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Best Practice: Implementation of a Central Line Bundle to Reduce Central Line-Associated Bloodstream Infections

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Executive Summary

Central line-associated bloodstream infections (CLABSIs) are among the most frequent health care-associated infections and are reported to be correlated with an increased number of inpatient days, higher cost, and attributable mortality rates (Devrim et al., 2016). For this reason, central line bundles (CLB) have been widely used in hospitals to aid in the decrease of CLABSIs. Through implementation of the prevention strategies included in CLBs, CLABSIs can be reduced by greater than fifty percent (Devrim et al., 2016). A decrease in CLABSIs is clinically significant with the avoidance of negative patient outcomes and a decrease in healthcare costs (Rinke et al., 2013).

Approximately 85% of pediatric hematology/oncology patients have long-term central venous access catheters, which places them at an extremely high risk for CLABSIs (Devrim et al., 2018). CLABSIs are increasingly recognized as a preventable health care-associated infection (Ziegler et al., 2015). This indicates that nurses, patients, and their families all play a crucial role in minimizing the risk of central line-associated bloodstream infections. Compliance with performing all components in a CLB is a significant factor in the decrease of CLABSI incidence rates (Devrim et al., 2018). By understanding the importance of CLB, especially in the pediatric hematology/oncology population, an increase in CLABSIs can be avoided and patients' quality of life can be improved. The PICOT question that will be used for this best practice project is: On a pediatric oncology unit (P), does adherence to a central-line bundle (I) compared to non-adherence (C) prevent or reduce (O) central line-associated bloodstream infections within 12 weeks (T)? Implementation of this best practice project will occur on a pediatric hematology/oncology unit over the course of a total of 13 weeks, not including four weeks prior that will be spent auditing the pre-implementation period. The first week will be dedicated to

educating staff, patients, and their families about the project and what it entails. The following 12 weeks will be spent implementing adherence to the CLB. Audits will occur throughout the 12 weeks to observe the trajectory of the project using a CLB checklist (See Appendix C). This project is unable to be implemented due to time constraints; however, it can be expected that findings will reflect what the literature suggests -a decrease in CLABSI incidence rates with adherence to CLBs. While the main goal of this project is to decrease CLABSI rates, other goals include educating, motivating, and supporting pediatric hematology/oncology nurses, patients, and their families, while also, sustaining best nursing practice. This project should be implemented to not only reduce hospital costs, but, most importantly, to provide the pediatric hematology/oncology population with a better quality of life by reducing their risk for central line-associated bloodstream infections.

Best Practice: Implementation of a Central Line Bundle to Reduce Central-Line Associated Bloodstream Infections

Patients in the pediatric hematology/oncology population are at a high-risk of developing CLABSIs due to the constant use of their central lines for treatment and the types of immunosuppressing agents they receive. To aid in the prevention of CLABSIs, a central line bundle is implemented when the patient is admitted to the hospital. While the staff nurses are required to ensure that each component of the central line bundle is completed, some components such as daily oral care and a daily shower or bath using chlorhexidine (CHG) wipes often get missed (Duffy et al., 2015). By implementing a best practice project on CLB adherence, our facility can expect decreased length of stay, improved patient outcomes, and increased savings.

Rationale for the Project

This topic highlights adhering to a central line bundle to assist in the prevention and reduction of central-line associated bloodstream infections (CLABSIs) in a pediatric hematology/oncology unit. A central line bundle can be classified as a standard combination of interventions to prevent CLABSIs (Oncology Nursing Society, 2024). This combination typically includes hand hygiene, use of maximum sterile barriers at line insertion, cleansing the insertion site with chlorhexidine (CHG), avoiding use of the femoral and jugular sites for line insertion, and prompt removal of unnecessary catheters (Oncology Nursing Society, 2024). Following a CLABSI, patients can potentially require prolonged antibiotic treatment, lengthy hospital stays, and higher healthcare costs. For each nosocomial infection, costs can amount to up to $55,000 (Willis et al., 2023). Furthermore, CLABSIs portray a notable source of morbidity and mortality in oncology patients (Willis et al., 2023). This topic is important because CLABSIs

are preventable and can have a detrimental effect on the health of pediatric hematology/oncology patients. By providing evidence as to how central line bundles assist in the reduction of CLABSIs, nurses and patients are more likely to strictly adhere to all aspects of the central line bundle to improve not only one patient's outcome, but also the institution's outcomes.

