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Implementation of a Daily Central Line Maintenance Audit Form in an Outpatient Infusion Center: A Quality Improvement Project

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Implementation of a Daily Central Line Maintenance Audit Form in an Outpatient Infusion Center: A Quality Improvement Project

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A DNP project submitted in partial fulfillment of the requirements for the degree of Doctor of Nursing Practice

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Approval

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Abstract

Significance and Background: Best evidence supports central venous access device (CVAD) dressing changes occur every 7 days or sooner, if indicated. At a community hospital in New England, patients receive outpatient antimicrobial therapy via CVADs. It is vital that nurses adequately maintain CVAD dressings according to evidence-based protocols to reduce the risk of central line-associated bloodstream infection (CLABSI). CLABSIs, associated with increased morbidity, mortality, and health care costs, are largely preventable through proper CVAD maintenance. At the project site, a review identified that dressing changes were frequently changed beyond the 7-day parameter. Documentation and surveillance processes were identified as opportunities for improvement. The Joint Commission's daily CVAD maintenance audit form (modified) was implemented. This quality improvement (QI) project is congruent with Quadruple Aim, as its outcomes focus on care, health, cost, and meaningfulness.

Purpose: Implement a daily central line maintenance audit form in an outpatient infusion center with the goals of improving adherence to CLABSI prevention protocol and quality of nursing documentation of CVAD maintenance.

Interventions and Setting: Setting: outpatient infusion center. Participants: adult patients with CVADS for daily antimicrobial treatment. The Model for Improvement including the Plan-Do-Study-Act cycle was utilized. Lewin's Theory of Planned Change was utilized to guide project progression. Unfreezing: infusion staff queried on current practice; gaps in best practice identified. Moving: infusion educated about QI project followed by 3-month implementation period. Refreezing: DNP student assists in form incorporation into EMR.

Evaluation: Rates of CVAD dressing change before and after implementation were analyzed using descriptive statistics. Length of change intervals ranged from 1-11 days pre-implementation and 1-10 days post-implementation. Pre-implementation, the mean, mode, and median were each 7 days. Post-implementation, the mean, mode, and median were 6.1, 7, and 7 days, respectively.

Discussion: Adopting a daily CVAD maintenance audit form will improve documentation and surveillance measures, with the goal of reducing rates of CLABSI. To make this intervention most effective and economical in accordance with Quadruple Aim, it is recommended that the form should be incorporated into the existing EMR.

Keywords: *CLABSI prevention, central line associated bloodstream infection, dressing change, nursing, protocol or policy or practice, documentation*

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Problem Identification & Evidence Review

Background and Significance of the Problem

At a 144-bed community hospital in a rural area of New England, patients are seen daily for antimicrobial treatment for the treatment of infections. Patients who are receiving daily antimicrobial therapy for infections often have a central venous access device (CVAD) in place for medication administration. Infusion nurses are responsible for the care and maintenance of CVADs. It is important that nurses adequately maintain dressings according to evidence-based protocols to reduce the risk of central line-associated bloodstream infection (CLABSI).

Current best evidence supports that CVAD dressing changes occur every 7 days, more frequently if clinically indicated (Chopra et al., 2013; Flodgren et al., 2013; Foka et al., 2021; Ista et al., 2016). However, at the project site, dressing changes are often delayed past 7 days related to lack of effective documentation and surveillance processes. One useful tool to support compliance with best practice is to implement a daily central line maintenance audit form (The Joint Commission, 2014). The purpose of this quality improvement (QI) project is to implement a daily central line maintenance audit form with the goal of improving adherence to CLABSI prevention protocol and support quality nursing documentation of CVAD maintenance.

National Description

The global aim of this QI project is to improve CVAD dressing change documentation for outpatients at one hospital to reduce CLABSI rates. The Joint Commission (2013) defines CLABSI as an infection that develops in a patient with a central line that is not related to an

infection at another site. CLABSIs are associated with increased mortality rates in patients and elevated healthcare costs (Ling et al., 2016), making it a pertinent issue in healthcare in the US.

Local Description

The current protocol at the project site states that CVAD dressings should be changed through sterile processes at least once every 7 days or sooner if clinically indicated (see Appendix A). The documentation process has led to breakdowns in communication among nurses and delayed dressing changes. This issue is multifactorial; some contributing causes are a variation in practice among nursing staff, inadequate protocol implementation, poor communication, and lack of surveillance measures. Dressing change documentation and protocol are in the electronic medical record (EMR) order associated with the patient's order. It is not easily accessible when caring for a patient as the protocol documentation does not populate in each daily encounter. Formerly, this information was kept in a physical folder with hand-written information kept on the nurses' station in a file basket. With the arrival of a new nurse supervisor last year, this process was changed to electronic documentation. However, some nurses continue to create folders and not use the EMR to track dressing changes. This has caused a disruption in communication resulting in dressing changes frequently occurring 10-12 days apart, well beyond the outer boundary of the existing practice policy.

Rationale

The Joint Commission (2013) states that CLABSIs are directly associated with increased morbidity, mortality, and health care costs. DeVries (2019) estimates that CLABSIs can cost an organization about $45,000 per case. CLABSIs are largely preventable through the utilization of evidence-based guidelines for proper insertion and maintenance of CVADs. Although the current policy at the project site states that CVAD dressings must be changed every 7 days or sooner if

clinically indicated (see Appendix A), there is no method of adherence surveillance in use. Marschall et al. (2014) state that surveillance is an important aspect of "prevention bundles" that are aimed at reducing rates of CLABSI.

As stated by Morrison (2017), the goal of routine central line management is to reduce catheter-based infections. Marschall et al. (2014) state that the success of a CLABSI prevention bundle depends on adherence to individual measures, including maintenance of dressings. Wasserman and Messina (2018) state prevention bundle elements must be used in a multi-model approach including performance and adherence surveillance to be successful. The project site has an opportunity to potentially reduce CLABSI rates by improving CVAD documentation and surveillance. This can be accomplished using a daily central line maintenance audit form. Nursing leadership at the project site has expressed support for this project and will consider implementing the audit form into the EMR if this pilot project is proven effective.

Development of Clinical Question

Identifying gaps in best practice measures was influential in developing an appropriate clinical question. There are several factors at the project site contributing to gaps in best practice. Documentation of CVAD dressing changes is obscure and difficult to locate in the EMR, and there is no simple way to track deviations from protocol. Additionally, nurses often do not label dressings appropriately making it more difficult to determine when the dressing was last changed through inspection of the dressing itself. Occasionally, the ink used to label the dressing is washed off in the shower or smudged and becomes impossible to read.

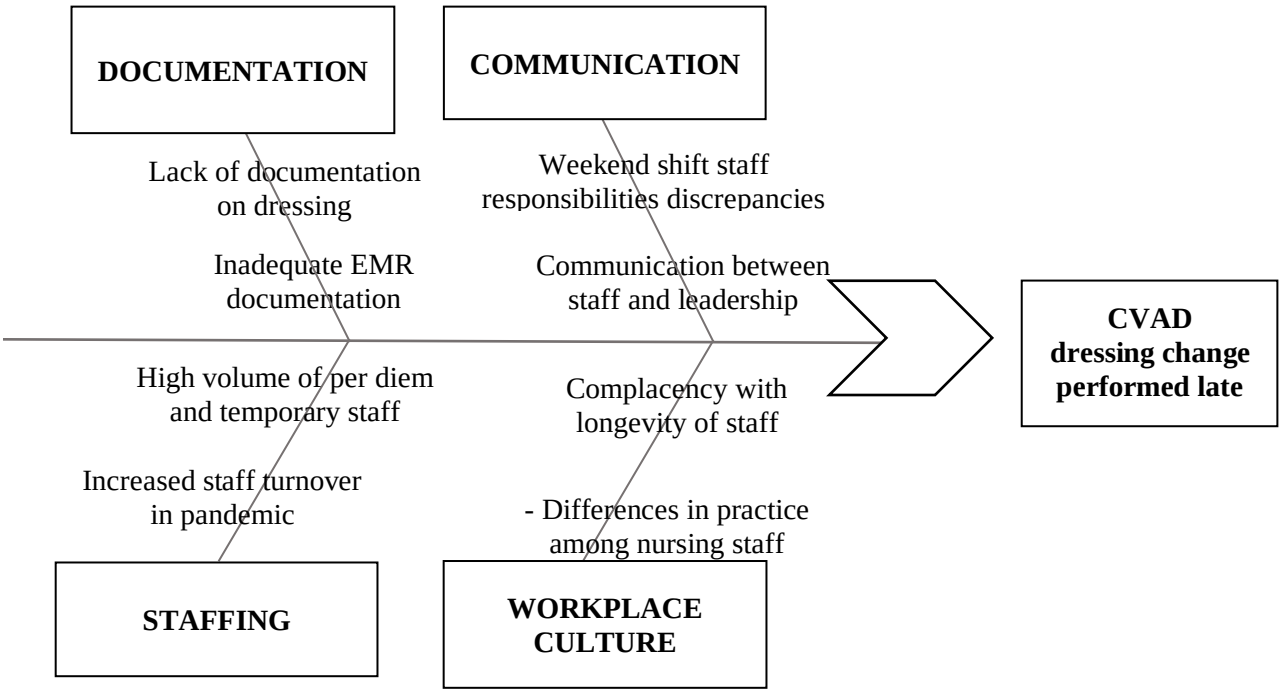
Communication is another gap in the use of best practice, as staff and leaders disagree on the best way to document CVAD dressing change information. In addition, some nurses do not feel they are responsible for dressing changes due on a weekend day, as there is only one nurse

staffed. Additional staffing-related issues that have support the need for change include increased staff turnover during the COVID-19 pandemic and a high volume of per diem staff.

Lastly, workplace culture provides a barrier to change. Some staff are resistant to change while other staff are eager to implement changes and improve efficiency using newer technology and methods. Figure 1 identifies contributing factors including documentation, communication, staffing, and workplace culture to the development of the clinical question.

Figure 1

Fishbone cause and effect diagram.



Note. Contributing factors to late CVAD dressing changes at the project site.

Evidence Review

Focused Search Question

In the care of adult outpatient infusion center patients with CVADs, how does the implementation of a Daily Central Line Maintenance Audit Form compared with current documentation protocol affect the rates of timely dressing changes over a 3-month period?

Systematic Search for Evidence: Process

External Evidence

An evidence search was conducted in the following databases: Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, Academic Search Premier (EBSCO), and Cochrane Library of Systematic Reviews. The keywords used in the search include: "CLABSI prevention," "central line associated bloodstream infection," "dressing change," "nursing," "protocol or policy or practice," and "documentation." Boolean operators were used to narrow results in progressive searches. Results were further limited by type of publication (peer-reviewed), date range (2012-2022), subject (Nursing), geography (United States), and language (English). The results of each database search are presented in Tables B1 through B4 in Appendix B. Additional articles were found through a Google Scholar search of the topic and from reference lists of articles obtained during the search process.

Internal Evidence

The project site infusion nurses were informally queried about their current practice for CVAD dressing change documentation. The infusion supervisor at the project site was also queried regarding current practice and to identify feasible protocol changes. Preliminary internal data from infusion nurses and the infusion supervisor support the need for quality improvement to enhance best practice in CVAD dressing change documentation.

Results: Critical Appraisal of Evidence

Nineteen articles were identified with evidence to support 5-to-7-day CVAD dressing change intervals and surveillance to reduce CLABSI rates. These articles with supporting evidence are summarized in the Evidence Summary Table (see Appendices B and C). Included are five systematic reviews (Level I), one qualitative study (Level III), one prospective study

(Level III), five clinical practice guidelines (Level IV), and three quality improvement articles (Level IV). In addition, several other sources were chosen as lower level supporting evidence and to gain background and knowledge on the subject. These sources include one expert committee report (Level V), two expert commentary pieces (Level V), and one staff education article (Level V). Table C1 (Appendix C) provides a summary of each article with an evidence level of IV or higher. Table D1 and Table D2 (Appendix D) identifies which of these nineteen articles support 5-to-7 dressing change intervals.

Rapid Critical Appraisals

Rapid critical appraisals were completed for each article with an evidence level of IV or higher. These articles were used to support the rationale of this quality improvement project. They also contributed to the body of evidence and support the practice change. Articles with an evidence level of V were used as anecdotal evidence to support the project, but not appraised critically. Rapid critical appraisals of articles with an evidence level of IV or higher are presented in Appendix E.

