Project Proposal on the Prevention of Central line Associated Blood Stream Infection in the Neonatal Intensive Care Unit

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In partial fulfillment of the requirements for the Doctor of Nursing Practice

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Abstract

Central line associated blood stream infection (CLABSI) is common in the neonatal intensive care unit and is associated with significant morbidity and mortality. The objectives of this study are to develop evidence-based practice guidelines to prevent CLABSI by decreasing peripherally inserted central catheter (PICC) access and line days based on achieved feeding volume and to continue the use of CLABSI bundles. The project started from June to July 2017 in three neonatal units. The project design was to implement new guidelines to decrease the use of PICC lines based on achieved feeding volumes: change intravenous (IV) medications to oral form once 80 ml/k/day was achieved and to discontinue PICC line once 120 ml/kg/day was achieved. A comparative analysis of PICC duration of use, CLABSI rates, use of CLABSI bundles, compliance with discontinuation of IV fluids and changing to oral medication in the pre- and post-implementation groups were done. Thirty-four PICCs were placed. The average line days decreased from 15.6 days to 14 days ($p=0.917$) during the intervention period. Compliance with the use of new guidelines improved from 50% to 83% for discontinuing PICC at 120 ml/k/d of feeds ($p=0.038$), and from 7% to 64% for changing IV medication to oral form at 80 ml/k/d of feeds ($p=0.007$). Compliance with use of the PICC bundles improved to 100 %. The CLABSI rate was maintained at zero. The use of the new evidence based guidelines improved significantly with decreased PICC line days, improved use of CLABSI bundles and maintained low CLABSI rates.

Keywords: Central line-associated bloodstream infections, peripheral inserted central catheters, practice guidelines, CLABSI bundles, compliance.

DNP Project Proposal on the Prevention of Central line Associated Blood Stream Infection in the Neonatal Intensive Care Unit

Introduction and Background

According to the Center for Disease Control and Prevention (CDC, 2016), central line associated blood stream infection or CLABSI is common in the neonatal intensive care unit (NICU) and is associated with significant morbidity and mortality. This leads to prolonged hospital stay and increased financial cost.

A systematic review of literature through CINHAL, PubMed Touro, Pediatrics, Neonatal Network, and CDC on CLABSI prevention using words as blood stream infection (BSI), catheter dwell time, CLABSI in neonates with peripherally inserted catheter (PICC), CLABSI and quality improvement, was completed to explore CLABSI prevention and develop an appropriate conceptual framework for a DNP project that will result in the adoption of a new clinical practice guideline that improves patient outcome.

A study by O'Grady et al. (2011) showed that CLABSI rates in the NICU ranged from 4 per 1,000 catheter days for infants with birth weight >2,500 grams to 11.3 per 1,000 for those with birth weight <1,000 grams. Several strategies for CLABSI prevention include improvements in key elements of central line insertion and maintenance, and decreased use and removal of central lines as soon as possible when they are no longer needed (O'Grady, et.al, 2011). This is imperative as frequent or prolonged use of central lines increases the risk of CLABSI (O'Grady et.al, 2011). Obviously, the absence of central line equates to the absence of CLABSI.

As a doctoral prepared leader and advanced neonatal nurse practitioner, I am committed to meeting the challenges of adapting and developing an evidence-based practice guideline to

continue to prevent and/or maintain low CLABSI rates in our NICU. Any change that will impact on the culture to preserve good outcome or prevent untoward results to patient care will have a lasting effect on the future and success of medical care. Infection prevention has and will always be a cornerstone of good medicine.

Problem Statement

A CLABSI prevention continuous quality improvement (CQI) initiative was started in 2011 using the CQI bundles for central line insertion and maintenance. The peripherally inserted central catheter (PICC) line is the most frequently used central line in our NICU. PICC is mostly placed in premature babies, especially the very low birth weight infants (less than 1500 grams), who automatically need it for total parenteral nutrition (TPN) and administration of intravenous (IV) medications (NANN, 2015). With this CQI initiative, our CLABSI rates had significantly decreased since 2015. Maintaining the success of the CQI project depends on the vigilance of the staff, especially the leadership group, on any factor that will negate the continuous success of the project. Complacency, inconsistent compliance to the program guidelines and areas of the targeted practice (central line care in this case) that are not given much attention (decreasing the use of central lines in this project proposal) can reverse the success of this undertaking. This concern was already evident in the inconsistent compliance of using the bundle forms during random audits of PICC lines at bedside. The NICU staff which includes the neonatologists, neonatal nurse practitioners and nurses, has no clear guidelines for the discontinuation of PICC line, as well as how to limit its use. These issues are major concerns, in spite of low CLABSI rates, as they will contribute to the increased risk of central line infection (O'Grady et al., 2011).

O'Grady et al. (2011) discussed several strategies to prevent central line infection that are

strongly supported by experimental studies in different categories. They include surveillance to determine CLABSI rates in category1A, monitoring trends and identifying infection control practices classified in Category IB, and investigation of unexpected life threatening results.

The PICOT question is when should the medical team discontinue PICC lines in our NICU for the purpose of decreasing the risk of CLABSI? Clear practice guidelines or protocols that limit access and set the timing of removal will alleviate this concern. These specific practice guidelines will recommend the intervention of early decreased usage of PICC lines to reduce CLABSI rate, a strategy found in Category 1 of the CDC (O'Grady et al., 2011). In this proposed study, the practice guidelines will set the limit of using the PICC line and the timing of removal based on the volume of feeds tolerated by the patient (at 80 ml/kg/day, medications given intravenously can be changed to PO administration, thus limiting access and at 120 ml/kg/day, removal of the PICC can be considered). Comparative analysis with other NICU's in the Pediatrix medical group network with regard to duration of central line usage will be done using our company's clinical data warehouse (CDW). Other data related to the problem of CLABSI will also be analyzed (i.e. compliance to using insertion and maintenance bundles and CLABSI rates). In addition, the following strategies by O'Grady et al. (2011) will be used for the surveillance and control of central line infections. These recommendations include education and training of nurses who insert PICC lines, using maximal barrier precautions during central line insertions, and using skin precautions with 0.5% chlorhexidine and alcohol for antisepsis (O'Grady et al, 2011).

The timeline for this project will be 8 weeks with weekly analysis of compliance and other data. Education of the NICU staff about the new guidelines will be done and chart reviews and audits will start after the implementation of the project.

Purpose Statement

The purpose of this DNP project was to develop and implement an evidence-based practice guideline to prevent and maintain low CLABSI rate in our NICU by decreasing the use of PICC lines.