Literature Synthesis

In an effort to educate unit nurses and patients, and their guardians, about why it is imperative that each component of the central line bundle is performed, a literature review was conducted to explore the significance of central line bundles as a factor in CLABSI reduction. A thorough literature search was performed using CINAHL Complete, MEDLINE, PubMed, and Wiley Online Library. In order to refine the search for articles, the "title search" strategy was utilized. The words: "pediatric", "hematology/oncology", "central line bloodstream infection", "CLABSI", and "central line bundle" were entered into the search bar. Some searches were combined by using the Boolean connector "AND" between each keyword. The Boolean connector "OR" was also used between the words "central line bloodstream infection" and "CLABSI". After this process, a total of twelve studies were selected for inclusion in the literature review.

All of the twelve studies selected (see Appendix A) support that implementation of a central line bundle results in a decrease in CLABSI incidence rates (Ardura et al., 2021; Choi et al., 2013; Dandoy et al., 2017; Devrim et al., 2018; Devrim et al., 2016; Duffy et al., 2016; Kemp et al. 2019; Linder et al. 2017; Rinke et al., 2013; Rinke et al., 2012; Tang et al., 2014; Willis et al., 2023). In five studies, it can be demonstrated that application of a daily central line catheter bundle in the pediatric hematology/oncology population has decreased CLABSIs by approximately 50% (Choi et al., 2013; Devrim et al., 2018; Kemp et al., 2019; Rinke et al., 2013;

Teng et al, 2014). One study reported as high as a 70% reduction in CLABSI rates resulting from increased adherence to central line bundles (Devrim et al., 2016). This evidence suggests that implementation of evidence-based practice guidelines for central line bundles leads to swift improvements in healthcare performance metrics (Choi et al., 2013). Additionally, these guidelines led to a decrease in antibiotic use, hospital length of stay, healthcare costs, and vastly improved quality of care in a notably high-risk patient population (Willis et al, 2023). By sharing the data with patients and their families, along with re-educating nursing staff, the CLABSI incidence rate will significantly decrease. Linder et al. (2017) states that engaging patients and families is a key component of CLABSI reduction initiatives.

Project Stakeholders

The stakeholders that will be affected by this project include pediatric hematology/oncology patients and their families, pediatric hematology/oncology nursing staff, hospital administrators, any patient with a central venous line, and nurses who care for patients with a central venous line. This project will be beneficial to patients and their families as CLB compliance will aid in contributing to improved patient outcomes and quality of life. Patients and their families will be directly involved in the project. Opportunities for accountability include performing the components they are asked to do as part of the CLB. Pediatric hematology/oncology nursing staff will be leading this project and are responsible for providing the data that will be assessed. Barriers on the nurses' part include failure to chart a component of the CLB that was performed. If the component was performed, but not charted, it would be considered not performed and this would be classified as non-adherence to the CLB. In an effort increase charting compliance and eliminate barriers, pre-implementation data will be shared with nursing staff prior to the implementation phase (Duffy et al., 2015). Hospital administrators act

as liaisons between nursing staff and can also assist in implementing this project outside of the primary unit. By expanding this project in the future, hospital administrators, patients with central lines, and nurses caring for patients with central lines will be positively impacted because a decrease in CLABSIs in other units will eventually lead to a decrease in total expenses for the hospital.

Patient Demographics

This project will take place at a children's hospital on a 42-bed pediatric hematology/oncology unit. The number of patients cannot be predicted, so all inpatient pediatric (6 months-18 years old) hematology/oncology patients who are admitted during the project implementation period will be included. The participants will include all patients with a central venous line (CVL). In addition, 82 inpatient pediatric hematology/oncology registered nurses will be included. Both seasoned nurses and new hires will be audited.

