after the initiative was fully implemented. The committee began to track the days immediately in November after the project initiation. Celebratory parties were held on the unit when the 100-, 200-, and 300-day milestones were achieved. This was done to help encourage staff and maintain the momentum that was established with the formation of the committee.

Results

Outcomes were evaluated by performing a retrospective study of CLABIs for the 6 months before the initiation of the standardization of central line management (May, June, July, August, September, and October of 2009) and then 3 months (July, August, and September of 2010) after the completion of the new policy practice. A neonate had to be admitted within the specified time frame for analysis to be included in the retrospective study. Length of stay (as some infants in the 2010 data were still admitted in the hospital) was counted until October 10, 2010. Specific outcomes measured were (*a*) number of CLABIs (*b*) LOS related to CLABIs, and (*c*) adherence to the policies and procedures.

Descriptives

Seventy-one infants were in the preprocess improvement change sample. These infants had a mean gestational age of 32.28 weeks (SD = 5.35), and a mean birthweight of 2042.70 g (SD = 1251.15 g). Their LOS ranged from 1 to 134 days, ($\bar{X}$ = 39.32, SD = 36.53) and central line days ranged from 1 to 86 ($\bar{X}$ = 17.41, SD = 18.06). Twenty-nine infants were in the sample after the completion of the process improvement project. These infants had a mean gestational age of 32.49 weeks (SD = 4.62), and their mean birthweight was 1825.59 g (SD = 1073.10). The LOS ranged from 1 to 95 days ($\bar{X}$ = 30.34, SD = 25.36) and central line days ranged from 1 to 68 ($\bar{X}$ = 12, SD = 14.2).

Outcome Analysis

We compared the incidence of CLABIs for the 6 months before the initiation of the project in 2009, to the 3 months after the final phase was completed in 2010. The incidence of CLABIs in the postimplementation group was zero. This is of great clinical significance for the unit. The rate of central line infection was decreased from 15.6 per 1000 line days to zero.

A z test for proportions revealed that the proportion of patients with CLABIs in 2009 (4.23%) is not statistically significantly different from the proportion in 2010 (0%). However, it is important to note that there is a difference in sample size. This difference in sample size could possibly contribute to the lack of significant findings in this analysis. Moreover, the clinical significance is of importance here, because there were no CLABIs in the postimplementation period.

The LOS in relation to CLABIs was analyzed using binary logistic regression, with LOS as the predictor and occurrence of CLABIs (yes or no) as the outcome. The results showed that LOS is related to CLABIs, omnibus chi-square (1) = 4.64, $P < .05$. For LOS, Exp (B) = 1.03 ($P = .04$) indicating that each week that is added to the LOS, the patient was 7 times more likely to have a CLABIs.

Discussion

The results of this project have already had significant impact on this unit. The incidence of CLABIs postimplementation is zero. Although the results of the changes may not hold statistically significant information yet, the clinical implications are apparent. It is important to note, that while the data were analyzed 6 months before the initiation of the project in 2009 and 3 months after the completion of the project in 2010, the unit had been CLABIs "free" since November of 2009. The unit had celebrated 365 days infection free in 2010.

It may be difficult to ascertain which specific changes may have contributed most to the clinical outcomes, because there were several changes that occurred within the project. We recognize that the importance of hand washing cannot be overstated. When looking at the preproject hand washing audit analysis (n = 154) there was a 30% noncompliance with hand washing. Since August 2010, there has been 100% compliance with hand washing. There has also been an increase in the amount of hand sanitizer used on the unit since the initiation and subsequent culture change within the unit.

When looking at the second phase, "scrub the hub," it is difficult to determine whether it was the solution, or the actual "scrubbing" that made the difference. No research was conducted when only 70% alcohol solution was used before accessing the hub of the catheter; therefore, one cannot make a specific correlation if it was the solution or the friction related to the scrubbing that made the difference.