Evaluation, Synthesis, and Recommendations

The Infusion Nurses Society's Standard of Care 42.4 indicates that a sterile dressing is maintained on a CVAD to protect the site of insertion, promote skin health, prevent invention, and secure the device (Gorski et al., 2021). Standard of Care 42.3 indicates that when caring for a patient with a CVAD, site care including skin antisepsis and dressing change is performed at established intervals and if the dressing is compromised (Gorski et al., 2021). The Joint Commission (2013) also instructs nurses to change clear dressings every 7 days, more frequently if soiled, damp, or loose. The Journal of Infection Prevention states that "transparent, semi-permeable polyurethane dressings should be changed every 7 days, or sooner, if they are no

longer intact or if moisture collects under the dressing" (Richardson, 2015). National Services Scotland, the United Kingdom Department of Health, and the Canadian Patient Safety Institute each echo the guidelines of dressing changes every 7 days (Joint Commission, 2013), indicating that protocols in the United States are consistent with international protocols.

Many sources of level I evidence in the literature support replacing the transparent dressing on CVAD sites at least every 7 days (Chopra et al., 2013; Flodgren et al., 2013; Foka et al., 2021; Ista et al., 2016). However, some contradictions are also reported. A systematic review published by Gavin et al., (2016) states that due to poor study designs and varying results, the quality of evidence in dressing change frequency guidelines is low). The five studies reviewed by Gavin et al. (2016) included a total of 2,277 participants from 4 countries between 1995 and 2009. From these studies, which were all randomized control trials (RCTs), Gavin et al. (2016) determined that they could not draw conclusions about the rates of CLABSI as they related to dressing change frequency. Similarly, nurse practitioners Matey and Camp-Sorrell (2016) highlight the fact that current standard protocols for the care and managing of complications of CVADS is very limited. They report that very few randomized control trials have been conducted to support nursing practice as it relates to the care of CVADs (Matey & Camp-Sorrell, 2016), invoking a call for more research in this area.

Organizations with guidelines for maintaining CVAD dressings include: the Healthcare Infection Control Practices Advisory Committee, Centers for Disease Control and Prevention, the Institute for Healthcare Improvement, the Agency for Healthcare Research and Quality, the American Pediatric Surgical Association Outcomes and Clinical Trials Committee, the Joint Commission, and the Infusion Nurses Society (Marschall et al., 2014). The consensus among these professional organizations includes the use of aseptic technique, chlorhexidine-based

products, a transparent dressing, and regular change intervals, most commonly every 7 days or sooner if clinically indicated. The Society for Healthcare Epidemiology of America suggests nurses performing care of maintenance of CVADs and their dressings should pass a standardized competency assessment (Marschall et al., 2014). The Joint Commission (2013) states that microbial colonization at the insertion site or lack of proper sterile dressings and their maintenance can contribute to CLABSIs.

Taken together, the evidence supports the need for adequate and timely dressing changes, as dressing changes are the first line of defense against CVAD site infection. Evidence based practice guidelines have been shown to decrease the incidence of CLABSI when implemented appropriately (Bell & O'Grady, 2017). A summary of evidence-based recommendations and supporting evidence for each can be found in Table D3 (Appendix D). An outcomes synthesis specifying study location and studies that support a 5-to-7-day dressing change interval is in Table D2 (Appendix D).

In addition, there are several studies in the literature of lower-level evidence that support these recommendations. Hicks and Lopez (2022) provide clinical guidelines which state that a sterile dressing should be applied and remain in place for 5 to 7 days. Additionally, Hicks and Lopez state that the need for central venous access should be reevaluated every day.

Quality improvement (QI) studies available in the literature which support the merits of this project. Carey et al. (2017) achieved 41-66% reductions in CLABSI rates on various wards of adult oncology patients through the implementation of a CLABSI prevention bundle. Duffy et al. (2015) conducted a QI project re-implementing a CVAD daily maintenance care bundle in a pediatric oncology unit. Their project confirmed that using a CVAD daily maintenance care bundle decreases CLABSI. Hugo et al. (2022) introduced a formalized nursing-led rounding

process to increase CVAD maintenance bundle compliance and determined that this intervention reduced the CLABSI 12-month cumulative standardized infection ratio (SIR) from 0.9 in November 2017 to 0.53 in June 2021. Wilder and colleagues (2016) established a formal line-rounding and dressing change competency including performing daily rounds and a 2-person sterile technique in a NICU. After this intervention, Wilder and colleagues identified that the CLABSI rate was reduced from 3.9 in 2011 to 0.3 per 1000-line days in 2014, with an overall 92% improvement.

Project Plan

Project Goals

1. Identify rates of delayed CVAD dressing changes (longer than 7 days) at project site over a 3-month period (October 10th to January 10th, 2023, in collaboration with EMR staff.
2. Improve adherence to CVAD dressing changes, an element of CLABSI prevention protocol, through the implementation of a central line maintenance audit form as a surveillance measure and evaluation of data for 3 months post-implementation.
3. Improve and standardize CVAD dressing change documentation in an infusion center.
4. Evaluate the effectiveness and utility of the central line maintenance audit form by comparing timely dressing change rates before and after implementation.

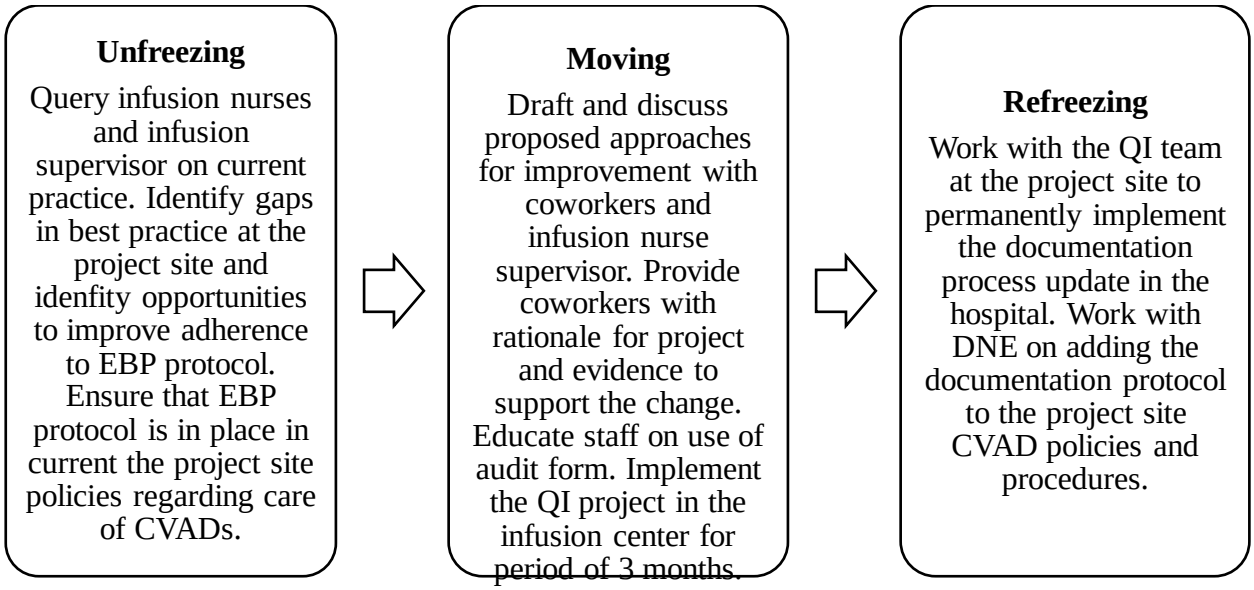
Quality Improvement Model and Change Theory

Quality improvement (QI) models and change theories provide best practices for change leadership and implementation (Barrow et al., 2021). This QI project used the Model for Improvement including the Plan-Do-Study-Act (PDSA) cycle (Raymond & Dawda, 2016). According to Raymond and Dawda (2016), this model is a simple but effective framework to guide quality improvement. PDSA cycles were informally conducted throughout the project

using monthly staff meetings to make project adjustments as appropriate. The change theory that will guide this QI project is Lewin's Theory of Planned Change (Lewin, 1935) which contains 3 steps: unfreezing, moving, and refreezing (Barrow et al., 2021). The steps of Lewin's theory as it relates to this project is outlined in Figure 2.

Figure 2

Lewin's change theory.



Context/Organizational Assessment

Setting and Population

The setting of this project was an outpatient infusion center within a community-based, Magnet recognized hospital in a rural area of Vermont. The patients chosen were adult patients in an outpatient infusion center with a CVAD. Specifically, these patients have a (peripherally inserted central catheter) PICC for the administration of frequent intravenous hydration or daily antimicrobial treatment for serious infections.

Stakeholders

The stakeholders for this QI project include the infusion nursing staff, infusion supervisor, infection prevention leader, practice mentor, and QI team leader Director of Nursing Excellence, and patients who are under care at the infusion center.

Barrier and Facilitators

Sterile dressing changes using the proper technique and frequency can greatly reduce the risk of CLABSIs (Joint Commission, 2013). One barrier to accomplishing this in practice at the project site is an ineffective documentation process. Another barrier is an increased number of per-diem and/or temporary staff nurses working in a particular unit. the project site has seen an increase since the beginning of the COVID-19 pandemic in per diem, float, and travel nurses working in the outpatient infusion center. It has been shown that the use of nonpermanent nursing staff is associated with a significant risk of healthcare acquired infection, including CLABSIs (Joint Commission, 2013). A facilitator to the success of this project is the collaboration with the EMR team at the project site. The project site utilizes Cerner, a nationally recognized EMR, which employs nurses located within the project site to support nursing staff. A Cerner employee agreed to assist with data collection for this QI project.

Practice Change Protocol

At the project site, when the need for a policy update is identified by an employee, the Director of Nursing Excellence (DNE), is consulted. The DNE will determine the appropriate members of the hospital staff to create a committee for policy review. Members meet in person several times to discuss the policy and can collaborate individually at their convenience on the project site Policy Stat intranet website. These staff members can log into Policy Stat, the project site's electronic clinical policy repository, to view, and edit any policy for which the DNE has

designated them a part of the review committee. Once each member of the committee feels the policy is updated appropriately, the DNE will finalize the review and it will be published in Policy Stat for all staff to read. Other members of the hospital staff do not have the ability to view the new policy being drafted until it is finalized and published. When it is published, an email will also be sent out to all staff in the "Scope" section of the policy to maintain consistency in processes throughout the hospital.

Figure 3

Project timeline.

Component	Definition	Date Completed
Phase 1: Problem Identification and Evidence Review		
Clinical Inquiry including background and significance of problem	Describe local problem and its significance. Include data to frame local problem.	4/10/22
Organizational priority	Summarize information that supports topic/problem is an organizational priority.	4/10/22
Searchable Question	Write a focused, searchable question using an established method (e.g., PICO).	4/10/22
Evidence search	External evidence • Summarize search strategy (e.g., databases, keywords, filters/limits, criteria for article selection, tools for critical appraisal). Include practice-based evidence (e.g., evidence-based solutions that experts/other health systems have implemented to address practice problem).	4/24/22
	Internal evidence • Summarize applicable unit/community/department/hospital/organizational level data or data required for national entities (e.g., CMS, NDNQI, AHRQ).	4/10/22
	Perform needs assessment if applicable.	N/A

Evidence appraisal, summary, and recommendation	Organize evidence that answers focused clinical question in a clear concise format (e.g., table or matrix).	4/24/22
	Appraise literature for quality and applicability of evidence using established method (e.g., Johns Hopkins Nursing EBP Research Evidence Appraisal Tool, Joanna Briggs Institute Critical Appraisal Tools, Fuld Institute for EBP critical appraisal tools etc.).	4/24/22
	State recommendations(s) and link to evidence strength and quality and risk/benefits.	4/24/22
Phase 2: Project Planning		
Project goals	State intended, realistic outcomes of project using established method (e.g., SMART criteria).	4/15/22
Framework	Select framework/model to guide implementation (e.g., EBP model, QI framework, Change model).	4/15/22
Context	Describe project setting and participants or population, or other elements that are central to where the change will occur.	4/15/22
Key stakeholders	Identify agencies, departments, units, individuals needed to complete the project and/or affected by project, and strategies to gain buy-in.	4/15/22
Practice change/intervention	Provided detailed description of practice change or intervention (e.g., new, or revised policy).	4/24/22
Evaluation	Summarize plan for evaluating the effectiveness of the practice change. Identify applicable process and outcome data to be collected/tracked and tools to do this. Identify the methods for analyzing/interpreting the data (e.g., control, run or Pareto charts).	5/1/22
Possible barriers to implementation	Identify possible barriers and implementation strategies to mitigate these barriers.	4/24/22
Sustainment	Identify strategies to sustain the change.	5/1/22
Timeline	Create a realistic timeline for project completion.	4/10/22
Resources	Identify all resources (e.g., indirect, and direct) needed to complete the project.	4/15/22
Ethical merit	Identify and obtain the required review and approval needed for implementation (e.g., institution, community agency, IRB).	5/27/22

Staff education	Provide staff with pertinent articles and project rationale via email to support buy-in and commitment to the project.	09/01/22
Phase 3: Implementation		
Implement project	Carry out the project using selected implementation framework/model. Track any deviations/changes from the project plan.	10/10/22-1/10/23
Phase 4: Evaluation		
Results/Interpretation	Using an established method display data and interpret project outcomes.	03/1/23
	Report evaluation of the effectiveness of the practice change, including extent the practice change was implemented (process outcome) and extent to which the desired outcome(s) were achieved.	03/1/23
Return on investment	Identify the final resources that were used to implement the project. Calculate and report the return on investment.	03/1/23
Phase 5: Dissemination		
Traditional	Disseminate to the project setting in a manner meaningful to them (e.g., executive report, poster, presentation at a meeting, poster with QR code to access details of project, etc.)	04/21/23 04/21/23
	Disseminate in the format required by the academic institution (e.g., poster, public presentation) and	04/15/23
	Prepare final project write-up using established reporting guidelines (e.g., EPQA, SQUIRE) and academic institution requirements.	