Implementation Plan

Implementation of this project will take place over the course of 13 weeks. The first week when the project begins, the central line bundle will be defined. The central line bundle will consist of: hand hygiene (before and after entering central line), dressings changed appropriately (sterile dressing change every seven days, unless soiled or non-occlusive), intravenous tubing changed appropriately (every 96 hours, unless contaminated prior), bathing or showering performed (daily with CHG wipes), and central lines entered appropriately during lab draws, medication administration, or cap changes (with clean or sterile gloves, depending on the task being performed) (Duffy et al., 2015). Then, changes will be made to the charting system. Currently, the charting system has separate areas to document each component of the CLB. The electronic medical record (EMR) will be updated so that all steps of the central line bundle will

be in one section. This will be more convenient for nurses to locate the CLB and chart on each component as it is completed throughout their shift. Chart auditing will be performed on CLB charted from May 6th, 2024 through June 28th, 2024. This auditing will be done prior to implementation of the project to obtain the total number of central line days and CLABSIs in order to calculate the CLABSI incidence rate. In addition, the number of completed CLB will be audited during a time when non-adherence to CLB was increased. These results will be compared to the outcomes evaluated at the end of this project.

All inpatient nurses on the unit will be informed about the best practice project, including the duration and expectations via a PowerPoint presentation. The presentation will include education on the components of the CLB, the importance of properly charting that each component was done or not done in the EMR, and data from other studies that indicates successful implementation of this project in other institutions. Additionally, nursing staff will be notified that a retrospective review has occurred prior to implementation. The pre-implementation CLABSI incidence rate will be shared with nursing staff, so that they understand that the goal of this project is to observe a decrease in the post-implementation CLABSI incidence rate when compared to the pre-implementation CLABSI incidence rate. Handouts that include each component of the CLB and the importance of adherence will be printed out for nurses to administer to the patients and their guardians as a reference. Education will be provided to the patients and their guardians. These handouts will be placed at the nurses' station, easily accessible to staff and families. Starting the first Friday in July, nurses' charting of CLBs will be audited every Friday for 12 weeks using the CLB checklist (See Appendix C). Should a positive blood culture result from a patient at any time, an audit will be performed at that time on that specific patient's chart.

Statistical analyses will be performed after 12 weeks to calculate the CLABSI incidence rate. Data will then be evaluated and compared to the data collected in the pre-implementation period. Once all the results are obtained, the data will be plotted on a chart and shared with all stakeholders.

Timetable/Flowchart

The decision to implement this project was made in January 2024. A literature review of the topic was conducted in February 2024, where 12 studies were identified. The week of June 24th-28th, 2024, staff will be notified about the project. An education session will occur each day that week and nurses will be required to attend one session. Additionally, auditing will occur over nurses' charting of CLBs from May 6th, 2024 and will end June 28th, 2024, using the EMR. On Monday, July 1st, the project will go in to effect, and reference handouts will be printed and placed on the unit. Education will be provided to patients and their guardians who are admitted that day and every day after. Starting the first Friday in July and every Friday for 12 weeks, the nurses' charting will be audited until September 20th, 2024. After 12 weeks, all data will be gathered, statistical analyses will be performed, and results will be evaluated. (See Appendix B). The results will then be shared with all stakeholders on Friday, September 27th, 2024.