Project Objectives

The project was conducted to meet the following objectives for the improvement of patient outcome:

1. Continue to prevent CLABSI and maintain low rates in our NICUs by decreasing the use of PICC lines through decreasing access and decreasing line days
2. To provide guidelines to the neonatologists, nurse practitioners and nurses on decreasing PICC line use based on achieved feeding volume
3. Continue to prevent CLABSI and maintain low rates in our NICUs by continuing to use the insertion and maintenance bundles for CLABSI prevention.

Project Questions

These questions were developed to specify what the DNP scholarly project would address to prevent CLABSI and maintain low rates in our NICUs:

1. How do we decrease the use of PICC lines in our NICUs?
2. How do we make sure that the insertion and maintenance bundles to prevent CLABSI are continuing to be used for every PICC line inserted?

Literature Review and Theoretical Framework for Proposed Project

The extensive review of the following literature CINHAL, PubMed Touro, Pediatrics, Medline, Neonatal Network, and appropriate selection of conceptual framework of Diffusion of Innovation Theory (DIT) will support the DNP 1 proposed project.

Diffusion of Innovation Theory by Rogers is a conceptual framework based on the theory that "the individual's adoption of any innovation involves the understanding of the characteristics of a particular guideline. This can then affect clinician's compliance". A new guideline is viewed as an innovation and defined as an idea, project or practice that leads to positive patient outcome. Diffusion of innovation theory emphasizes the role of the change agent or individual who influences decisions on the adoption of the innovation. The four stages of adoption of the DIT are identified: 1) knowledge phase that involves learning about the guideline 2) persuasive stage that involves the individual forming positive and negative attitudes about the guideline 3) testing the acceptability of the innovation in the decision phase, and 4) final stage of adoption or rejection of the guideline. Framing the theoretical research question, this scholarly DNP project would address "how to further prevent CLABSI and maintain low rates in our NICUs". The project was conducted to meet and support the proposed project's objectives for improvement of patient outcome.

The first stage of adoption of DIT conceptual framework is the knowledge phase that involves learning about the innovation. According to Erdei et al. (2015), CLABSI rate reduction is sustainable for at least 1 year, and they identified the key determinants of this sustainability at the NICU of the Floating Hospital for Children at Tufts Medical center. The study reviewed the incidence of CLABSI in the NICU after the implementation of new practices, policies and procedures from July 2008 to Dec 2013. The study discussed that very low rates of CLABSI are

"achievable" but maintaining a zero CLABSI rate continues to be challenging.

This 5-year study showed that adoption and implementation of evidence-based measures for catheter care could lead to reductions in CLABSI rates in the NICU. The inclusion criteria included infants in level III NICU, who have critical medical and surgical conditions with PICC and positive for CLABSI. Erdei et al. (2015) defined CLABSI as a blood stream infection due to the presence of a central line, up to 48 hours of a central line being removed, with the absence of another source of infection. In addition to part to the Erdei study (2015) and per NICU Hospital System Infection policy, 2 sets of peripheral blood culture from 2 different sites are done. Exclusion criteria included infants with secondary infections or positive blood culture interpreted as contaminant (positive blood culture in only 1 out of 2 blood cultures if common skin flora grew). The study showed that the use of standardized care practices that included CLABSI bundles and checklists were associated with significant reduction of the CLABSI rate to zero for >370 consecutive days in 2012. However, there was an increase in CLABSI rate to 3.3 per 1000 line days in the first quarter of 2013. After shared several interventions, CLABSI rate was at zero for >600 days. The study further showed that "high quality ongoing training of the staff, surveillance of catheter line insertion and maintenance practices, decreased line days, and improved documentation were key drivers to success." All these variables led to significant reduction in CLABSI. The study further discussed a change in clinical practice to reduce line days through the introduction of strict feeding protocols that entailed discontinuation of central catheters when a volume of 100ml/kg/day was reached. Compliance was tracked through strict data collection, monitoring and auditing system. The last part of the study compared their CLABSI rate with the published National Healthcare Safety Network (NHSN) data as a benchmark.

O'Grady et al. (2011) also discussed several strategies to prevent central line infection that were strongly supported by experimental studies in different categories. The authors included surveillance to determine CLABSI rates in category1A, monitoring trends and identifying infection control practices in Category IB, and investigation of unexpected life threatening results. The summary of recommendations included education and training of health care personnel regarding indications for vascular catheter, proper procedures for insertion and maintenance and appropriate infection control measures to prevent intravascular catheter related infections. These include the use of central catheter cart, checklist to ensure adherence to practices, sterile barrier precautions, antibiotic prophylaxis and prompt removal of central lines as soon as it is not needed. Signs that indicate the occurrence of CLABSI, like vascular insufficiency or thrombosis, must be noted. If managed aseptically, central lines can be used up to 14 days (O'Grady et al., 2011) The study also discussed the use of collaborative-based performance improvement initiatives in which multifaceted strategies are bundled to improve compliance by using evidence -based recommend practices. The quality improvement strategies target primarily educational interventions such as hand hygiene, use of maximal sterile barriers during insertion, use of chlorhexidine and prompt removal of unnecessary catheters if no longer needed. Finally, the study emphasized performance improvements and quality assurance in all programs. The interventions were to improve reliability of care and focus on making the implementation of best practice easier to achieve "(O'Grady et al., 2011).

Milstone et al. (2013) explored whether the risk of CLABSI increases over the dwell time of peripherally inserted central catheters (PICC) in high- risk neonates. This study is the first multicenter study to examine the association between dwell time and CLABSI. Multicenter retrospective cohorts of NICU patients with PICC inserted from January 2005 to June 2010 were

studied. Inclusion criteria included all PICC associated CLABSI in all NICU of participating hospitals with criteria from the CDC and NHSN. The NHSN CLABSI definition includes two or more positive blood cultures drawn on 2 separate occasions for common bacteria such as coagulase negative staphylococci. Exclusion criteria included all PICC that did not meet NHSN criteria of having 2 positive blood cultures drawn on 2 separate occasions for common bacteria. The incidence rates were calculated to assess the risk of developing CLABSI as a function of PICC dwell time. Results showed an increased risk of CLABSI in neonates with concurrent PICCs. The incidence of gram negative CLABSIs were greater in PICCs with increased dwell times of >50 days. The data confirmed that the daily risk of infection was higher in PICCs that had been in place for > 2 weeks. However, there was no evidence that the daily risk of infection changed after the 2-week time point. The decision to remove a functioning PICC must consider the daily risk of infection and complications associated with PICC replacement. In this project, several considerations were discussed: PICC maintenance bundles that include hand hygiene before contact with the catheters and thorough scrubbing of the catheter hub, compliance with PICC insertion bundle and early removal of PICC catheters. In conclusion, the data confirmed the risk of CLABSI increased after the first 2 weeks of PICC insertion and remained elevated after. Health care workers should review daily the need for PICC, remove the PICC if not needed, and optimize practices in maintaining the catheter to prevent infections (Milstone et al., 2013). However, Milstone et al. concluded that there is a need for further studies to determine additional measures to reduce the risk of infection for neonates with prolonged PICC dwell time.