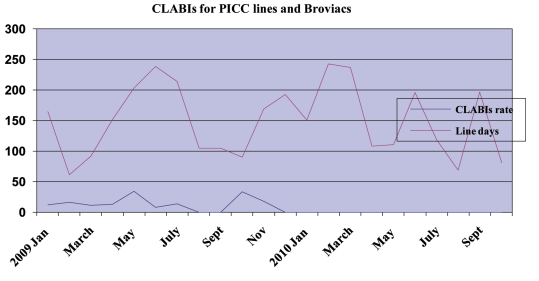
The third phase was related to the central line tubing change policy. This policy was met with the most resistance by the nursing staff. It was felt by the committee that this was related to the fact that it took more time and effort to perform the line changes. This particular phase also took the longest time to complete because every nurse on the floor was required to demonstrate proper line tubing change after review of the new policy and procedure.

The fourth phase was the central line insertion, removal, and dressing change. Not only is maintaining the sterility a key component as well in this phase, but having a check system is also important. A check system was also established when anyone, at any time, can inform the person that they have broken sterile technique. This did not just apply during critical points in the dressing change or insertion, but also during routine care in the NICU. The goal was and is to continue to foster an environment where it is acceptable to stop someone and redirect his or her behavior. In addition, of importance are the daily rounds on the neonate with a central line to determine whether the line is still needed. Removal of a central line when it is no longer needed is essential to reducing CLABIs. Therefore, every attempt is made to remove the line as soon as it has been determined it no longer necessary for the neonate.

Often, the staff may lose interest in the project. In the beginning of this project, there was a lot of emphasis and energy surrounding the initial implementation. As time went on, the emphasis may have shifted a little, and staff may change their focus. To keep the momentum of the innovation going, every week the audit results were displayed in several areas around the unit (break room, bathrooms) for the nursing staff to monitor continued progress. This was also thought to help keep the focus on the project.

To keep continued interest of the nursing staff, it was also important to make sure the nursing staff had

FIGURE 2.



Comparison of line days and CLABIs rate for 2009 and 2010.

TABLE 2. Depicts Rate of Infection Per Line Day for Each Month in 2009 and 2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2009[a]												
Line days	165	61	92	152	203	239	214	105	105	90	169	193
Rate	12.1	16.3	10.9	13.1	34.4	8.4	14.0	0	0	33.3	17.8	0
2010[b]												
Line days	151	243	237	108	111	196	119	69	197	81		
Rate	0	0	0	0	0	0	0	0	0	0		

[a] 2009
Peripherally inserted venous catheters and Broviac line days 1727.
Catheter-associated infections 27.
Rate/1000 line days: 15.6.

[b] 2010
Peripherally inserted venous catheters and Broviac line days (Jan-Oct) 1512.
Catheter-associated infections: 0.
Rate/1000 line days: 0.

access to the evidence-based practice literature. Nursing staff often feel that they are just "mandated" to abide by the new policies verses understanding the rationale behind the changes. The literature was displayed for the hand hygiene protocol change. A PowerPoint education piece was also posted on the education Web site for the nurses to view. This PowerPoint gave the evidence-based practice information to back up the changes that were going to be implemented. To maintain sustainability of this project, evidence-based practice literature , as well as more examples of success stories in the NICU, will be provided to the staff. Also, whenever there was an investigation into a positive blood culture result, the root cause analysis was displayed in the break room for everyone to read. Reminders will be posted in the monthly NICU education updates. The NICU education updates are sent out via email and there are hard copies in the break room. This will help remind the nursing staff of the progress of the innovation and what the future focus will be. This will help in reminding the staff to maintain diligence with central line maintenance.

Overall, the rate of CLABIs is decreased in the unit, and significant improvement has been made (see Figure 2 and Table 2). The rate of infection for 2009 was 15.6 per 1000 line days, and for 2010 was zero. Not only has the incidence of CLABIs improved, but also the overall culture of the unit has changed. Where it was once thought to be an acceptable part of the NICU to acquire a central line infection, this is no longer the case. With the culture change, the team is hopeful that the results from this project will eventually become statistically significant. For now, the results have been positive for the newborns who have not acquired a CLABIs during the stay in the NICU. Further monitoring of the progress will be ongoing because it is realized that for this to be sustainable "attention" has to be maintained at all times to the central lines.

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