Data Collection Methods

Data collection for the pre-intervention period will begin May 6th, 2024 and will end June 28th, 2024. For the intervention period, data collection will begin July 1st, 2024 and will end September 20th, 2024. The data will be collected by calculating CLABSI incidence rates. First, the CLABSI rates will be calculated by dividing the total number of CLABSIs reported per year by the total number of catheter days in that year. They will then be reported as the number of infections per 1,000 central venous catheter days (CVC) days (Ardura et al., 2021). These

numbers will be input in an excel spreadsheet where the results will be compared during the pre-implementation period and the post-implementation period. Then, statistical analyses will be performed using SAS software, version 9.4 (SAS Institute, Cary, North Carolina) to calculate CLABSI incidence rates. These rates will be calculated using a 95% confidence interval. In addition, audits will be conducted over the nurses' charting of the number of central line bundles completed during the pre-implementation and implementation timeframe. A checklist will be used to track each component of the bundle (See Appendix C). The number of central line bundles completed in the pre-intervention period will be compared to the number post-intervention. This number will be separate from the CLABSI rates, but the pre-intervention and post-intervention dates will be the same for both.

Evaluation

This is a benchmark project, so an official evaluation is unavailable at this time. The data that would be assessed includes the CLABSI incidence rate from the pre-intervention period and the post-intervention period. The number of CLB that were completed in the pre-intervention period and post-intervention period will also be compared. These results will indicate if the project was successful or not.

It would also be important to encourage staff and patients to discuss how they felt about the project. A post-intervention debriefing can be planned to discuss results and feelings. This will provide valuable insight on the change that occurred over the last 12 weeks. Additionally, any recommendations for the future can be made based off of the feedback provided by nursing staff, patients, and their families.

Cost/Benefit Analysis

According to Duffy et al. (2015), the annual cost of CLABSIs to the United States health system amounts to more than two billion dollars. For each nosocomial CLABSI that occurs, attributable costs can total up to $55,000 (Willis et al., 2023). Following a CLABSI, patients potentially require prolonged antibiotic treatment, lengthy hospital stays, and higher healthcare costs. Dandoy et al. (2016) provided data about CLABSIs in patients, who were stem-cell recipients, that demonstrated an increased use of healthcare resources, including treatment for septic shock, transfer to the Pediatric Intensive Care Unit (PICU), along with the need for removal of the central line, and replacement of a new central line. Through implementation and management of this best-practice project, money will be saved over time for the unit, the hospital, and for families. It is important to note that no additional supplies are being used for this project, aside from printing copies for CLB reference handouts. At the start of the project, 300 handouts will be printed. This will cost $339.00 (Office Depot OfficeMax, 2024). More handouts will be printed at a later date, if needed; however, it can be predicted that the total cost of handouts will be significantly lower than the cost of one CLABSI. While the central line bundle does not necessarily omit the potential for all CLABSIs, it significantly decreases the risk of infection, therefore reducing costs (Ardura et al., 2021).

Discussion of Results

This project was unable to be implemented due to the amount of time required in order for this project to be successful. It can be expected that this project would result in substantially improved compliance with CLB adherence and charting, along with a reduction in CLABSI incidence rates. Since there is a set plan for this project, a predictable outcome can be expected. However, one aspect of this project that is unpredictable is the team's perspective about the change.

A transformational approach encourages group working and decision making (Lumbers, 2018). It is important to encourage others to work together, especially in the field of nursing. Nursing can be difficult and challenging, but through collaboration, the workload is more manageable. While team leaders are not necessarily in charge of how the team gets along, they can encourage and foster an environment that is based on foundation of teamwork. It is extremely crucial to be part of a team that empowers its members and listens to feedback, along with making changes based off of that feedback. To foster a transformational approach, the team members must be involved in decision making. Two-way communication should also be encouraged in order to motivate nursing staff. For this project to be successful, the team members must be satisfied, feel empowered, and be motivated to make a difference.

Asurakkody & Shin (2018) states, to enhance the quality and safety of patient care, innovative behavior was recognized as key to promoting nursing care practices. The creativity and innovation that comes with changing practice is necessary. Staff must fully participate in this project and remain inspired, in order for this project to be successful. Once the project is live, it would be beneficial to be mindful of how the team responds to the change, in order to make alterations, if necessary.