The CDC reported a decrease in incidence of CLABSI in hospitals by 46% from 2008-2013, although an estimated 30,000 CLABSI infections still occur in intensive care units in the US acute care facilities each year, resulting in prolonged hospital stay and increased cost and risk

of mortality. (CDC,2016, p.41). Surveillance and managements of PICC bundles were discussed with primary and secondary blood stream infection (BSI) guidelines. Specific examples of determining a CLABSI versus BSI definition were discussed. Guidelines for specific patients of interest, the < 1 year old include the following – fever (>38C) or hypothermia (<36C), or apnea and bradycardia, with organism not related to infections at another site. This article emphasized on the management practices of central lines, surveillance for CLABSI in ICU settings, specialty care areas, NICU, long-term facilities and wards, and prompt reporting of CLABSI incidences to NHSN.

Greenberg et al. (2016) also investigated the effect of catheter dwell time on the risk of CLABSI. The authors defined CLABSI using the NHSN criteria. Dwell time is defined as the number of days from line insertion until line removal. Inclusion criteria included infants with PICC or tunneled catheters obtained from NCLABSI from Sept 2011 to August 2013. Central lines that were inserted and discontinued within the first 2 days were excluded from analysis. The study also excluded PICC done for surgical babies. The retrospective cohort study showed that increased dwell time was not associated with increased risk for PICC's but the risk increased for tunneled catheters in week 7 and week 9 compared to week1. The authors concluded that clinicians should consider removing tunneled catheters before week 7 if no longer needed. They also showed that the use central venous catheters, used to provide medications and nutrition to sick infants in the NICU, were associated with increased risk of infection. But replacing catheters unnecessarily for fear of infection was dangerous. It was of serious consideration to remove tunneled catheters that are longer than week 7. This study concluded that "clinicians should focus their efforts to reduce CLABSI on proper maintenance and timely removal when the line is no longer needed". The removal of PICC is when infants achieve 120ml/kg/day of enteral feeds

and techniques for senile dressing change and catheter access. The study also concluded that there should be additional studies that can identify and describe particular central line practices that may decrease the risk of infection.

The persuasion stage of DIT involves individuals forming positive or negative attitudes toward the innovation. The DNP project will recommend the reduction of CLABSI rate to zero or maintain low CLABSI rate with new guidelines of changing intravenous medications to oral administration once at 80 ml/kg/day of feeds and PICC s are discontinued once enteral feeds are at 120 ml/k/d. The proposed new guidelines were presented to the medical group of neonatologists and neonatal nurse practitioners in the monthly meeting. The approved recommendations were presented to neonatal intensive care nurses, charge nurses and nurse managers, and infectious disease coordinators in the annual CLABSI Summit.

The third stage of DIT tests the acceptability of the innovation in the decision stage. After the guidelines are presented to the medical group and NICU staff, as a DNP practice leader and CLABSI CQI member, this author would facilitate vigilant monitoring of chart audits and random bedside checking of babies with PICC lines. Compliance with the new guidelines will also be followed by checking medical orders by neonatologists and advance nurse practitioners to change IV medications to oral route at 100 ml/k/day of feeds and discontinuation of PICC at 120ml/kg/day of feeds. As a DNP leader and advance nurse practice, it is essential to use nurse empowerment by facilitating a transfer of project results into practice by raising awareness of the new innovation.

The final stage of DIT is characterized as the acceptability or rejection of the innovation. Using nurse empowerment strategy to encourage adoption of the innovation, the implementation of the CLABSI project will be tested by the rate of compliance of medical personnel in the use of

practice. In the study of Moulding et al. (1999), guidelines are more accepted if they were endorsed or promoted by a respected peer. The CLABSI team, under the leadership of Dr. Cruz, has fully endorsed these new guidelines.

Project Design

The purpose of this DNP project is to develop and implement an evidence-based practice guideline to prevent CLABSI and maintain low rates in our NICU by decreasing the use of PICC lines.

The project design is to evaluate the implementation of the new guidelines, as part of the CLABSI continuous quality improvement (CQI) project, to decrease the use of PICC lines based on achieved feeding volumes: 1. Change IV (intravenous) form of medication to PO (per Orem) form once 80 ml/k/day is achieved and 2. Discontinue PICC line once 120 ml/k/d is achieved.

A comparative analysis of PICC line dwell time or line days in 2 groups of PICC lines placed was done - group A, the pre-implementation group, are those PICC lines placed within 4 weeks before the implementation of the new guidelines, and group B, the post-implementation group, are those PICC lines placed within 4 weeks after the implementation of proposed guidelines. Compliance with the new guidelines of when to change IV medication to PO form and when to discontinue PICC was analyzed as well as the compliance with the use of the IB (insertion bundle) and MB (maintenance) forms. Chart reviews were done and data were obtained from the following:

1. Clinical data warehouse (company's database) was used to collect data for PICC lines inserted and PICC dwell time or line days
2. Cerner (hospital system's database) was obtained data for compliance using insertion

bundle if the insertion bundle form is missing and dates when PO medication is started.

3. CLABSI CQI insertion and maintenance bundle forms
4. Hospital system's Infectious Disease report

Other strategies for the project includes: education, training, and empowerment of the NICU nurses who insert central catheters and advocacy for bedside nurses who are ultimately responsible for each PICC line (CDC, 2016) and use of signs and posters of CLABSI reminders.

Population of Interest and Stakeholders

The populations of interest are all PICCs placed within 4 weeks before the implementation of the new guidelines and all PICC placed within 4 weeks after the implementation of the guidelines. The three level three NICUs include: 1. the 52-bed unit with 500-600 admissions per year, 2. the 27-bed unit with 300-400 admissions per year, and 3. the 15-bed unit with 200- 250 admissions per year, all located in Southern Nevada.

The Stakeholders are the medical providers made up of neonatologist, advance nurse practitioners, NICU medical directors, NICU nurses, and infectious disease (ID) coordinators. The ID coordinators are the ones who monitor CLABSI occurrences and prepare the reports for the hospitals.