PICO, Population, Intervention, Comparison, Outcome; **CMS**, Center for Medicaid and Medicare Services; **NDNQI**, National Dataset of Nursing Quality Indicators; **AHRQ**, Agency for Healthcare Research and Quality; **SMART**, specific, measurable, attainable, relevant, timely; **IRB**, Institutional Review Board; **EPQA**, Evidence-Based Practice Process Quality Assessment Guidelines; **SQUIRE,** Standards for Quality Improvement Reporting Excellence

Resources and Budget

This quality improvement (QI) project has a very high level of cost-effectiveness. The costs to consider for this QI project are the materials needed for manual documentation, such as binders, paper, and ink, totaling approximately $400 annually. If the change is adopted within the organization, the long-term cost to the project site would be negligible, as the documentation

would be incorporated into the current EMR rather than on paper. There would be one-time costs (base rate per hours worked) to pay EMR staff to adopt this into the EMR. The few resources and affordability of this intervention will positively affect the sustainment of the proposed practice change.

Ethical Review

The project is a quality improvement project without human subject intervention and has a single site focus (see Figure 4). The project was deemed and approved as a quality improvement project by the project site IRB and by Sacred Heart University IRB and exempt from full IRB review. Copies of these approvals can be found in Appendix J.

Figure 4

Quality improvement vs. research tool.

Question	Y	N
Is the project designed to bring about immediate improvement in patient care?	X	
Is the purpose of the project to bring new knowledge to daily practice?	X	
Is the project designed to sustain the improvement?	X	
Are findings specific to this hospital?	X	
Are all patients who participate in the project expected to benefit?	X	
Is the intervention at least as safe as routine care?	X	
Will all participants receive at least usual care?	X	
Do you intend to gather just enough data to learn and complete the cycle?	X	
Do you intend to limit time for data collection to accelerate the rate of improvement?	X	
Is the project intended to test a novel hypothesis or replicate one?		X
Does the project involve withholding any usual care?		X
Does the project involve testing interventions/practices that are not standard of care?		X
Will any of the 18 identifiers according to the HIPAA Privacy Rule be included?		X
Is the purpose to measure the effect of a process change on delivery of care?	X	

Note. Adapted from "Differentiating Quality Improvement and Research Activities", by Foster, J., (2013). Retrieved from https://doi.org/10.1097/NUR.0b013e3182776db5

Data Collection Plan

The daily central line maintenance audit form that was used in data collection for this QI project is presented in Appendix E. This form was modified from The Joint Commission's Daily Central Line Maintenance Checklist Template, which is presented in Appendix F. The Joint Commission states that the form may be adapted for internal use. Rates of timely and delayed dressing changes from the 3-month period of May 1st, 2022 through August 1st, 2022, were obtained through retrospective review of relevant documentation in the EMR. The DNP student used the EMR to collect this data which served as the baseline pre-project implementation dataset.

The DNP student educated the infusion department nursing staff on the project plans, purpose, goals, and use of the audit tool. Rates of timely and untimely dressing changes were tracked concurrently by the DNP student through weekly analysis during the implementation phase of the project. The implementation phase length was 3 months, from October 10th, 2022, through January 10th, 2023. Forms were stored in the infusion center nurses station in a binder within a locked drawer. Project data was entered into a password protected spreadsheet throughout data collection by the DNP student. No individually identifying patient data was collected or documented.

Data Analysis Plan

Data was analyzed using descriptive statistics. Data was displayed using bar graphs comparing pre- and post-implementation results. A line graph was used to display concurrent review findings of average number of days for dressing changes over a 3-month period. Control charts were used to display data. and to identify the variability from the standard of care (Brady et al., 2017) within the project results.

Project Implementation

Creating Awareness and Commitment

Utilizing email, the project topic was introduced to nurses in the infusion center for preliminary feedback. The proposal presentation and strongest supporting clinical evidence was emailed to leadership and the DNP project advisor, for feedback. More information and a project proposal presentation were provided to all colleagues and leadership in the infusion center in September of 2022. As stated by Powell et al. (2015), and in accordance with the quality improvement (QI) process, the next appropriate step in implementation is to capture and share local knowledge. To do so, peers gave feedback and were given an opportunity to engage in a discussion about the project's goals, implications, and anticipated outcomes. This feedback was used to modify the daily central line maintenance form, which was modified with open permission from The Joint Commission.

According to Powel et al. (2015), the next step is to assess for readiness and identify barriers and facilitators. This was completed at the presentation in September of 2022. Infusion center nurses and the Diagnostic Imaging department leadership identified no significant barriers to implementation. Those in attendance pledged to act as facilitators and encourage participation in the project. The consensus from discussions with stakeholders was that the project would be beneficial to the infusion center and improve patient care and safety.

Promoting Action and Adoption

In October 2022, the project was formally implemented in the infusion center. Data collection began on October 10th, 2022 and continued until January 10th, 2023. The intended plan was to hold monthly meetings via Zoom to assess progress, however, this proved unnecessary. Several smaller meetings were held informally to meet with staff nurses and leaders to discuss

project implementation. This phase went very smoothly as nurses completed the forms each day and put in great effort to facilitate the project's success.

Project Results and Evaluation

Process and Outcome Measures

According to the AHRQ (Agency for Healthcare Research and Quality), process and outcome measures should be linked to the larger goal of the project and to the intervention itself (2017). One QI expert in the public health field, Elmi (2012) provides potential questions to determine the process effectiveness in a QI project. Figures 5 and 6 display processes and outcomes respectively. This model was used at the completion of the implementation phase to evaluate the effectiveness of this project.

Figure 5

Process evaluation table.

Question	Answer
What QI activities have been implemented?	The addition of new central line dressing maintenance surveillance documentation in an outpatient infusion center
To what extent has the QI support (trainings, tools) been useful?	They have been useful in guiding the QI process by providing standardization in the approach and delivery of staff education and project formatting.
How are data being used to inform QI?	The data will be submitted to the project site Quality Improvement team with the hope that this will be added into the EMR.
To what extent is the QI process working? How can it be improved?	The QI process worked well in the implementation stage of the project. The QI process can be improved in the future through the addition of appropriate CVAD dressing change surveillance into the EMR
What types of QI activities have been found not to be most successful?	Charting on paper versus in the EMR due to usability and time effectiveness

Figure 6

Outcomes evaluation table.

Question	Answer
How have implemented QI efforts improved the efficiency or effectiveness of practices/program?	Efficiency will be approved if this pilot QI study affects change within the EMR documentation.
What has been the impact of QI efforts on provider adherence to evidence-based guidelines?	The efforts in this QI project improved adherence to the most current evidence-based guidelines.
To what extent have QI efforts influenced knowledge and behavior in individuals?	The QI efforts have engaged staff nurses in focusing on CVAD care more closely and encourage better surveillance of dressing change timeliness.
To what extent have patient health outcomes improved as a result of implemented QI efforts?	Patient health outcomes have improved due to the implemented QI efforts as fever dressing changes occurred outside of the appropriate window (7 days).

Patient Data

In the pre-implementation data group (n= 11), patients range from 51 to 95 years of age. 27% of patients are female and 73% patients are male. Data was collected from May 1st, 2022 through August 1st, 2022. The post implementation data group of patients (n=8) are between the ages of 52 and 77. Within that group, 25% are female and 75% are male. Data was collected from October 10th, 2022, through January 10th, 2023. The length of dressing change intervals for pre-implementation patients (Figure 7) ranged from 1 to 11 days. The length of dressing change intervals for post implementation patients (Figure 8) was 1 to 10 days. The mean, median, and mode prior to implementation were all 7 days. The mean change interval post implementation was improved at 6.1 days and the mode and median were each 7 days.

Figure 7

Pre-intervention dressing change data column graph.

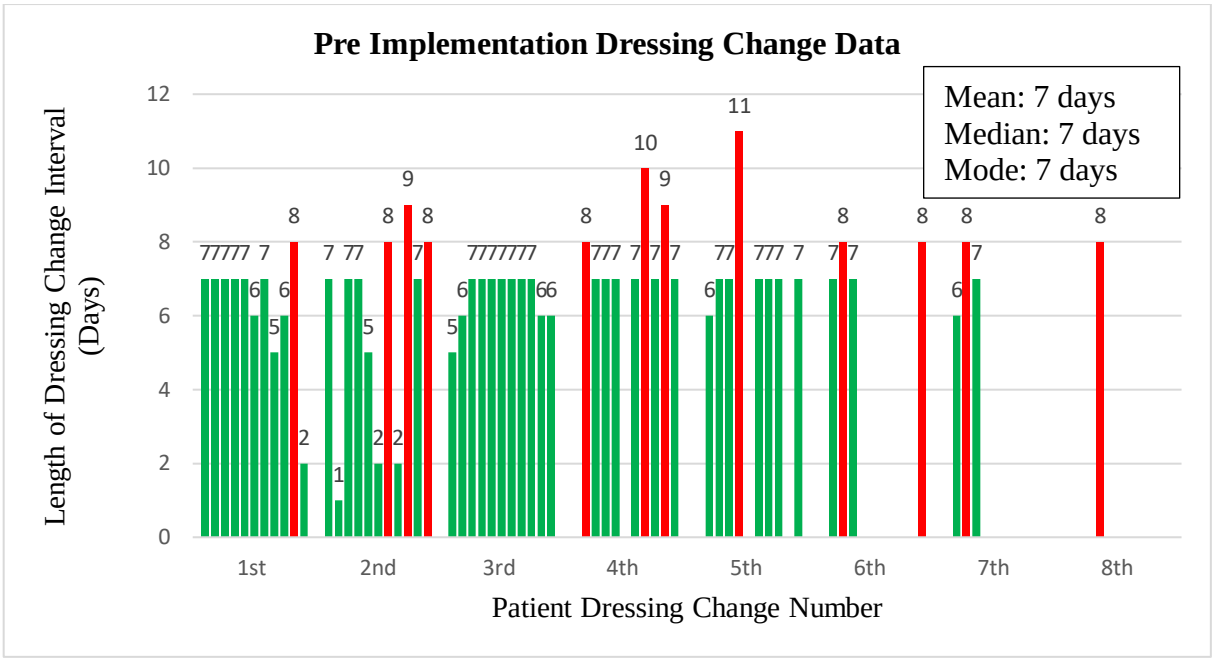
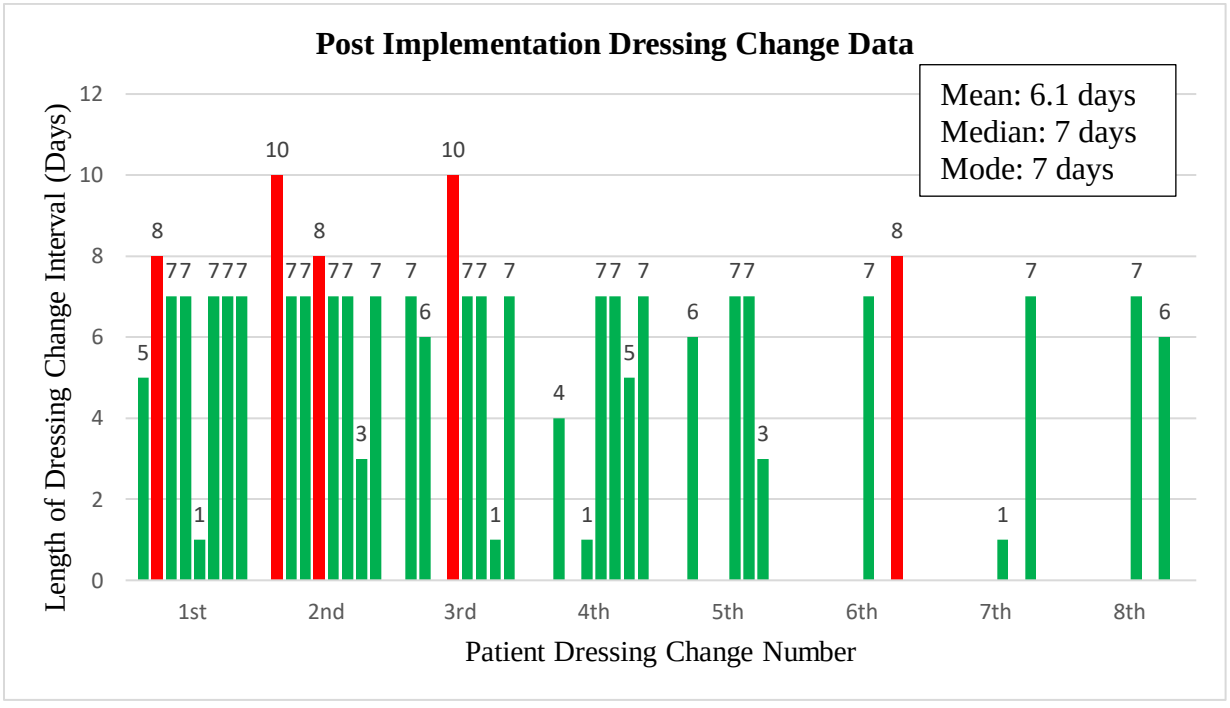


Figure 8

Post-intervention dressing change data column graph.