A few factors that are classified as barriers to change include lack of support, inefficient communication, resistance to change, and technical problems (Verhulst & Lambrechts, 2014). It is paramount to constantly communicate with the team and provide updates on the status of the project, especially because nursing staff is providing the majority of the data. Nurses involved need to feel supported and understood. The opportunity to listen to any suggestions or questions they may have should be provided at any time throughout the duration of the project. The team must have access to any resources they may need or supplies they request. By ensuring these

processes occur and by providing constant communication, this project will be successful and sustained for years to come.

Conclusion/Recommendations

This project has the potential for a high success rate with a 50% decrease in CLABSIs after implementation of a CLB (Choi et al., 2013; Devrim et al., 2018; Kemp et al., 2019; Rinke et al., 2013; Teng et al, 2014). As the next step, one recommendation is for this project to be expanded to other units in order to decrease CLABSI rates hospital-wide. This would provide more data on the effect of CLB adherence. Another recommendation is to explore the components of the CLB. CLBs are typically slightly different in other facilities. It would be helpful to have a standard set of components in a CLB all-around to avoid confusion.

A reduction in CLABSI rates needs to be a priority because central line-associated bloodstream infections are preventable. The use of central line bundles has significantly decreased the risk for CLABSIs in pediatric hematology/oncology patients. By ensuring adherence to CLBs, CLABSI incidence rates are decreased, patients' quality of life is improved, and healthcare costs are reduced. This project seeks to enforce the most sustainable and effective evidence-based patient-care practices.

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Appendix A

Evidence Table with Synthesis

PICOT Question: On a pediatric oncology unit (P), does adherence to a central-line bundle (I) compared to non-adherence (C) prevent or reduce (O) central line-associated bloodstream infections within 12 weeks (T)?

Citation:	Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables Studied and Their Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Strength of the Evidence
1. (Ardura et al., 2021) Impact of a Best Practice Prevention Bundle on Central Line-Associated Bloodstream Infection (CLABSI) Rates and Outcomes in Pediatric Hematology, Oncology, and Hematopoieti	N/A	RCS	41-bed H/O/HCT unit	IV1: CLABSI n=159 IV2: Total CVC Days n=344,886 DV: CLABSI rate/1000 CVC days= 0.46	SAS software, R Founding for Statistical Computing, *fmsb* R package	Statistical Significance: $p < 0.05$	Pre-int: 2.85 CLABSI/1000 CLD Post-int: 2.04 CLABSI/1000 CLD	Strength of the evidence: B. Strengths: cost-effective, ↓ in CLABSIs observed Weaknesses: small Sample size, single institution, type of data collection LOE: V

c Cell Transplantation Patients In Inpatient and Ambulatory Settings								
2. (Choi et al., 2013) Rapid Reduction of Central Line Infections in Hospitalized Pediatric Oncology Patients Through Simple Quality Improvement Methods	N/A	RR	PHO 26-bed unit	IV1: CLABSIs n=102 IV2: PD DV: CLABSI rate	Wilcoxon rank sum and *t*-tests	$p < 0.033$	Pre-int: 2.92 CLABSI/1000 PD Post-int: 1.61 CLABSI/1000 PD	Strength of the evidence: B. Strengths: successful implementation EBP Weaknesses: non-randomized study, single-institution LOE: III
3. (Dandoy et al., 2017) Bacterial Bloodstream Infections in the Allogenic Hematopoietic Cell Transplant Patient: New	N/A	LR	PHOBMT unit	IV1: CLABSIS (n=68) IV2: CLD DV: CLABSIs per 1000 CLD	Wilcoxon rank sum test	$p < 0.05$	29% ↓ in CLABSIs after implementation of CLB	Strength of the evidence: C. Strengths: ↓ in CLABSI rates with CLB Weaknesses: small sample size LOE: VI