Recruitment Methods

All PICC lines placed were included. Being a CQI project, charts were audited to obtain and monitor compliance levels. PICC as the identifier will be used for chart review and obtain some characteristics of the population. No parental consent was needed, as this is part of the ongoing CQI project. As each PICC line is placed, the compliance to the guidelines from

insertion to maintenance up to its removal was followed thus obtaining dwell time or line days. The consequent CLABSI rate was obtained from the report of the ID coordinators and not from the patient chart review.

Tools and Instrumentation

The proposed DNP project used the hospital's Cerner database and the practice's clinical data warehouse (CDW). CDW is a Health Insurance Portability and Accountability (HIPAA) consisting of information on patients admitted to the NICU. SPSS program was used to analyze compliance, CLABSI rates and dwell time (line days) in the pre- and post- implementation groups.

Audit tools used in the CLABSI improvement project were selected for the proposed project and include: 1) central line insertion safety checklist that include hand hygiene, time out, use of maximal sterile barriers during insertion, use of chlorhexidine, and radiologic confirmation of PICC locations, 2) central line maintenance random audit will be used to monitor strategies that include hand hygiene, PICC dressing integrity, PICC sterile care with IV hubs, and 3. PICC monitoring when IV medications changed to PO form and time PICC is discontinued at certain volume of feeds.

Data Collection Procedures

The new guidelines to decrease PICC line use based on achieved feeding volume were presented for implementation on July 15, 2017. Chart reviews and data gathering were started June 1, 2017, 4 weeks before the implementation date, for the pre-implementation group (Group

A, weeks 1-4), and on July 15 to August15, 2017, for the post implementation group (Group B, weeks 5-8), up to 4 weeks after the implementation date.

The advanced practice nurses of the medical group who are part of the CLABSI quality improvement project in which the author is a member, continued with data collections and daily audits of all PICC inserted in our three level 3 NICUs. The following data were gathered:

1. The total number of PICC lines placed per week
2. The weekly CLABSI rate.
3. Demographics of PICCs users inserted during the study period (gestational and birth weight).
4. The total and average duration of PICC
5. Compliance with discontinuation of IVF at 120 ml/kg/day of feeds.
6. Compliance with changing of IV medications to PO at 80 ml/kg/day of feeds.
7. Compliance with the use of insertion and maintenance bundle forms
   a. Compliance with the use of the insertion bundle checklist

      Number of patient with a PICC who have an insertion bundle checklist filled up divided by the number of patients with a PICC multiplied by 100 to express the measurement as a percentage.

   b. Compliance with the use of the maintenance bundle checklist

      Number of patient with a PICC who have a maintenance bundle checklist filled up divided by the number of patients with a PICC multiplied by 100 to express the measurement as a percentage.

A statistician was also consulted to audit proper data collection and analysis.

The data collection was initiated at the time of PICC insertion, with the insertion bundle form to be completed by two RNs, the PICC inserter and the bedside nurse. Audits were done on all PICC by the author. Data were collected weekly for 8 weeks. Clinical data warehouse and Cerner verified the number of PICC's placed per month, and the time and date when PICCs were discontinued. Data collection also included tracking time when the medications were changed from IV to PO at a certain feeding volume. The data was filed and kept in the medical office for at least 12 months accounting for privacy and confidentiality issues.

Intervention and Project Timeline

The intervention started with the introduction and implementation of the new guideline to the group. Introduction of the policy to the NICU staff was discussed through the charge nurses during meetings and huddles that are short informational meetings with the nurses at shift changes. Education of the RNs regarding the use of the new audit forms, change of medications from IV to PO form at 80 ml/kg/day of feeds and PICC removal at 120 ml/kg/day of feeds was facilitated by the CLABSI team members, which included the author.

The timeline for this project was 8 weeks: chart review and data collection 4 weeks before the implementation of the new guidelines and 4 weeks after the implementation. Nurse empowerment with education of the NICU staff about the new guidelines was done.

Ethical and Human Subjects Protection

It is critical to consider the ethical aspects of a DNP project at the initial stage of project planning. The ethics review process is vital to safeguard the DNP project that will protect the rights, safety, dignity and wellbeing of all participants (Resnik, 2015). Hence, the following are required before initiating the DNP project- a written approval of the project proposal, collecting

data anonymously, and defined recruitment procedures. IRB approval is not needed for this DNP project, as this is part of the CLABSI CQI program. This proposed project must respect the autonomy of the participants, must be fair in both conception and implementation and must maximize benefits while minimizing possible harms while ensuring that the patients are getting the best evidenced care (National Bioethics Advisory Commission, 2001).

Another important aspect of ethical considerations is protecting the anonymity and confidentiality of all participants. Protecting theses aspects is a DNP prepared nurse duty and responsibility.

Since this is a QI project, the data and information collected will be used for auditing purposes and public reporting. No patient identifiers will be collected. In my QI study, consents were obtained from the parents before PICC is placed with discussion of the benefits as well as the risks and complications involved in the procedure. Chart reviews with the procedure PICC as the identifier for each case will be done without any patient identifier. This DNP project as part of the QI initiative is meant to improve and maintain good patient outcome with regard to preventing central line infection, as proven by previous studies.

It is imperative that protection of the anonymity and confidentiality of the participants is a major component of nursing research ethics. It is important to protect the above aspects as the investigator. Data are kept in the private office of the medical group for safekeeping.

Results

Descriptive analysis with independent t– test using Statistical Package for the Social Science (SPSS) version 23 was used to compare the means of average PICC line days. A chi-square statistic was calculated to examine if there was a difference in

compliance with the discontinuance of IVF at 120 ml/kg/day of feeds in the pre-implementation and post implementation group. A Fisher's exact test was used to determine a difference in compliance with change of IV medications to PO at 80 ml/kg/day of feeds. The significant result is a p value less than or equal 0.05 (Pallant, 2016). Percentages were used to calculate compliance with PICC insertion guidelines as documented on an insertion and maintenance checklist bundle. During the project period, there were 34 PICCs inserted, 16 during the pre- and 18 in the post- group. The following are the results.

Compliance with PICC Line Discontinuance

In order to measure the compliance with discontinuing PICC lines at 120 ml/kg/day of feeds, a chi square test was used. The chi square test was used to compare the proportions of the categorical variables, comparing the expected versus the observed counts that are >5. (Tables 1 and 2).