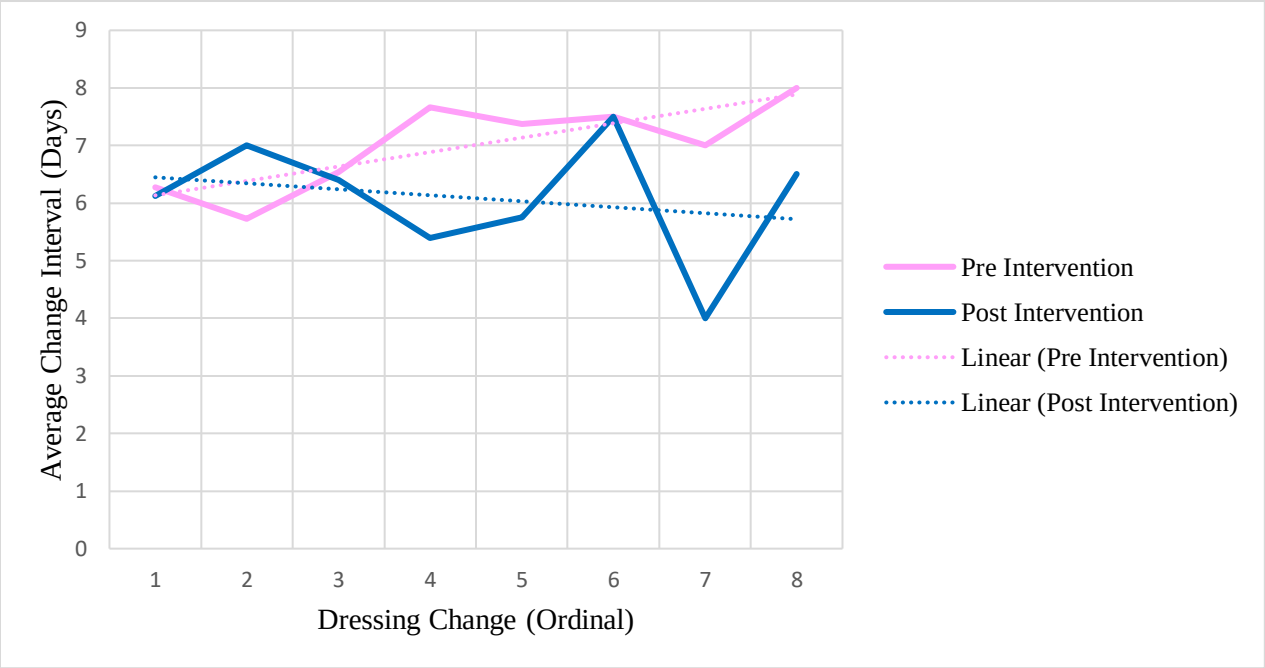


Line Chart

Dressing change interval means, both pre and post implementation, are depicted along with linear mean lines in Figure 9. These results support that the proposed practice change would be effective, as the mean change interval following implementation was congruent with current evidence-based guidelines (less than 7 days).

Figure 9

Line chart indicating average dressing change intervals pre and post intervention.



Control Charts

A control chart was generated using the mean number of days per dressing change interval for each dressing change for each patient. This was completed for the data obtained both pre and post implementation. These control charts are depicted in Figures 10 and 11. Utilizing Microsoft Excel software, the control line, upper line, and lower line were generated using the mean and standard deviation of the mean dressing change interval data for the pre implementation and post implementation periods.

Figure 10

Pre-implementation control chart using mean dressing change intervals.

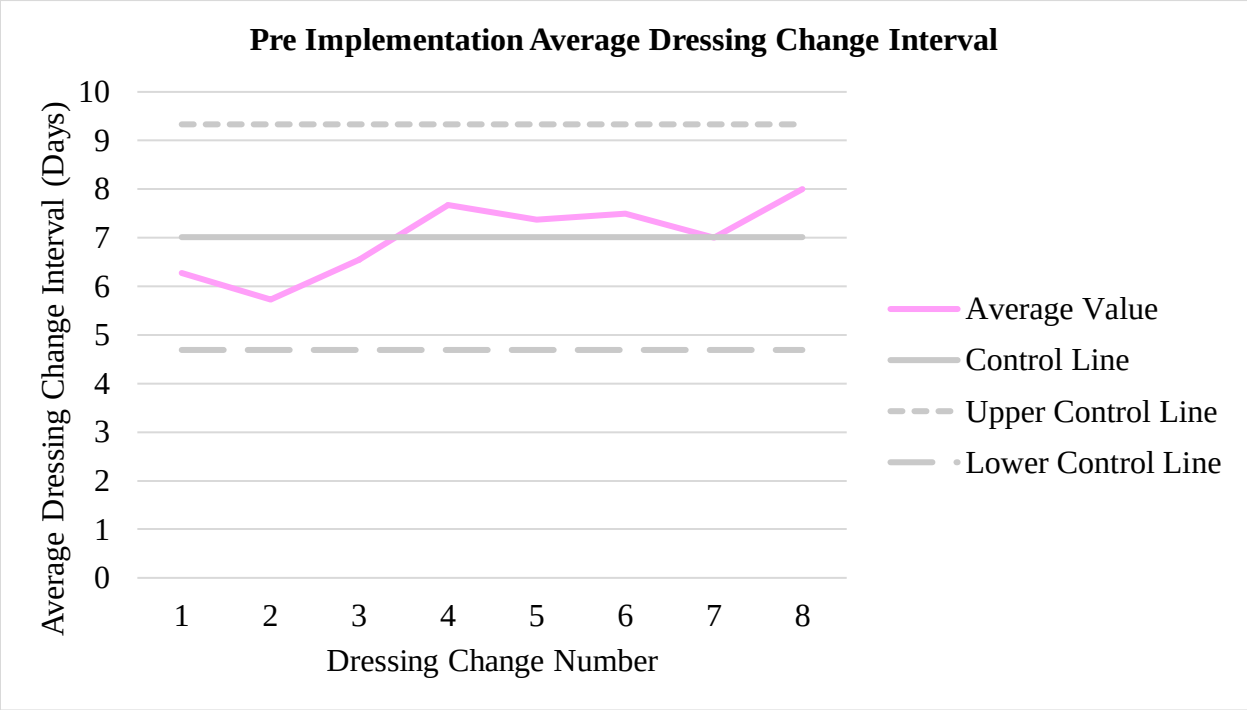
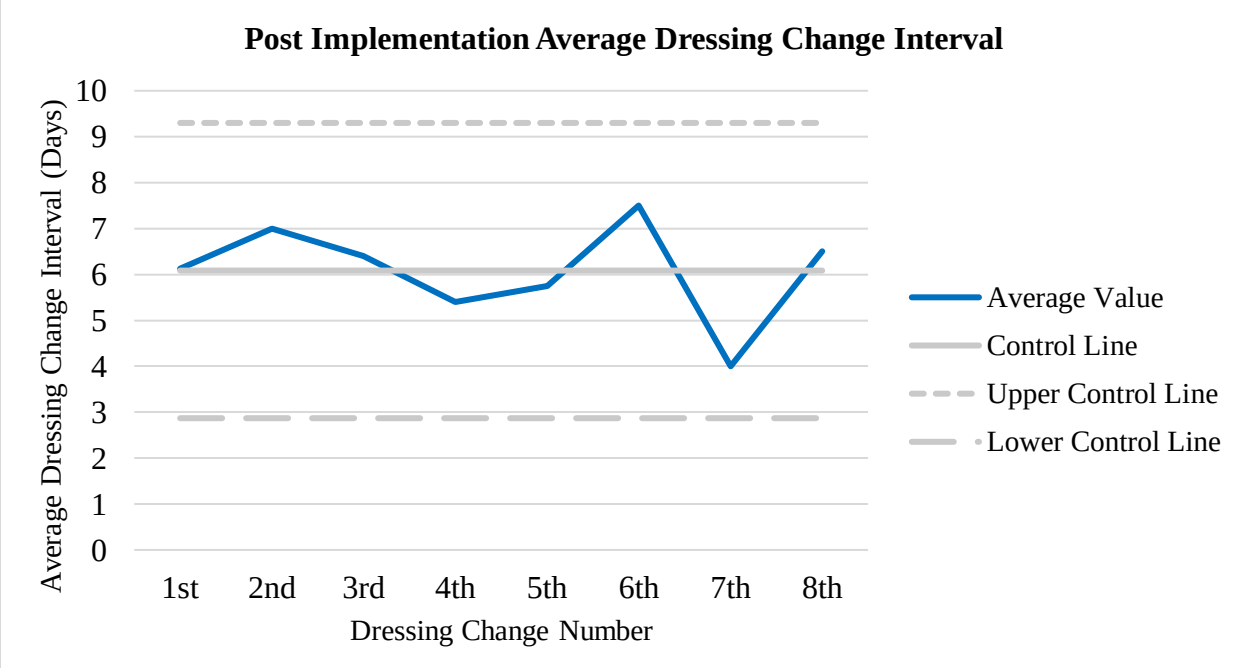


Figure 11

Post-implementation control chart using mean dressing change intervals.



Return on Investment

This project will yield a high level of return on investment due to its emphasis on resource stewardship and patient safety. Resource stewardship considers two important aspects of healthcare today: financial burden to the organization and environmental impact of healthcare delivery (Okpala, 2018). It is important that the costs of healthcare changes do not negatively affect the quality of patient care (Okpala, 2018). This project presents a very low cost, low resource solution to an important patient safety issue. Patient care will be improved while maintaining a high level of resource stewardship and a high return on investment through improved patient safety with anticipated reduction in CLABSI for this patient group.

Sustainability Plan

The importance of sustainability is highlighted by the Institute of Medicine, as sustainability as one of the six domains of quality in healthcare (Mortimer et al., 2018). Methods to sustain this project's proposed practice change include cultivating a culture of resource stewardship. Resource stewardship is essential to this project due to the potential costs it poses to the hospital related to EMR changes and staff education hours.

This QI project has a very high level of cost-effectiveness. Costs to consider for this project are the materials needed for manual documentation, such as binders, paper, and ink, totaling approximately $400 annually. There are no additional staff costs as staff participation was done during normal work hours. If the change is adopted within the organization, the long-term cost to the project site would be almost negligible, as the documentation would be incorporated into the current EMR rather than on paper. There would be one-time costs to pay EMR staff of approximately $160 (estimated 4 hours at $40 per hour) to adopt this into the EMR.

The few resources and affordability of this intervention will positively affect the sustainment of the proposed practice change.

Including methods of sustainability in staff education can promotes a culture of resource stewardship (Mortimer et al., 2018) among all team members which aids in the success of QI projects. This will be addressed in the final presentation at the project site to promote this spirit within the staff members, slated for the summer of 2023.