Considerations for a Persistent Nemesis								
4. (Devrim et al., 2018) Central Line Bundle for Prevention of Central Line–Associated Bloodstream Infection for Totally Implantable Venous Access Devices (Ports) in Pediatric Cancer Patients	N/A	RCSS	28-bed POHD	IV1: number of CLABSIs IV2: CLD DV: CLABSIs per 1000 CLD	Poisson 95% confidence interval Statistical analysis using Medcalc v 11.6	*p*= <0.05	Pre-int: 14.5 CLABSI/1000 CLD Post-int: 5.49 CLABSI/1000 CLD	Strength of the evidence: B. Strengths: ↓ in CLABSI rates with CLB Weaknesses: small sample size LOE: V
5. (Devrim et al., 2016) Clinical Impact and Cost-Effectiveness of a Central Line Bundle Including Split-Septum	N/A	RS	PICU 24 bed unit	IV1: CLABSIs (PBP, n=33) IV2: CLABSIs (BP, n=24) IV2: TVCVD (PNP,	SPSS version 15.0	*p* =.05	Pre-int: 24.5 CLABSI/1000 CLD Post-int: 14.29 CLABSI/1000 CLD	Strength of the evidence: B. Strengths: ↓ in CLABSI rates, cost-effective Weaknesses: LOE: III

and Single-Use Prefilled Flushing Devices on Central Line–Associated Bloodstream Infection Rates in a Pediatric Intensive Care Unit				n=1,355) BP, n=1,679) DV: CLABSI rate/1000 CVC days (PBP=24.35) (BP=14.29)				
6. (Duffy et al., 2016) Implementing A Daily Maintenance Care Bundle to Prevent Central Line-Associated Bloodstream Infections in Pediatric Oncology Patients	N/A	QIP	32-bed PHOBMT unit Pre-intervention CA: 35 patients Post-intervention CA: 45 patients	IV1: compliance with MCB IV2: # CLABSIs reported DV: infection rate	Mann-Whitney *U* test	*p*=.001	Pre-int: 2.92 CLABSI/1000 CLD Post-int: 1.6 CLABSI/1000 CLD	Strength of the evidence: B. Strengths: cost-effective, consistent data Weaknesses: short timeframe (6 months) LOE: VI
7. (Kemp et al. 2019). Back to Basics: CLABSI Reduction	N/A	LR	2 IP PHOU, 48 beds	IV1: CLABSIs IV2: CLD DV: CLABSI	exact Poisson test	α=.05	LCBI pre-Intervention CLABSI rate: 1.05 LCBI post-	Strength of the evidence: Strengths: ↓ in CLABSI rates Weaknesses: inconsistent

Through Implementation of an Oral Care and Hygiene Bundle				rate/1000 CLD			Intervention CLABSI rate: 0.54 MBI pre-intervention CLABSI rate: 2.98 MBI post-intervention CLABSI rate: 1.27	compliance LOE: VI
8. (Linder et al. 2017). Using Practice-Based Evidence To Improve Supportive Care Practices to Reduce Central Line–Associated Bloodstream Infections in a Pediatric Oncology Unit	PBE	RR	32-bed IU, serving children with ICC	IV1: Adherence to BPBC IV2: PC: Leukemia (n=36/44), AML (n=20/36), Neutropenic (n=33/44), Patient w/ OM (n=14/44), compromise in SI (n=11/44) IV3: organisms:	Poisson regression using R	p=0.45	Pre-int: 3.29 CLABSI/1000 CLD Post-int: 2.16 CLABSI/1000 CLD	Strength of evidence: B Strengths: same facility, population Weaknesses: small sample size LOE: III QOE: Fair