			Pre vs Post group		
			Pre	Post	Total
Compliance w/dc IV	0	Count	8	3	11
		% within Compliance w/dc IV	72.7%	27.3%	100.0%
		% within Pre vs Post group	50.0%	16.7%	32.4%
	1	Count	8	15	23
		% within Compliance w/dc IV	34.8%	65.2%	100.0%
		% within Pre vs Post group	50.0%	83.3%	67.6%
Total		Count	16	18	34
		% within Compliance w/dc IV	47.1%	52.9%	100.0%
		% within Pre vs Post group	100.0%	100.0%	100.0%

Table 1. Compliance with discontinuing IV pre versus post group

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.300[a]	1	.038		
Continuity Correction[b]	2.912	1	.088		
Likelihood Ratio	4.405	1	.036		
Fisher's Exact Test				.066	.043
Linear-by-Linear Association	4.174	1	.041		
N of Valid Cases	34				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.18.

b. Computed only for a 2x2 table

Table 2. Chi square test for compliance to discontinue IV at 120 ml/kg/day

A significant difference (Chi-square (1) =4.3, p=0.038) was noted, with an increase in percentages of compliance from 50% in the pre- group to 83.3% in the post- group (Figure 1). With the use of this new guideline, average PICC line days were lower in the post implementation group, 14.2 versus 15.6 in the pre implementation group, but the difference was not significant (p=0.916).

The results of the project indicated that the goals of the DNP project to implement new PICC line guidelines to decrease the risk of CLABSI were achieved. The first goal to minimize the use of PICC lines by discontinuing its use at 120 ml/kg/day of feeds was achieved in terms of compliance (50% to 83%, p=0.038). However, with this guideline, the secondary goal to decrease average PICC line duration time was not achieved (15.6 days in the pre- versus 14.2 in the post group, p=0.916). Although there was improvement in compliance levels, the compliance in the post implementation group did not reach the desired 100% compliance. Lack of full compliance with removal of PICC lines once the patient reached the desired volume feeds resulted in longer PICC line duration.

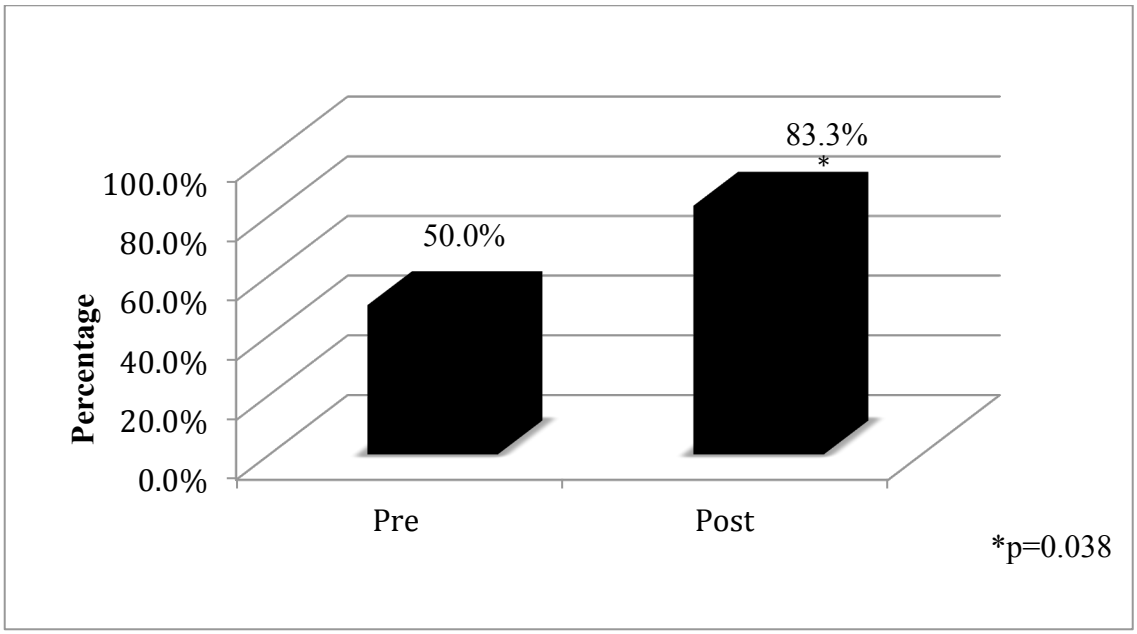

Figure 1. Compliance with IVF discontinuation at 120 ml/kg/day of feeds pre and post implementation

Compliance With Changing IV Medications to PO

Using the Fisher's exact Test, a significant difference was found (p = 0.007) when comparing the compliance to changing IV medication to PO form, 7.1% in the pre- group compared to 63.6% in the post- group (Figure 2). Fischer's exact test was used to compare two proportions of categorical variables with expected compared to observed counts less than 5, as seen on tables 3 and 4. In the pre- group only one out of fourteen complied with the guideline. The findings demonstrate a significant decrease in unnecessary IV usage in figure I.

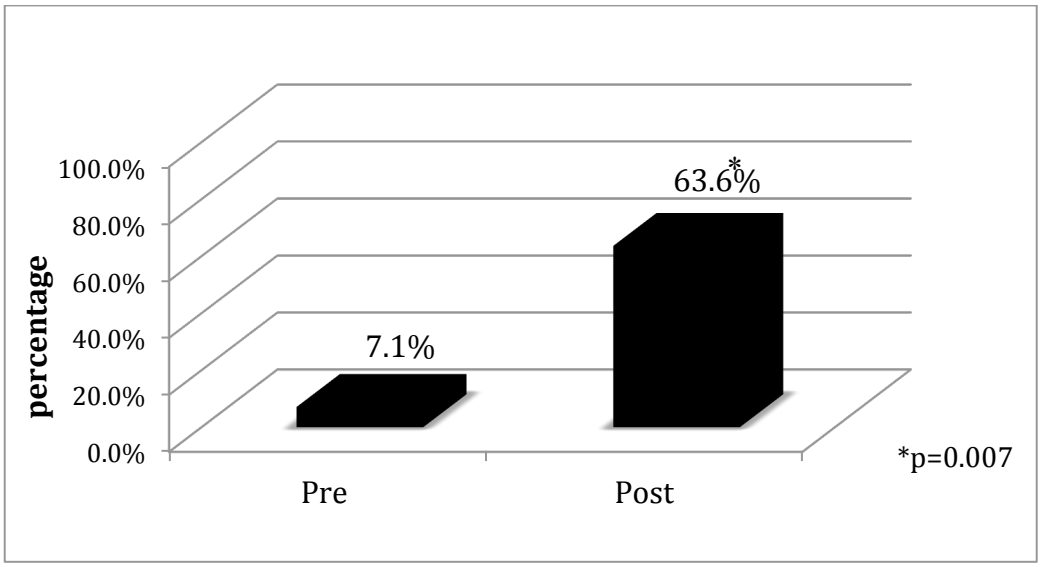

Figure 2. Compliance with changing IV medications to PO medications pre and post implementation