After the final presentation, the QI team at the project site will determine whether the proposed practice change should be implemented as an update to the current CVAD dressing change policy. If so, the current policy will need to be amended and updated in Policy Stat, the intranet platform of policies and procedures at the project site. Periodic adherence review will be a part of the ongoing QI program at the project site to ensure that the practice change is sustained.

Although statistical improvements in this pilot study were modest, results indicate that impactful change could be made over time. Each CLABSI prevented saves hospitals an estimated $45,000 per case, making even modest improvements significant. Adopting a daily CVAD maintenance audit form will improve documentation and surveillance measures to support the goal of reducing CLABSI rates. To make this intervention most effective, sustainable, and economical in accordance with Quadruple Aim (Bodenheimer, 2014), it is recommended that the form be incorporated into the EMR.

Project Dissemination

Internal Dissemination

Melnyk and Fineout-Overholt (2019) emphasize that the purpose of disseminating evidence is to facilitate the transfer and adoption of EBP QI projects into clinical practice. One

strategy for internal dissemination of this project is a poster presentation at the project site delivered to an audience of other healthcare professionals. Poster presentations provide an opportunity for a visual display of evidence and for presenter-audience interaction, as they are less formal than podium presentations (Melnyk & Fineout-Overholt, 2019). As recommended by Melnyk & Fineout-Overholt, the poster will be brightly colored with contrasting text and background shades to optimize readability. Included on the poster will be the following sections: abstract, introduction, findings, in a graphic format, discussion, resources, acknowledgements, and plans for full implementation at the project site, if appropriate. As suggested by Melnyk and Fineout-Overholt, PowerPoint copies of the information in the poster will be distributed to the audience. This poster presentation, which will also displayed at SHU in the spring of 2023, is depicted in Appendix H.

External Dissemination

According to Melnyk & Fineout-Overholt (2019), publishing a journal article is one effective was to share evidence-based information with colleagues in the same field. For external dissemination, this QI project and results will be submitted for publication to the *Journal of Infusion Nursing* during the fall of 2023.

Implications of Project Results

It is anticipated that the results of this project will influence the policy regarding CVAD dressing change documentation at the project site. Implementing valid documentation measures provides a foundation for quality surveillance of infection rates, which is central to patient care in this population. Although this QI project was conducted using handwritten documentation, as this project proved effective, leadership is expected to consider adding the documentation form

to the electronic medical record (EMR) for ease of access. This process will be discussed with the project site quality improvement leadership during the summer of 2023.

Key Lessons Learned

Internal Support Challenges

During the project, several key stakeholders at the project site unexpectedly departed the organization. The role held by these individuals remained vacant and the project site made the decision to temporarily discontinue services to the patient population identified for this QI project. Patients were referred during this time to other facilities. As a result of these changes, the sample size for the project was limited and additional attention to the identification and education of internal resources was required. As the project site is a small hospital, challenges exist in establishing a deeper based of internal support; however, future projects will consider how to possibly mitigate ill effects of these challenges.

PDSA Cycle Throughout the Project

During the evaluation phase, staff nurses identified that several outliers occurred in the post-implementation phase (dressing changes at 9 or 10 days) due to factors beyond nurse control. Factors include patient non-attendance and refusal of dressing changes. As a result of this feedback, this was considered carefully when evaluating results. Listening to staff and mentor's comments and incorporating improvements during the process will support 'buy in' and will likely yield a smoother process.

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Appendix A

Rutland Regional Medical Center: Central Venous Catheters Policy

Rutland Regional Medical Center

Status: Active
PolicyStat ID: 9899013
Created: 11/20/2015
Last Revised 8/4/2021
Effective 8/4/2021
Owner: Rhonda Roberts
Area: Nursing General

Central Venous Catheters

Central Line – Maintenance and Dressing Change

- Assessment performed with any change in primary RN and includes:
  - Signs of pain, redness, swelling, and/or inflammation.
  - Date on dressing and needleless injection cap(s).
- Change dressing 24 hours after line insertion ONLY if hemostatic CHG (GuardIVa) dressing is saturated with bloody drainage.
- Hemostatic CHG (GuardIVa) dressing with transparent dressing:
  - Will be used unless otherwise ordered.
  - Must be dated.
  - Will be changed every 7 days.
- *For Chlorhexidine Gluconate/Chloraprep sensitive patients*, use standard transparent dressing change.
  - 4 hours after insertion.
  - Every 72 hours.
  - As needed, if wet or compromised.
- Dressing change equipment.
  - Central line dressing kit.
  - Sterile 10 cc normal saline syringe.
- Dressing removal.
  - Perform hygiene, wear face mask, apply face mask to patient (if tolerated), and don sterile gloves. *Note: Always keep dressing removal low and slow.*
  - Remove tape strips used to secure tubing. Grasp edge of dressing and slowly peel from skin TOWARD site.
  - May wipe skin with alcohol swab or sterile normal saline to facilitate removal.
  - Support skin and catheter to minimize risk of dislodgement.
  - Inspect site for redness, swelling, and drainage.
  - Discard dressing, gloves, and repeat hand hygiene.
- New dressing application.
  - Open dressing kit and prepare sterile area and supplies.
  - Apply sterile gloves.
  - Cleanse site with 70% Isopropyl alcohol for 15 seconds and let air dry (until evaporated).

    - Cleanse site with Chloraprep swab (if not sensitive). Cleanse site with Chloraprep in a back and forth motion for 30 seconds. Allow 2-minute dry time. *Note: use 70% isopropyl alcohol for infants <8weeks, and for CHG sensitive patients.*
    - Apply hemostatic CHG (GuardIVa) dressing with writing face-up.
    - Apply Skin Protectant to area that will be in contact with the adhesive part of the dressing if patient does not refuse skin protectant.
    - Center transparent dressing over site.
    - Date dressing.
- If hemostatic transparent dressing becomes saturated, change dressing.
- Needleless cap change.
    - Clamp lumens.
    - Twist off old needleless cap.
    - Maintain sterility of catheter hub.
    - Scrub catheter hub with alcohol for 15 seconds.
    - Twist on new needleless cap.
    - Flush each lumen with 10 cc or larger syringe. Use push-pause method and end with positive pressure. See Central Venous Catheter Table for additional flushing information.
    - Date each needleless cap.
    - Document dressing/needleless cap change activities in EMR.

Note. Excerpt taken from: Rutland Regional Medical Center. (2021). *Central venous catheters* (Policy No. 9899013). http://the project site.policystat.com/policy/9899013/

Appendix B

Systematic Search for Evidence: Results

Table B1

CINAHL Complete: Search Terms and Results

Search Terms	Number of results	Number of title & abstract reviewed	Number of full-text articles reviewed	Number of duplicates	Number of articles selected
(CLABSI prevention) OR (central line associated bloodstream infection) AND (dressing change)	104	0	0	N/A	N/A
(CLABSI prevention) OR (central line associated bloodstream infection) AND (dressing change) AND (nursing)	100	0	0	N/A	N/A
(CLABSI prevention) OR (central line associated bloodstream infection) AND (dressing change) AND (nursing) AND (protocol or policy or practice)	96	0	0	N/A	N/A
(CLABSI prevention) OR (central line associated bloodstream infection) AND (dressing change) AND (nursing) AND (protocol or policy or practice) AND (documentation)	78	0	0	N/A	N/A
Above criteria met and includes “CLABSI” in title of article	10	10	7	2	4

Table B2

PubMed: Search Terms and Results

Search Terms	**Number of results**	**Number of title & abstract reviewed**	**Number of full-text articles reviewed**	**Number of duplicates**	**Number of articles selected**
(CLABSI prevention) OR (central line associated bloodstream infection) AND (dressing change)	36	0	0	N/A	N/A
(CLABSI prevention) OR (central line associated bloodstream infection) AND (dressing change) AND (nursing)	15	14	8	0	N/A
(CLABSI prevention) OR (central line associated bloodstream infection) AND (dressing change) AND (nursing) AND (protocol or policy or practice)	11	10	7	0	5

Table B3

Academic Search Premier (EBSCO): Search Terms and Results

Search Terms	Number of results	Number of title & abstract reviewed	Number of full-text articles reviewed	Number of duplicates	Number of articles selected
(CLABSI prevention) OR (central line associated bloodstream infection) AND (dressing change)	2	2	2	0	N/A
(CLABSI prevention) OR (central line associated bloodstream infection) AND (dressing change) AND (nursing)	2	2	2	0	2

Table B4

Cochrane Library of Systematic Reviews.

Search Terms	Number of results	Number of title & abstract reviewed	Number of full-text articles reviewed	Number of duplicates	Number of articles selected
(CLABSI prevention) OR (central line associated bloodstream infection) AND (dressing change)	2	2	0	0	N/A
(CLABSI prevention) OR (central line associated bloodstream infection) AND (dressing change) AND (nursing)	2	2	2	0	1

Appendix C

Evidence Summary Table

Table C1

Evidence Summary Table.

#	Article Citation and Funding	Conceptual Framework	Design and Method	Sample and Settings	Variables and Outcome Measure	Data Analysis	Findings	Evidence Level and Quality
1	**Title:** Prevention of central line-associated bloodstream infections **Author:** Bell & O'Grady **Year:** 2017 **Funding:** N/A	**Theoretical basis:** Evidence-based guidelines have led to a significant reduction in the incidence of blood stream infections associated with CVADs.	**Design:** Clinical practice guideline **Level:** IV **Method:** N/A	**Sample Number:** N/A **Inclusion criteria:** N/A **Exclusion criteria:** N/A **Attrition:** N/A	**IV:** practice guidelines and nursing interventions **DV:** CLABSI rates	**Statistics Used:** N/A	**Statistical:** N/A **Qualitative:** Insertion strategies including education and training of those who insert catheters, use of chlorhexidine for skin antisepsis, and maximal sterile barrier precautions are best practice	**Strengths:** Extensive list of sources with a high level of evidence used to form guidelines **Limitations:** Low level of evidence (IV), clinical practice guideline only
3	**Title:** The risk of bloodstream infection associated with peripherally inserted central catheters compared with	**Theoretical basis:** PICCs and CVADs (central venous catheters) are associated with CLABSI; relative risk	**Design:** Systematic review with meta-analysis **Level:** I **Method:** Search of EmBASE,	**Sample Number:** 23 studies **Inclusion criteria:** involving adults who underwent insertion of	**IV:** interventions for infection prevention **DV:** risk and occurrence of CLABSI	**Statistics Used:** relative risk analysis, subgroup analyses; Random effects	**Qualitative:** Hospital patients are just as likely to experience CLABSI with PICCs as with CVADs; CLABSI reduction was	**Strengths:** highest level of evidence, throughout search and analysis conducted **Limitations:** only 1 RCT met criteria, strategies

	central venous catheters in adults: A systematic review and meta-analysis **Author:** Chopra et al. **Year:** 2013 **Funding:** Not specified	between the 2 is unknown.	Scopus, MEDLINE, and CENTRAL.	PICC or CVAD and reported CLABSI; systematically compared frequency of CLABSI between the 2 and also to PICs, case reports or care control studies **Exclusion criteria:** Pediatric patients, CLABSI rates not reported, patients without central line **Attrition:** 1,162 studies	**Scales:** Downs and Black scale used to identify risk of bias	meta-analyses used to generate summary estimates	greater in outpatients than inpatients. All central lines pose a risk of CLABSI.	for prevention and CLABSI definition variable between studies
5	**Title:** Implementing a daily maintenance care bundle to prevent central line-associated bloodstream infections in	**Theoretical basis: A** decrease in CLABSI rate is clinically significant with a potential decrease in the health care costs and voidance of	**Design:** Quality improvement **Level:** V **Method:** pre-post program design comparing rate of CLABSI over 6 months after	**Sample Number:** N/A **Inclusion criteria:** N/A **Exclusion criteria:** N/A **Attrition:** N/A	**IV:** care bundle interventions **DV:** CLABSI rates	**Statistics Used:** median infection rates pre and post intervention displayed in chart; Ax2 test and Mann-	**Statistical:** CLABSI rate was higher during pre-intervention phase than post-intervention phase **Qualitative:** decrease in CLABSI rate is clinically significant with a	**Strengths:** clinically significant results; multidisciplinary approach used **Limitations:** results clinically significant but not statistically significant; EMR chart audit did not

	pediatric oncology patients **Author:** Duffy et al. **Year:** 2015 **Funding:** Not specified	negative patient outcomes	implementation of daily maintenance catheter care bundle; 32 bed pediatric hematology, oncology, and bone marrow transplant unit at a large tertiary medical institution			Whitney U test used	potential decrease in the health care costs and voidance of negative patient outcomes	measure compliance with all componence of the care bundle; number of CVAD accesses not documented; compliance with CHG bathing not measured
6	**Title:** Interventions to improve professional adherence to guidelines for prevention of device-related infections **Author:** Flodgren et al. **Year:** 2013 **Funding:** Not specified	**Theoretical basis:** Healthcare associated infections are a major threat to patient safety and are associated with mortality rates from 5-35%.	**Design:** Systematic review **Level:** I **Method:** Search of EPOC, CENTRAL, MEDLINE, EMBASE, and CINAHL, Cochrane. Data synthesis and analysis.	**Sample Number:** 13 articles **Inclusion criteria:** RCTs, NRCTs, CBA, ITS studies that complied with Cochrane EPOC Group criteria **Exclusion criteria:** did not identify interventions to improve professional adherence to guidelines or	**IV:** compliance with infection control recommendations **DV:** Proportion or rate of invasive decide-related infections provider performance, patient outcomes **Scales:** GRADE tool	**Statistics Used:** Stata 11; presented findings via median step change and forest plots	**Statistical:** Largest median effect for IQR for the 6 CLABSI studies being observed at 3 months follow-up was a decrease of 0.6 (-2.74 to 0.28) cases per 1000 central line days (6 studies and 36 sites). **Qualitative:** Improved patient outcomes and provider performance	**Strengths:** highest level of evidence, thorough search and analysis conducted **Limitations:** Low to very low quality of the evidence of the studies included in review. All studies identified to be moderate to high risk of bias.