				VGS (n=10), CNS (n=6) IV4: clinical care environment DV: Number of CLABSIs (n=44)				
9. (Rinke et al., 2013) Central Line Maintenance Bundles and CLABSIs in Ambulatory Oncology Patients	CQI	PITSS	Children's center	IV1: CLABSIs IV2: CLD DV: CLABSI IR/1000 days	standard Poisson regression model with a single covariate	*p*=0.58 *p*=0.91	BL CLABSI IR: 0.63/1000 CLD IP CLABSI IR: 0.32/1000 CLD	Strength of the evidence: C. Strengths: ↓ in CLABSI rates Weaknesses: IP longer than pre-IP, single-institution LOE: III
10. (Rinke et al., 2012) Implementation of a Central Line Maintenance Care Bundle in	Translating Evidence into Practice	PITSS	18-bed POU	IV1: DDLE (P=.21) IV2: AEIL (P=.12) IV3: APCLC (P=.64)	Poisson regression model with a single covariate, Wilcoxon rank-sum test	CI= 0.39-0.98	BLP: 9 CLABSIs, 4007 CLD; CLABSI rate: 2.25 CLABSI/ 1000 CLD IP: 18 CLABSIs, 10,052 CLD; CLABSI rate:	Strength of the evidence: B. Strengths: same facility Used over 2 years, ↓ in CLABSIs observed

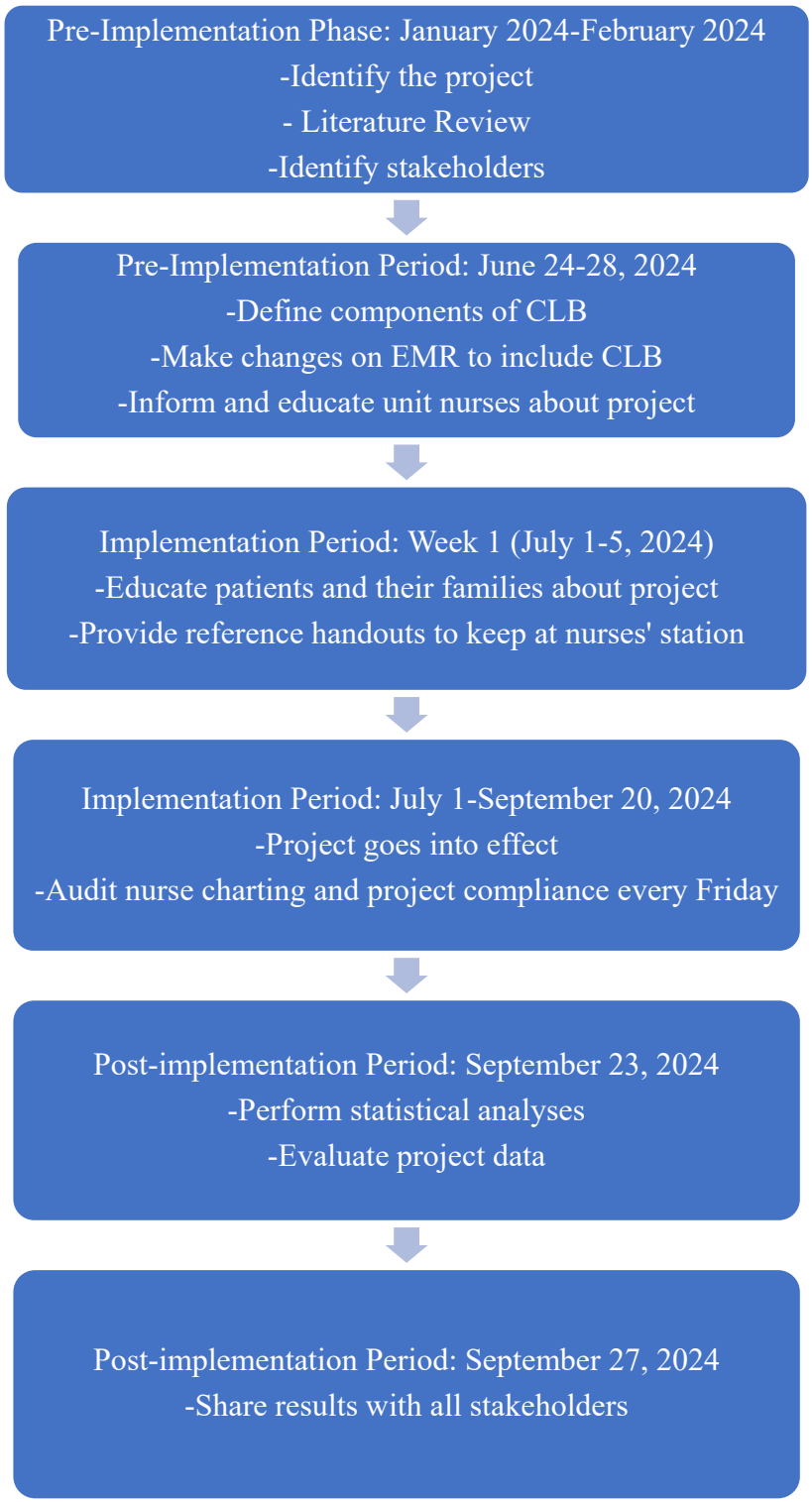
Hospitalized Pediatric Oncology Patients				DV: Number of CLABSIs			1.79 CLABSI/ 1000 CLD SYI: 4 CLABSIs, 4913 CLD; CLABSI rate: 0.81 CLABSI/ 1000 CLD	Weaknesses: limited sample size, low risk for misclassification bias LOE: III
11. (Teng et al., 2014) The Impact of Central Line Insertion Bundle on Central Line-Associated Bloodstream Infection	N/A	QII	adult ICU	IV1: CLABSIs IV2: CLD DV: CLABSI IR/1000 days	logistic-regression model	p <0.05	Pre-int: 0.84 CLABSI/ 1000 CLD Post-int: 0.32 CLABSI/ 1000 CLD	Strength of the evidence: B. Strengths: ↓ in CLABSI rates Weaknesses: short timeframe, single institution LOE: VI
12. (Willis et al., 2023) Eliminating Central Line Associated Bloodstream Infections in Pediatric Oncology Patients: A Quality	SMART aim	QIP	PHO unit	IV1: CLABSIs IV2: CLD DV: CLABSI rate 1.89/1000 CLD in 2020 0.73/1000 CLD in 2021	U chart, 12 data points plotted on run charts		Pre-int: 1.89 CLABSI/1000 CLD Post-int: 0.73 CLABSI/1000 CLD	Strength of the evidence: C. Strengths: single unit, successful interventions Weaknesses: short timeframe LOE: VI