			Pre	Post	
Compliance w/ IV to PO	0	Count	13	4	17
		% within Compliance w/IV to PO	76.5%	23.5%	100.0%
		% within Pre vs Post group	92.9%	36.4%	68.0%
	1	Count	1	7	8
		% within Compliance w/IV to PO	12.5%	87.5%	100.0%
		% within Pre vs Post group	7.1%	63.6%	32.0%
Total		Count	14	11	25
		% within Compliance w/IV to PO	56.0%	44.0%	100.0%
		% within Pre vs Post group	100.0 %	100.0%	100.0%

Table 3. Compliance to changing IV to PO medication

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	9.035[a]	1	.003		
Continuity Correction[b]	6.625	1	.010		
Likelihood Ratio	9.718	1	.002		
Fisher's Exact Test				.007	.004
Linear-by-Linear Association	8.673	1	.003		
N of Valid Cases	25				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 3.52.

b. Computed only for a 2x2 table

Table 4. Fisher's Exact Test for compliance to change IV medication to PO

Compliance With Insertion and Maintenance Bundles

Compliance with the use of the PICC bundles is shown in Figure 3. Compliance with the use of the insertion and maintenance checklist increased from 87.5 % to 100 % percent during the post- implementation period. The third goal to continue the use of insertion and maintenance bundles was achieved reaching 100% compliance during the implementation.

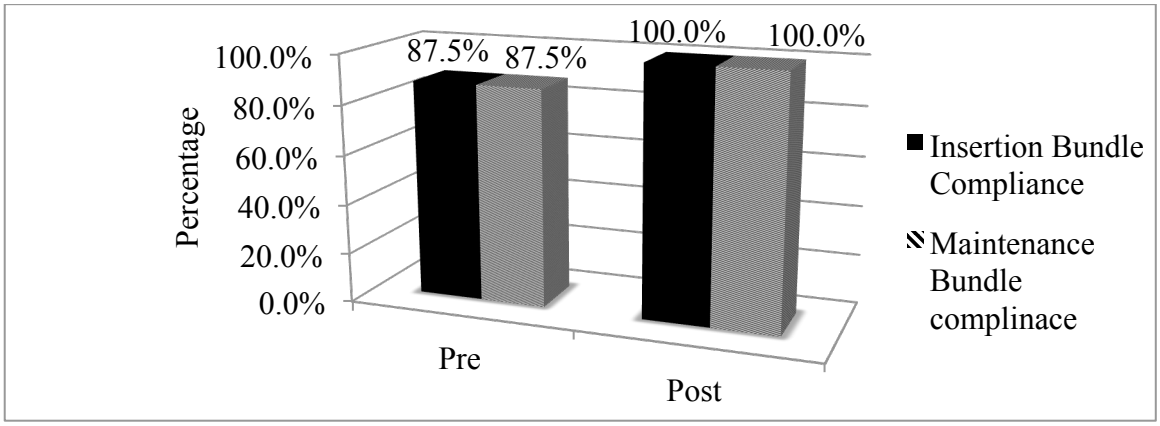

Figure 3. Compliance with PICC bundle checklist pre and post implementation

CLABSI Rate Pre and Post Implementation

A low CLABSI rate was maintained, zero before and after the implementation of the project as verified by the ID coordinators in the three NICUs.

CLABSI Rates

The ultimate goal to maintain low or zero CLABSI rate was also achieved. The combination of the use of the bundles and the new guidelines along with the re-education of the staff about CLABSI prevention may have contributed to the sustained rate.

Discussion of the Findings

PICC line insertion is one of the most common procedures performed in the NICU especially in the low birth weight infants. It is used for the provision of nutrition, delivery of fluid management, and administration of medications. It is however, not without associated risks. The most common of these risks is central line associated bloodstream infections (CLABSI).

During the eight-week project period, this DNP project was successful in implementing new practice guidelines that reduce the use of PICC lines for CLABSI prevention. There are multiple approaches to PICC line care and one of the greatest successes is the use of the catheter checklist (insertion and maintenance). In this project, it is likely that zero CLABSI rate was sustained due to the maintained and even improved compliance with the use of both insertion and maintenance bundles, improving from 87.5% pre implementation to 100% post implementation. This finding is similar to the studies of Greenberg, et al. (2015), McMullen, et al., (2016), Milstone, et al., (2013), O'Grady et al., (2011) and Ting, (2013) which report that a PICC line checklist effectively reduces central line infection.

However, the insertion procedure is only one aspect of the risk for CLABSI, with the risk extending to all aspects of care and maintenance during the PICC dwell time or duration of use.. CLABSI prevention strategies have expanded as new studies are published to limit PICC line dwell time to avoid complications (Milstone, et al., (2010, 2013), O'Grady et al., (2011), Sengupta et al., 2010). In a study conducted by Milstone (2013) PICC associated CLABSI in the NICU increased during the two weeks post insertion. Segupta (2010) found that PICC replacement might be necessary if intravascular access is necessary beyond 35 days. The QI projects concluded that there should be additional studies that can identify and describe

particular central line practices that may decrease the risk of infection. The post implementation group showed an average dwell time of 14.2 days, near the goal of <14 day use. Longer observation time and increased compliance may further decrease line days to <14.

Greenberg, et al. (2015) used a strategy that recommended to remove central lines when infants achieved 120 ml/kg/day of enteral feedings. This DNP CLABSI prevention initiative developed similar guidelines to discontinue PICC lines at 120 ml/kg/day of enteral feeds. The goal was to decrease the use of PICCs by early initiation and faster enteral feeding advancement in bigger preemies, avoiding the need for PICCs and strict directives for removal after a set feeding volume goal is achieved (120 ml/k/day). Our results showed an improved and significant improvement in compliance with this new strategy of discontinuing PICCs at 120 ml/k/day of feeds (p=0.038). However, a comparative analysis of PICC line days did not show a significant difference in the amount of PICC line days (15.6 days versus 14.2 days, p=0.198). Despite a significant difference in compliance with discontinuing PICCS at 120 ml/kg, average PICC line days remained the same and slightly above 14 days. However, the total compliance was not 100%. Medical indications like recurrent intolerance to feedings in some patients resulted in delaying the discontinuation of central lines thus, affecting the compliance of the providers. In this situation PICCs were discontinued at full feeds of 150 ml/kg/day instead of the guidelines' 120 ml/kg/day of feeds. Early removal of PICCs after achieving enteral volume of 120 ml/k/day has decreased total line days in a previous study (Greenberg et al., 2016). Greenberg's study included a 2 -year review of 15,567 PICCs that may have showed the difference. Our project included a review of only 34 PICCs in an 8- week period that the trend was not yet established. In this DNP project, an insignificant PICC dwell time pre- and post- guideline intervention may be due to the small population size and shorter observation period. A longer time frame of >8