				comply with EPOC criteria **Attrition:** 6,036 articles	used to assess quality of evidence; classified interventions using EPOC taxonomy			
7	**Title:** Prevention of central line-associated bloodstream infections through educational interventions in adult intensive care units: A systematic review **Author:** Foka et al. **Year:** 2021 **Funding:** Not specified	**Theoretical basis:** CLABSIs represent a severe systemic threat to patients in ICUs and contribute to increased mortality, prolonged length of stay, and increased costs	**Design:** Systematic review **Level:** I **Method:** comprehensive literature review of Medline, CINAHL, Cochrane Database	**Sample Number:** 339 **Inclusion criteria:** RCTs, studies with data on pre and post implementation of infection prevention; primary outcome incidence of CLABSI, examined effectiveness of education intervention for CLABSI prevention; adult ICU setting **Exclusion criteria:** did not measure CLABSI	**IV:** infection prevention interventions **DV:** CLABSI rates per 1,000 catheter days **Scales:** MINOR scale used for all studies and displayed in table	**Statistics Used:** MINORS used to assign and evaluate scientific value to studies; this was factored into data collection and drawing conclusions	**Statistical:** N/A **Qualitative:** several interventions identified that decrease CLABSI rates, either together or alone; Regular follow up, resource support, and multifaceted cooperative approaches essential	**Strengths:** Flow diagram showing inclusion of studies, studies summarized in thorough tables; high level of evidence (I) **Limitations:** only studies in the English language used, heterogenous studies, rejected other definitions for bloodstream infections beside CLABSI

				incidence as primary outcome, pediatric or outpatient setting; did not document CLABSI rates per 1,000 catheter days **Attrition:**				
8	**Title:** Frequency of dressing changes for central venous access devices on catheter-related infections **Author:** Gavin et al. **Year:** 2016 **Funding:** Not specified	**Theoretical basis:** Less frequent CVAD dressing changers may reduce skin damage, but it is unclear if this practice affects CLABSI rates.	**Design:** Systematic review **Level:** I **Method:** Used Cochrane review methodology; 2 authors assessed studies independent for inclusion, performed risk of bias assessment, and data extraction. Conducted meta-analysis and synthesized	**Sample Number:** 5 RCTs, 2,277 patients **Inclusion criteria:** RCTs evaluating the effect of frequency of CVAD dressing changes on the incidence of catheter-related infections on all patient in any healthcare setting. **Exclusion criteria:** non-RCT studies **Attrition:** Flow diagram used to	**IV:** intervals between CVAD dressing changes **DV:** incidence of confirmed CLABSI, suspected CLABSI, and all-cause mortality **Scales: N/A**	**Statistics Used:** Risk of CLABSI in intervention group (with 95% CI) was based on the assumed risk in the comparison group and relative effect, represented using risk ratio and odds ratio	**Statistical:** **Qualitative:** Best evidence regarding longer intervals between CVAD dressing changes and CLABSI rates is inconclusive.	**Strengths:** All studies were RCTs **Limitations:** All studies were rated low to very low level of evidence; high risk of bias. No sensitivity analysis done.

			data descriptively.	represent attrition at each search step				
9	**Title:** Infusion therapy standards of practice **Author:** Gorski et al. **Year:** 2021 **Funding:** N/A	**Theoretical basis:**	**Design:** Clinical practice guideline **Level:** IV **Method:** N/A	**Sample Number:** N/A **Inclusion criteria:** N/A **Exclusion criteria:** N/A **Attrition:** N/A	**IV:** practice guidelines and nursing interventions **DV:** CLABSI rates	**Statistics Used:** N/A	**Statistical:** N/A **Qualitative:** Many explicit best practice guidelines,	**Strengths:** Created by expert committee of international specialists, combines best evidence available **Limitations:** Low level of evidence (IV), clinical practice guideline
11	**Title:** A quality improvement initiative to increase central line maintenance bundle compliance through nursing-led rounds **Author:** Hugo et al. **Year:** 2022 **Funding:** Not specified	**Theoretical basis:** Improvements in maintenance bundle compliance around CLABSIs lack standardization	**Design:** Quality improvement **Level:** V **Method:** **Formal** nursing-led rounds process implanted in a 364-bed freestanding quaternary care, urban, academic children's hospital; comprehensive rounding tolls created on	**Sample Number:** N/A **Inclusion criteria:** N/A **Exclusion criteria:** N/A **Attrition:** N/A	**IV:** nursing led rounds implementation **DV:** CLABSI rates	**Statistics Used:** standardized infection ratios (SIR)	**Statistical:** CLABSI 12-month cumulative SIRE dropped from 0.9 to 0.53 at the conclusion of the 2.5 year implementation phase **Qualitative:** nursing-led rounding is an effective CLABSI prevention strategy	**Strengths:** long implementation period (2.5 years) **Limitations:** study conducted during COVID-19 which made data collection and implantation somewhat non-prioritized or non-consistent at times

		digital platform and championed by designated RNs					
Title: Effectiveness of insertion and maintenance bundles to prevent central-line-associated bloodstream infections in critically ill patients of all ages **Author:** Ista et al. **Year:** 2016 **Funding:** none	**Theoretical basis:** Healthcare associated infections are a major problem in hospitals worldwide; they are associated with impaired immunity of critically ill patients	**Design:** Systematic review and meta-analysis **Level:** I **Method:** systematic search of multiple databases to identify studies with primary outcome of number of CLABSI rates before and after implementation of central line maintenance bundles from 1990 to 2015	**Sample Number:** 96 studies **Inclusion criteria:** primary outcome of number of CLABSI rates before and after implementation of central line maintenance bundles **Exclusion criteria:** different primary outcome measured, out of date range, reviews, editorials, or congress abstracts **Attrition:** 4,241 records	**IV:** implementation of central line maintenance bundles **DV:** CLABSI rates **Scales:** Forest plot used to display results	**Statistics Used:** incidence risk ratio with 95% CI, cumulative meta-analysis, SPSS version 21.0	**Statistical:** Median CLABSI incidence reduced from 6.4 to 2.5 per 1000 catheter days after implementing central line maintenance bundles **Qualitative:** central line maintenance bundles significantly reduced CLABSI rates	**Strengths:** large sample size, systematic search methodology, quality assessment of articles completed **Limitations:** no standard reporting was used for outcome of bloodstream infections; definition varied among studies

13	**Title:** APSIC guide for prevention of Central Line Associated Bloodstream Infections (CLABSI) **Author:** Ling et al. **Year:** 2016 **Funding:** N/A	**Theoretical basis:** CLABSIs are associated with increased morbidity, mortality, and increased healthcare costs.	**Design:** Clinical practice guideline **Level:** IV **Method:** N/A	**Sample Number:** N/A **Inclusion criteria:** N/A **Exclusion criteria:** N/A **Attrition:** N/A	**IV:** practice guidelines and nursing interventions **DV:** CLABSI rates	**Statistics Used:** N/A	**Statistical:** Recent systematic review revealed pooled incidence density of 4.7 per 1,000 catheter days **Qualitative:** Surveillance for CLABSI is a primary outcome. Monitoring adherence to EBP central line insertion and maintenance practices is helpful in identifying QI opportunities	**Strengths:** Extensive list of sources with a high level of evidence used to form guidelines. Referenced recent systematic review. **Limitations:** Low level of evidence (IV), clinical practice guideline only
14	**Title:** Strategies to prevent central line-associated bloodstream infections in acute care hospitals **Author:** Marschall et al. **Year:** 2014 **Funding:** N/A	**Theoretical basis:** Purpose is to highlight practical recommendations for CLABSI prevention in a concise format; update to 2008 SHEA guideline	**Design:** Clinical Practice Guideline **Level:** IV **Method:** Expert recommendations created through a collaborative effort between SHEA, AHA, APIC, and The	**Sample Number:** N/A **Inclusion criteria:** N/A **Exclusion criteria:** N/A **Attrition:** N/A	**IV:** CLABSI prevention strategies; clinical best practice guidelines **DV:** CLABSI rates **Scales:** N/A	**Statistics Used:** N/A	**Statistical:** N/A **Qualitative:** N/A	**Strengths:** Extensive list of sources with a high level of evidence used to form guidelines **Limitations:** Low level of evidence (IV), clinical practice guideline only

			Joint Commission					
16	**Title:** Impact of personalized report cards on nurses managing central lines **Author:** Morrison, Raffaele, & Brennaman **Year:** 2017 **Funding:** Not specified	**Theoretical basis:** The impact of guidelines for the maintenance of the central venous lines (CVL) is not well studied	**Design:** Quality Improvement **Level:** IV **Method: "**The intervention consisted of providing confidential feedback on central line audit deviations, through the systematic delivery of unit case reports and personalized nurse report cards" and analyzing results.	**Sample Number:** 600+ **Inclusion criteria:** N/A **Exclusion criteria:** N/A **Attrition:** N/A	**IV:** unit-based reports and nurse specific reports on central line care **DV:** absolute number of CLABS	**Statistics Used:** N/A	**Statistical:** decrease in the CLABI rate in the critical care units and a decrease in the absolute number of CLABI from 18 to 10 in the medical surgical units **Qualitative:** identified the need for greater training	**Strengths:** organization added training for new hires on CVL care, a computerized training course and changes in the EMR based on study results **Limitations:** lower level of evidence
17	**Title:** Central venous catheter dressing durability: An evaluation	**Theoretical basis:** Skin organisms at insertion site are frequently implicated in central venous catheter blood	**Design:** Prospective cohort study **Level:** III **Method:** Data was collective prospectively over a 12-	**Sample Number:** Total of 1,229 dressing changes studied. **Inclusion criteria:**	**IV:** various CVAD dressings **DV:** BSIs and dressing adherence **Scales:** N/A	**Statistics Used:** IQR, p value	**Statistical:** mean dressing change time 13.5 min. Cost of dressing change $1.97-$4.97. Median dressing duration time 68.5 hours.	**Strengths:** Secondary analysis with subgroups was used to control for variables which improved the

	Author: Richardson et al. **Year:** 2015 **Funding:** Declared no funding received	stream. Infections (CVAD BSIs) yet few studies have compared the durability of CVAD dressings in critically ill patients	month period in 5 nursing units.	CVADs with dressings **Exclusion criteria:** non-adherence, clammy skin, bleeding **Attrition:** not specified			**Qualitative:** Downward trend in CVAD BSIs observed over course of study. Few dressings remained adherent for 7 days.	strength of the study findings. **Limitations:** Not randomized; possibility of allocation bias. Data collection "patchy at times", required staff motivation. Nursing judgment required in dressing removal decisions and variability between nurses is likely.
	Title: Guide to infection control in the healthcare setting: Bundles in infection prevention and safety **Author:** Wasserman & Messina **Year:** 2018 **Funding:** N/A	**Theoretical basis:** Care "bundles" in infection prevention and safety are simple sets of EBPs which improve the reliability of their delivery and improve patient outcomes	**Design:** Clinical Practice Guideline **Level:** IV **Method:** Implemented care "bundles" in infection prevention	**Sample Number:** N/A **Inclusion criteria:** N/A **Exclusion criteria:** N/A **Attrition:** N/A	**IV:** interventions in care bundles **DV:** rates of infections	**Statistics Used:** N/A	**Statistical:** N/A **Qualitative:** Care bundles can assist in enhancing compliance to evidence-based quality process measures to improve patient care	**Strengths:** strong generalizability between hospital, easily applicable to practice **Limitations:** Low level of evidence (IV), clinical practice guideline only
19	**Title:** CLABSI reduction strategy: A	**Theoretical basis:** Reduce CLABSI rates	**Design:** Quality Improvement	**Sample Number:** not specified	**IV:** CVAD maintenance protocols	**Statistics Used:** Algorithm	**Statistical:** Reduced CLABSI rate by 92% in 3	**Strengths:** identifies methods that helped reduce

systematic central line quality improvement initiative integrating line-rounding principles and a team approach **Author:** Wilder et al. **Year:** 2016 **Funding:** Not specified	from 3.9 per 1000 line days by 50% through a dedicated CLABSI team	**Level:** V **Method:** daily internal line-observation rounding in a 36-bed level IV NICU	**Inclusion criteria:** NICU patients with central lines **Exclusion criteria:** NICU patients without central line **Attrition:** not specified	**DV:** CLABSI rates per 1000 line days **Scales:** national Children's hospital benchmark	to identify cost of care and preventable CLABSI infections. No other specific statistical analysis identified.	years (reduction by 7 CLABSIs) **Qualitative:** Decreased costs of treating CLABSI to hospital; improved patient outcomes	CLABSI rates; applicable and generalizable; clear summary of recommendations **Limitations:** sample number not identified; pt population and criteria for selection not thoroughly described

Appendix D

Synthesis and Recommendations Tables

Table D1

Levels of Evidence Synthesis Table.