Improvement Effort								

Legend: AEIL (aseptic entries into line), APCLC (aseptic procedures when changing line components), BLP (baseline period), BP (bundle period), BPBC (best practice bundle components), BPMB (best-practice maintenance bundles), CA (chart audits), CI (confidence interval), CLABSI (central line-associated bloodstream infection), CLB (central line bundle), CLD (central line days), CNS (coagulase-negative staphylococci), CQI (continuous quality improvement), CVC (central venous catheter), DDLE (daily discussion of line entry), EBP (evidence-based practice), H/O/HCT (hematology/oncology/hematopoietic cell transplantation), IC (infection characteristics), ICC (immune compromised conditions), ICLB (initiation of central line bundle), ICU (intensive care unit), IP (intervention period), IR (incidence rate), IU (inpatient unit), LR (literature review), MCB (maintenance care bundle), OM (oral mucositis), PBE (practice-based evidence), PBP (pre-bundle period), PC (patient characteristics), PD (patient days), PHO (pediatric hematology-oncology), PHOBMT (pediatric hematology oncology and bone marrow transplant), PICU (pediatric intensive care unit), PITSS (prospective interrupted times series study), POHD (pediatric oncology-hematology department), POU (pediatric oncology unit), QII (quality improvement intervention), QIP (quality improvement project), RCS (retrospective cohort study), RCSS (retrospective cross-sectional study), RR (retrospective review), RS (retrospective study), SI (skin integrity), TCVCD (total central venous catheter days), VGS (viridans group streptococci), ↓ (decrease)

Appendix B

Flowchart



Appendix C

Central Line Bundle Audit Tool

Daily Central Line Bundle Checklist
☐ Hand hygiene performed
☐ Dressing changed (every 7 days)
☐ Tubing changed (every 96 hours)
☐ Clean or sterile gloves used
☐ Bath with CHG wipes