weeks and a larger sample size in a multicenter study may be needed to show significant changes. A target feeding volume lower than 120 ml/k/day to discontinue PICC may also be considered to really reduce PICC dwell time, especially to less than 14 days that was not achieved in this project. Other units have used 100 ml/k/day of feeds as the goal to discontinue PICC line. Erdei et al. (2015) showed that a reduction in line days with discontinuation of central catheters with at enteral feeds of 100 ml/kg/day could be achieved. An approach to lower our feeding volume goal is another approach to lower PICC line duration.

This DNP project also investigated the effect of changing IV to PO medication at 80 ml/kg/day of enteral feeds to reduce CLABSI rate. This study has found a significant difference in compliance pre- and post- implementation ($p=0.007$). This strategy to changing intravenous to PO medication early reduces unnecessary line access and breakage in the closed PICC system thus reducing the risk of infection.

Significance for Nursing

CLABSI is an expensive complication related to a health care procedure. It is expensive in terms of the cost of lives, and in dollars and cents to a hospital (Woodward & Umberger, 2016). The use of bundles, those multimodal interventions that have been proven to make a difference, can change the rate of infection. The findings also support the vigorous identification and adherence to all best central line insertion and maintenance practices. Our opportunity lies in the 100% compliance with PICC bundles. The author postulates that the following project identified areas of needed improvement in CLABSI prevention practices and strategies in education and empowerment of the NICU nurses and PICC team members. As this project evolves, the continued success hinges on full compliance with clinical practice guidelines and meticulous root cause analysis of each CLABSI event. Each audit will measure provider's

compliance with the new guidelines. Continuing audits and evaluation of the goals, achievements and limitations of the project by the author, CLABSI CQI director, PICC nurse champions, advance nurse practitioners, PICC team members will achieve sustainability of this project. All the findings could then be shared to all stakeholders, innovators and early adopters who are responsible for the full implementation of the program. Team collaboration among all members of the CLABSI committee is essential to draw the focus on the process and not the person.

As a DNP leader, the significance of the DNP proposed project to the nursing community actively lead this author to be involved in education, search of appropriate theoretical conceptual framework, monitoring of the project and support of the staff as they comply with the principles of the program. This project with the critical appraisal of associated literature review, and adoption of the diffusion of innovation theory (DIT) theoretical framework, which involves nurse empowerment with knowledge and change in attitude, can lead to a positive clinical practice and outcome. Both extensive literature review and DIT conceptual framework have reiterated the central core of this project- prevent CLABSI by decreasing the use of central lines.

Education for this project with nurse empowerment will be instrumental in its success. Education was provided initially, during the implementation, and annually. Providing education to the staff in a variety of ways reinforced the message. Case studies, pocket cards, posters, online in services education, journal clubs, on-the-go in services, CLABSI Project Power Point and PICC team conferences led by the author and nurse CLABSI champions support the need for the change process and bundle implementation. Part of the educational process is the development of competencies and CLABSI committee's vigilance in monitoring competencies in the CLABI bundles. and the yearly education update.

Limitations of the Project and Areas for Further Discussion

Several limitations of the project were noted. The design was limited to PICCs placed four weeks before and four weeks after the implementation of the new guidelines. The short time period resulted in recruitment of a small sample size. A closer monitoring of care practices could have helped correct factors that affected compliance issues. Additional measures to promote compliance towards the guidelines like weekly posters, emails, additional staff meetings can be done to reach 100% compliance, thus identifying problems related to the program. Reinforcing the role of the CLABSI team members will help achieve these goals along with the development of a CLABSI committee that involved all the stakeholders. Quality improvement work and behavioral change can be slow processes that take time and energy to mature and succeed (Rinke, 2012). As a consequence of a limited sample size, the design of the project was to all PICCs placed instead of limiting only to the most vulnerable group of babies, the VLBW (< 1500 grams). This design will better control the populations' characteristics by limiting the analysis to PICCs used in the VLBW patients who need them mostly for nutritional purposes. The comparison of results was affected as other larger patients with PICC were included whose needs for PICC were for other reasons.

The data collection was affected by the short study time. Fewer PICCs were included as this was dependent on admission. The summer months when the project was done were low for NICU admissions. Extending to the next months may have led to higher recruitment. As mentioned, the population was not limited to the VLBW population. The collection method was limited to PICCs placed and discontinued during the project's timeline. Other analyses were discarded if the PICCs were still in use. This is true for VLBW population, whose need for PICC line takes a longer time, eliminating the data for analysis. Data collection was also done in three

facilities and analysis combined together as CLABSI rates were zero in all facilities. Although all facilities were participants in the QI initiative, differences in feeding practices and line care can affect duration of use (Greenberg, 2015). Information on known risks for CLABSI and increased dwell time, such as severity of illness, presence of necrotizing enterocolitis or short bowel syndrome was not explored in this project. The population's severity of illness could contribute to prolonged dwell time as feeding is delayed in sicker patients.

The analysis was based on preliminary data using the small sample size in a short observation period. The compliance for the new guidelines was significantly different after the implementation but did not reach 100%. The weekly compliance also decreased with time. This result may have affected the duration of PICC line use that did not decrease, which was one of the goals of the project. A longer duration of observation with bigger sample size might have achieved the goal (Rinke, 2012).

The dissemination process of the DNP project started with the presentation of the new guidelines to the stakeholders which included the medical providers- the neonatologists and neonatal nurse practitioners, CLABSI PICC team, NICU managers, and nurse champions. The guidelines were accepted for implementation as a consensus guideline. A policy of the new CLABSI guidelines was created and was presented in monthly High Reliability Unit (HRU) meetings and on line CLABSI in-services. The project power point and PICC team conferences led by the author and nurse CLABSI champions was done to support the need for the change process and bundle implementation. Posters, pocket cards, and markers in the providers' offices and computers were placed as guideline reminders. The nurses were reminded of the new guidelines through the huddles on every shift and monthly staff meetings. Bedside rounds by the author were done to remind bedside nurses of PICC line bundles, and the new guidelines and

check proper compliance. Continuous monitoring of PICC was done with the weekly, monthly reviews of bundle forms in all the NICU that included compliance to the new guidelines.