	Article Citation	Design	Level of Evidence
1	Bell & O'Grady, 2017	Clinical practice guideline	IV
2	Carey et al., 2017	Expert committee report	V
3	Chopra et al., 2013	Systematic review with meta-analysis	I
4	DeVries, 2019	Expert opinion	V
5	Duffy et al., 2015	Quality improvement	IV
6	Flodgren et al., 2013	Systematic review	I
7	Foka et al., 2021	Systematic review	I
8	Gavin et al., 2016	Systematic review	I
9	Gorski et al., 2021	Clinical practice guideline	IV
10	Hicks & Lopez, 2022	Staff education	V
11	Hugo et al., 2022	Quality improvement	IV
12	Ista et al., 2016	Systematic review with meta-analysis	I
13	Ling et al., 2016	Clinical practice guideline	IV
14	Marschall et al., 2014	Clinical practice guideline	IV
15	Matey & Camp-Sorrell, 2016	Expert commentary	V
16	Morrison, 2017	Qualitative improvement	IV
17	Richardson et al., 2015	Prospective study	III
18	Wasserman & Messina, 2018	Clinical practice guideline	IV
19	Wilder et al., 2016	Quality improvement	IV

Note. Levels of evidence as defined by *Johns Hopkins Nursing Evidence-based Practice Guidelines* (Dearholt & Dang, 2018).

Table D2

Outcomes Synthesis Table.

	Article Citation	Supports dressing change interval of 5-7 days	Setting
1	Bell & O'Grady, 2017	Y	IP (ICU)
2	Carey et al., 2017	N/A	N/A
3	Chopra et al., 2013	N/S	IP & OP
4	DeVries, 2019	N/A	N/A
5	Duffy et al., 2015	Y	IP
6	Flodgren et al., 2013	Y	N/S
7	Foka et al., 2021	Y	ICU, IP
8	Gavin et al., 2016	N/S	IP & OP
9	Gorski et al., 2021	Y	N/S
10	Hicks & Lopez, 2022	Y	IP
11	Hugo et al., 2022	Y	IP
12	Ista et al., 2016	Y	IP
13	Ling et al., 2016	Y	N/S
14	Marschall et al., 2014	Y	IP
15	Matey & Camp-Sorrell, 2016	N/S	N/A
16	Morrison, 2017	Y	IP
17	Richardson et al., 2015	Y	IP & OP
18	Wasserman & Messina, 2018	Y	N/S
19	Wilder et al., 2016	Y	IP (NICU)

KEY
N/S: not specified
N/A: not applicable
Y: yes
IP: inpatient
OP: outpatient

Table D3

Evidence-based Recommendations.

Recommendation	Supporting Evidence
CVAD dressings should be changed every 5-7 days, or sooner if clinically indicated.	Duffy et al., 2015; Flodgren et al., 2013; Gorski et al., 2021; Hicks & Lopez, 2022; Joint Commission, 2013; Ling et al., 2016; Marschall et al., 2014; Matey & Camp-Sorrell, 2016; Richardson et al., 2015; Wasserman & Messina, 2018; Wilder et al., 2016
Dressing changes should be done with sterile technique using chlorhexidine-based products.	Bell & O'Grady, 2017; Carey et al., 2017; DeVries et al., 2019; Duffy et al., 2015; Foka et al., 2021; Gorski et al., 2021; Hicks & Lopez, 2022; Hugo et al., 2022; Joint Commission, 2013; Ling et al., 2016; Marschall et al., 2014; Matey & Camp-Sorrell, 2016; Morrison et al., 2017; Richardson et al., 2015; Wasserman & Messina, 2018; Wilder et al., 2016
Dressing change documentation and surveillance is a priority in the care of patients with CVADs.	Carey et al., 2017; Chopra et al., 2013; DeVries et al., 2019; Flodgren et al., 2013; Foka et al., 2021; Gorski et al., 2021; Ista et al., 2016; Joint Commission, 2013; Ling et al., 2016; Marschall et al., 2014; Matey & Camp-Sorrell, 2016; Morrison et al., 2017; Wasserman & Messina, 2018; Duffy et al., 2015
Proper dressing change technique, intervals, and surveillance methods decrease the risk and incidence of CLABSIs.	Bell & O'Grady, 2017; Carey et al., 2017; Chopra et al., 2013; DeVries et al., 2019; Flodgren et al., 2013; Foka et al., 2021; Gavin et al., 2016; Gorski et al., 2021; Hicks & Lopez, 2022; Hugo et al., 2022; Ista et al., 2016; Joint Commission, 2013; Ling et al., 2016; Marschall et al., 2014; Matey & Camp-Sorrell, 2016; Morrison et al., 2017; Richardson et al., 2015; Wasserman & Messina, 2018; Wilder et al., 2016; Duffy et al., 2015
Multidisciplinary approach is important to reduce CLABSIs.	Carey et al., 2017; Chopra et al., 2013; DeVries et al., 2019; Flodgren et al., 2013; Foka et al., 2021; Gavin et al., 2016; Gorski et al., 2021; Hugo et al., 2022; Ista et al., 2016; Joint Commission, 2013; Marschall et al., 2014; Matey & Camp-Sorrell, 2016; Morrison et al., 2017; Wasserman & Messina, 2018; Wilder et al., 2016; Duffy et al., 2015

Appendix E

Rapid Critical Appraisals

Rapid critical appraisals were completed for each article with an evidence level of IV or higher. These articles were used to support the rationale of this quality improvement projectand contributed to the body of evidence supporting the need for practice change. Articles with an evidence level of 5 (expert opinions) were not appraised critically and were used as anecdotal evidence only to support the project.

Rapid Critical Appraisal: Article #1

For Evidence-based Guidelines

Article Citation: Bell, T., & O'Grady, N. (2017). Prevention of central line-associated bloodstream infections. *Infectious Disease Clinical of North America, 31*(3): 551-559. https://doi.org/10.1016/j.idc.2017.05.007

Format and Level of Evidence: Clinical practice guideline (IV)

CREDIBILITY			
1. Who were the guideline developers? NIH Critical Care Medicine Department			
2. Were the developers representative of key stakeholders in this specialty (interdisciplinary)?	YES	NO	UNK
3. Who funded the guideline development?	YES	NO	UNK
4. Were any of the guideline developers funded researchers of the reviewed studies?	YES	NO	UNK
5. Did the team have a valid development strategy?	YES	NO	UNK
6. Was an explicit (how decision were made), sensible, and impartial process used to identify, select, and combine evidence?	YES	NO	UNK
7. Did the developers carry out a comprehensive, reproducible literature review within the past 12 months of tits publication/revision?	YES	NO	UNK
8. Were all important options and outcomes considered?	YES	NO	UNK
9. Is each recommendation in the guideline tagged by the level/strength of evidence upon which it is based and linked with scientific evidence?	YES	NO	UNK
10. Do the guidelines make explicit recommendations (reflecting value judgements about outcomes)?	YES	NO	UNK
11. Has the guideline been subjected to peer review and testing?	YES	NO	UNK
APPLICABILITY/GENERALIZABILITY			
12. Is the intent of use provided (e.g., national, regional, local)?	YES	NO	UNK
13. Are the recommendations clinically relevant?	YES	NO	UNK
14. Will the recommendations help me in caring for my patients?	YES	NO	UNK
15. Are the recommendations practical/feasible (e.g., resources-people and equipment- available)?	YES	NO	UNK
16. Are the recommendations a major variation from current practice?	YES	NO	UNK
17. Can the outcomes be measured through standard care?	YES	NO	UNK

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Rapid Critical Appraisal: Article #3

For Systematic Reviews and Meta-analysis

Article Citation: Chopra. V., O'Horo, J. C., Rogers, M. A., Maki, D. G., & Safdar, N. (2013). The risk of bloodstream infection associated with peripherally inserted central catheters compared with central venous catheters in adults: A systematic review and meta-analysis. *Infection Control and Hospital Epidemiology, 34*(9): 908-918. https://doi.org/10.1086/671737

Format and Level of Evidence: Systematic review with meta-analysis (I)

VALIDITY			
Are the results of the review valid?			
Are the studies contained in the review randomized controlled trials?	YES	NO	UNK
If not, were all relevant studies included in the review?	YES	NO	UNK
Does the review include a detailed description of the search strategy?	YES	NO	UNK
Does the review describe how validity of the individual studies was assessed?	YES	NO	UNK
Were the results consistent across studies?	YES	NO	UNK
Were individual (I) patient data or aggregate (A) data used?	I	A	UNK
Does the review include a description of how studies were compared using statistical analysis?	YES	NO	UNK
RELIABILITY			
What were the results?			
How large is the intervention or treatment effect (OR, RR, effect size??	RR 0.62		
How precise is the intervention or treatment (CI)?	95%		
APPLICABILITY			
Will the results assist me in caring for my patients?			
Are my patients similar to the ones included in the review?	YES	NO	UNK
Is it feasible to implement the findings in my practice setting?	YES	NO	UNK
Were all clinically important outcomes considered, including the risks and benefits of the treatment?	YES	NO	UNK
What is my clinical assessment of the patient- are there contraindications that would inhibit me from implementing the treatment?	YES	NO	UNK
Would you use the study results in your practice to make a difference in patient outcomes?	YES	NO	UNK

Additional Comments/Reflections	Limitation: only 1 RCT met inclusion criteria; CLABSI definition and infection prevention strategies variably reported; few studies reported infection by catheter days
Use in body of evidence?	Yes, include in body of evidence

Note. Adapted from *Evidence-based practice in nursing & healthcare: A guide to best practice* (pp. 710), by Melnyk, B. M., & Fineout-Overholt, E, 2019, Wolters Kluwer Health. Copyright [2019] by Wolters Kluwer. Reprinted with open permission from Melnyk and Fineout-Overholt.