The continuation of the project will target the population that needs to be followed, the very low birth weight (VLBW) babies with PICCs. As the DNP leader, the author together with Dr. Mercedes Cruz, the CLABSI CQI director, and CLABSI QI team in collaboration of the interdisciplinary team, will continue to lead to keep the project going. Further studies with longer observation for at least two years to recruit larger sample size and longer observation time for compliance will be facilitated to determine if the project will achieve it's ultimate goal to decrease PICC dwell time. At the same time, the project will further investigate PICC guidelines for CLABSI prevention, such guideline using volume of 120 ml/k/day of feeds can decrease PICC duration to less than 14 days, maintaining zero CLABSI rate.

The DNP project will be sustained by doing yearly evaluation of the program goals especially maintaining low CLABSI rate. The yearly CLABSI summit will be continued for all members of the team in which the author is part of and stakeholders that include PICC inserters, NICU managers, ID coordinators and hospital administration leaders. The successful outcome of the DNP project will be presented in the yearly Mednax CQI meetings as well as future challenges that lie ahead. Bi-annual reporting of the project's progress and status by the author and CQI director will be reported to the medical group as required by the CQI committee. The author will continue with education of the nursing and medical staff during yearly High Reliability Unit (HRU) training and the yearly QI conferences. Consistent monitoring by the author and members of the CLABSI QI is critical towards the implementation of the DNP project.

CLABSI will always be a potential problem with PICC line use. Milstone, et al., (2013), Greenberg, et al, (2016) & Ting, et al. (2013), emphasize that ongoing quality improvement (QI) projects must be continued. In addition, ongoing QI measures must be evaluated for their relevance and effectiveness. Lastly, the further studies on new QI measures must be explored for CLABSI prevention in the NICU.

Conclusion

The DNP CLABSI project started a question– " What more can be done to prevent CLABSI and maintain low rates in the NICU?" The proven theory is – "Premature babies are prone to infection because of their immature immune system and their exposure to numerous interventions in the NICU that increases the risk for infection, one of which is the necessity for central lines." However, the initial success and new barriers seen did not discourage this author and CLABSI team to explore other interventions to keep the success of the project. This proposed DNP project deals with the basic knowledge- the absence of central line equates to the absence of CLABSI. In conclusion, new quality improvement measures can help sustain the success of an ongoing CQI project as limiting the use of central lines for CLABSI prevention. The use of CLABSI bundles and new proposed guidelines are all-multimodal interventions that have been proven to make a difference, can change the rate of infection. Our opportunity lies in the utilization of the bundles consistently. As a DNP leader, the author together with a highly collaborative CLABSI director and team has been prepared with the knowledge, the expertise, and the process to maintain a significant change.

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Appendix A

New Proposed Guidelines for the Prevention of
Central Line Associated Bloodstream Infection (CLABSI) in the NICU

1. Purpose:
    a. To develop and implement a new evidence-based practice guideline as part of the CLABSI continuous quality improvement (CQI) and DNP capstone project to prevent CLABSI by decreasing the use of peripherally inserted central catheter (PICC.

    b. Continue to prevent CLABSI and maintain low rates in our NICU by continuing to use insertion and maintenance CLABSI bundles.

2. All medical care providers in the NICU (neonatologists. advance nurse practitioners, and nurses) will adhere to the new proposed guidelines as part of the CLABSI CQI project, to decrease the use of PICC lines based on achieved feeding volumes. The new proposed evidence-based guidelines will include:

    Medical orders will be placed in Cerner (electronic database) to change IV medications to PO form once 80 ml/k/day of feeds is achieved (caffeine as the most used medication for very low birth weight babies)

    Physician orders will discontinue PICC lines once feeds at 120 ml/k/d are achieved. Information of present proposed guideline will be included in the central line maintenance random audit.

3. Supportive Data with CLABSI Prevention strategies will include initial steps such as:

a. Mandatory education of all NICU staff in HRU annual meeting on CLABSI
b. Identification of certified PICC team members
c. Provision of PICC carts
d. Availability and use of Chorhexidine 60% Alcohol (Avagard) in every bedside and wash stations
e. Implementation of insertion and maintenance bundles using CLABSI CQI forms (Appendix B and C)

Supportive Data:

1. PICC bundle sets on pre- and during insertion checklist
2. PICC maintenance random audit bundle sets checklist

Appendix B

Central Line Insertion Checklist

Before the Procedure, did the Inserter:

Yes No* Perform hand hygiene before the procedure?

Yes No* Put on a cap, mask, sterile gown and sterile gloves?

Yes No* Prep the insertion site per protocol?

Yes No* Cover the patient and procedural field with a large sterile drape?

During the Procedure:

Yes No* Was a sterile field maintained at all times?

Yes No* Was an observer present?

Yes No* Did any staff within 3 feet of the sterile field wear a cap and mask?

***If "No" for any of the above:**

Yes No Was the procedure stopped (if non-emergent) and corrective action taken?

Any "No" responses, without corrective action taken, are considered *"non-compliance with the central line insertion bundle"*

Date: Line Type(circle): UAC – UVC – PICC – PAL – Other:

Appendix C

CENTRAL LINE MAINTENANCE RANDOM AUDIT

PICC #: _____ Date Inserted: _____ Date Removed: _____
PICC #: _____ Date Inserted: _____ Date Removed: _____
Other central line: _____ Date Inserted: _____ Date Removed: _____
Feeds at 80 ml/kg/day (IV meds to PO) ____ml Q3 hrs Date: _____
Feeds at 120 ml/k/d (d/c PICC):_____ ml Q3 hrs Date:_____

	DATE:	DATE:	DATE:	DATE:	DATE:	DATE:	DATE:	DATE:	DATE:
1. Was appropriate hand washing and gloves used prior to accessing central line?	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No
2. Was the hub appropriately and vigorously scrubbed prior to accessing the central line?	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No
3. Was the dressing integrity evaluated and, if found to not be intact, were appropriate measures taken to address the issue?	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No
4. Was the central line discontinued when feeds established at 120ml/kg/day?	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No
5. Was the IV medication/s changed to PO form when feeds were established at 80 ml/kg/day?	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No	□Yes □No

Appendix D

CLABSI WATCH REMINDER

@120ML/KG/DAY FEEDS--→
DC PICC

@80 ML/KG/DAY FEEDS→ IV TO
PO MEDS