Rapid Critical Appraisal: Article #5

For Evidence-based Practice Implementation or Quality Improvement Projects

Article Citation: Duffy, E. A., Rodgers, C. C., Shever, L. L., & Hockenberry, M. J. (2015). Implementing a daily maintenance care bundle to prevent central line-associated bloodstream infections in pediatric oncology patients. *Journal of Pediatric Oncology Nursing, 32*(6): 394-400. https://doi.org/10.1177/1043454214563756

Format and Level of Evidence: Quality improvement (IV)

Table Scoring Key
1: no, 2: a little, 3: somewhat, 4: quite a bit, 5: very much

Validity of Evidence Synthesis (i.e., good methodology) 1- No, 2- A little, 3- Somewhat, 4- Quite a bit, 5- Very	**1**	**2**	**3**	**4**	**5**
The title of the publication identifies the report/project as an evidence-based practice implementation or quality improvement project.			X		
The project report provides a structured summary that includes, as applicable: data to establish the existent and background of the clinical issue, inclusion and exclusion criteria and source(s) of evidence, evidence synthesis, objective(s) and setting of the EBP or QI project, project limitations, results/outcomes, recommendation, and implications for policy.					X
Report includes existing internal evidence to adequately describe the clinical issue					X
Provides an explicit statement of the question being addressed with reference to participants or population/ intervention/ comparison/ outcome (PICO).					X
Explicitly describes the search method, inclusion and exclusion criteria, and rationale for search strategy limits.					X
Describes multiple information sources (e.g., databases, contact with study authors to identify additional studies, or any other additional search strategies) included in the search strategy, and date.					X
States the process for title, abstract, and article screening for selecting studies.					X

Describes the method of data extraction (e.g., independently or process for validating data from multiple reviewers).					X
Includes conceptual and operational definitions for all variables for which data were abstracted				X	
Describes methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level).			X		
States the principal summary measures (e.g., risk ratio, difference in means).					X
Describe the method of combining results of studies including quality, quantity, and consistency of evidence.					X
Specifies assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).					X
Describes appraisal procedure and conflict resolution.			X		
Provides number of studies screened, assessed for eligibility, and included in the review, with reasons for exclusion at each stage, ideally with a flow diagram.					X
For each study, presents characteristics for which data were extracted (e.g., study size, design, method, follow-up period) and provides citations.			X		
Presents data on risk of bias of each study and, if available, any outcome-level assessment.			X		
For all outcomes considered (benefit or harms), include a table with summary data for each intervention group, effect estimates, and confidence intervals, ideally with a forest plot.		X			
Summarizes the main findings including the strength of evidence for each main outcome; considering their relevance to key groups (health care providers, users, policy makers).					X
Discusses limitations at study and outcome level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified research, reporting bias).					X
Provides a general interpretation of the results in the context of other evidence, and implications for further research, practice or policy changes.					X

Validity of Implementation (i.e., well-done project)					
Purpose of project flows from evidence synthesis					X
Stakeholders (active & passive) are identified and communication with them is described					X
Implementation protocol is congruent with evidence synthesis (fidelity of the intervention)					X
Implementation protocol is sufficiently detailed to provide for replication among project participants				X	
Education of project participants and other stakeholders is clearly described				X	
Outcomes are measured with measures supported in the evidence synthesis					X
Reliability of Implementation Project (i.e., I can learn from or implement project results)					
Data are collected with sufficient rigor to be reliable for like groups to those participants of the project.				X	
Results of evidence implementation are clinically meaningful (statistics are interpreted as such)					X
Application of Implementation (i.e., this project is useful for my patients)					
How feasible is the project protocol?				X	
Have the project managers considered/included all outcomes that are important to my work?				X	
Is implementing the project safe (i.e., low risk of harm)?					X
Summary Score	0	2	15	24	100

Total Score: 141

Recommendations with consideration of this type of level IV evidence:

32-64: consider evidence with extreme caution
65-128: consider evidence with caution
128-160: consider evidence with confidence

Note. Reprinted from *Evidence-based practice in nursing & healthcare: A guide to best practice* (pp. 717-719), by Melnyk, B. M., & Fineout-Overholt, E, 2019, Wolters Kluwer Health.

Rapid Critical Appraisal: Article #6

For Systematic Reviews and Meta-analysis

Article Citation: Flodgren, G., Conterno, L. O., Mayhew, A., Omar, O., Pereira, C.R., & Shepperd, S. (2013). Interventions to improve professional adherence to guidelines for prevention of device-related infections. *Cochrane Database of Systematic Reviews, 3.* https://doi.org/10.1002/14651858.CD006559.pub2

Format and Level of Evidence: Systematic review (I)

VALIDITY			
Are the results of the review valid?			
Are the studies contained in the review randomized controlled trials?	YES	NO	UNK
If not, were all relevant studies included in the review?	YES	NO	UNK
Does the review include a detailed description of the search strategy?	YES	NO	UNK
Does the review describe how validity of the individual studies was assessed?	YES	NO	UNK
Were the results consistent across studies?	YES	NO	UNK
Were individual (I) patient data or aggregate (A) data used?	I	A	UNK
Does the review include a description of how studies were compared using statistical analysis?	YES	NO	UNK
RELIABILITY			
What were the results?			
How large is the intervention or treatment effect (OR, RR, effect size??	YES	NO	UNK
How precise is the intervention or treatment (CI)?	YES	NO	UNK
APPLICABILITY			
Will the results assist me in caring for my patients?			
Are my patients similar to the ones included in the review?	YES	NO	UNK
Is it feasible to implement the findings in my practice setting?	YES	NO	UNK
Were all clinically important outcomes considered, including the risks and benefits of the treatment?	YES	NO	UNK
What is my clinical assessment of the patient- are there contraindications that would inhibit me from implementing the treatment?	YES	NO	UNK
Would you use the study results in your practice to make a difference in patient outcomes?	YES	NO	UNK

Additional Comments/Reflections	Sensitivity analysis not performed. Data described using IQRs. Risk of biased assessed by two sources individually.
Use in body of evidence?	Yes, include in body of evidence

Note. Adapted from *Evidence-based practice in nursing & healthcare: A guide to best practice* (pp. 710), by Melnyk, B. M., & Fineout-Overholt, E, 2019, Wolters Kluwer Health. Copyright [2019] by Wolters Kluwer. Reprinted with open permission from Melnyk and Fineout-Overholt.

Rapid Critical Appraisal: Article #7

For Systematic Reviews and Meta-analysis

Article Citation: Foka, M., Nicolaou, E., Kyprianou, T., Palazis, L., Kyranou, M., Papathanassoglou, E., & Lambrinou, E. (2021). Prevention of central line-associated bloodstream infections through educational interventions in adult intensive care units: A systematic review. *Cureus, 12*(8). https://doi.org/10.7759/cureus.17293

Format and Level of Evidence: Systematic review (I)

VALIDITY			
Are the results of the review valid?			
Are the studies contained in the review randomized controlled trials?	YES	NO	UNK
If not, were all relevant studies included in the review?	YES	NO	UNK
Does the review include a detailed description of the search strategy?	YES	NO	UNK
Does the review describe how validity of the individual studies was assessed?	YES	NO	UNK
Were the results consistent across studies?	YES	NO	UNK
Were individual (I) patient data or aggregate (A) data used?	I	A	UNK
Does the review include a description of how studies were compared using statistical analysis?	YES	NO	UNK
RELIABILITY			
What were the results?			
How large is the intervention or treatment effect (OR, RR, effect size??	YES	NO	UNK
How precise is the intervention or treatment (CI)?	YES	NO	UNK
APPLICABILITY			
Will the results assist me in caring for my patients?			
Are my patients similar to the ones included in the review?	YES	NO	UNK
Is it feasible to implement the findings in my practice setting?	YES	NO	UNK
Were all clinically important outcomes considered, including the risks and benefits of the treatment?	YES	NO	UNK
What is my clinical assessment of the patient- are there contraindications that would inhibit me from implementing the treatment?	YES	NO	UNK
Would you use the study results in your practice to make a difference in patient outcomes?	YES	NO	UNK

Additional Comments/Reflections	Although this review focused on studies in the inpatient adult ICU setting, the principles and interventions of infection prevention can be applied to outpatients with CVADs.
Use in body of evidence?	Yes, include in body of evidence

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Rapid Critical Appraisal: Article #8

For Systematic Reviews and Meta-analysis

Article Citation: Gavin, N. C., Webster, J., Chan, R. J., & Rickard, C. M. (2016). Frequency of dressing changes for central venous access devices on catheter-related infections. https://doi.org/10.1002/14651858.CD009213.pub2

Format and Level of Evidence: Systematic review (I)

VALIDITY			
Are the results of the review valid?			
Are the studies contained in the review randomized controlled trials?	YES	NO	UNK
If not, were all relevant studies included in the review?	YES	NO	UNK
Does the review include a detailed description of the search strategy?	YES	NO	UNK
Does the review describe how validity of the individual studies was assessed?	YES	NO	UNK
Were the results consistent across studies?	YES	NO	UNK
Were individual (I) patient data or aggregate (A) data used?	I	A	UNK
Does the review include a description of how studies were compared using statistical analysis?	YES	NO	UNK
RELIABILITY			
What were the results?			
How large is the intervention or treatment effect	RR different for each intervention		
How precise is the intervention or treatment (CI)?	95%		
APPLICABILITY			
Will the results assist me in caring for my patients?			
Are my patients similar to the ones included in the review?	YES	NO	UNK
Is it feasible to implement the findings in my practice setting?	YES	NO	UNK
Were all clinically important outcomes considered, including the risks and benefits of the treatment?	YES	NO	UNK
What is my clinical assessment of the patient- are there contraindications that would inhibit me from implementing the treatment?	YES	NO	UNK
Would you use the study results in your practice to make a difference in patient outcomes?	YES	NO	UNK

Additional Comments/Reflections	This review is extremely thorough, and results are broken down both by studies and by intervention. In turn, there is a large amount of data to sort through, but it does give a thorough picture of results and implications for practice.
Use in body of evidence?	Yes, include in body of evidence

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Rapid Critical Appraisal: Article #9

For Evidence-based Guidelines

Article Citation: Gorski, L. A., Hadaway, L., Haggle, M. E., Broadhurst, D., Clare, S., Kleidon, T., Meyer, B. M., Nickel, B., Rowley, S., Sharpe, E., & Alexander, M. (2021). Infusion therapy standards of practice. *Journal of Infusion Nursing, 44*(15), 1-133.

Format and Level of Evidence: Clinical practice guideline (IV)

CREDIBILITY			
1. Who were the guideline developers? Infusion Nurses' Society			
2. Were the developers representative of key stakeholders in this specialty (interdisciplinary)?	YES	NO	UNK
3. Who funded the guideline development?	YES	NO	UNK
4. Were any of the guideline developers funded researchers of the reviewed studies?	YES	NO	UNK
5. Did the team have a valid development strategy?	YES	NO	UNK
6. Was an explicit (how decisions were made), sensible, and impartial process used to identify, select, and combine evidence?	YES	NO	UNK
7. Did the developers carry out a comprehensive, reproducible literature review within the past 12 months of tits publication/revision?	YES	NO	UNK
8. Were all important options and outcomes considered?	YES	NO	UNK
9. Is each recommendation in the guideline tagged by the level/strength of evidence upon which it is based and linked with scientific evidence?	YES	NO	UNK
10. Do the guidelines make explicit recommendations (reflecting value judgements about outcomes)?	YES	NO	UNK
11. Has the guideline been subjected to peer review and testing?	YES	NO	UNK
APPLICABILITY/GENERALIZABILITY			
12. Is the intent of use provided (e.g., national, regional, local)?	YES	NO	UNK
13. Are the recommendations clinically relevant?	YES	NO	UNK
14. Will the recommendations help me in caring for my patients?	YES	NO	UNK
15. are the recommendations practical/feasible (e.g., resources-people and equipment- available)?	YES	NO	UNK
16. Are the recommendations a major variation from current practice?	YES	NO	UNK
17. Can the outcomes be measured through standard care?	YES	NO	UNK

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Rapid Critical Appraisal: Article #11

For Evidence-based Practice Implementation or Quality Improvement Projects

Article Citation: Hugo, M. C., Rzucidlo, R. R., Weisert, L. M., Parakati, I., & Schroeder, S. K. (2022). A quality improvement initiative to increase central line maintenance bundle compliance through nursing-led rounds. *Pediatric Quality and Safety, 7*(1). https//doi.org/10.1097/pq9.0000000000000515

Format and Level of Evidence: Quality improvement (IV)

Table Scoring Key
1: no, 2: a little, 3: somewhat, 4: quite a bit, 5: very much

Validity of Evidence Synthesis (i.e., good methodology) 1- No, 2- A little, 3- Somewhat, 4- Quite a bit, 5- Very	**1**	**2**	**3**	**4**	**5**
The title of the publication identifies the report/project as an evidence-based practice implementation or quality improvement project.					X
The project report provides a structured summary that includes, as applicable: data to establish the existent and background of the clinical issue, inclusion and exclusion criteria and source(s) of evidence, evidence synthesis, objective(s) and setting of the EBP or QI project, project limitations, results/outcomes, recommendation, and implications for policy.					X
Report includes existing internal evidence to adequately describe the clinical issue					X
Provides an explicit statement of the question being addressed with reference to participants or population/ intervention/ comparison/ outcome (PICO).				X	
Explicitly describes the search method, inclusion and exclusion criteria, and rationale for search strategy limits.					X
Describes multiple information sources (e.g., databases, contact with study authors to identify additional studies, or any other additional search strategies) included in the search strategy, and date.					X
States the process for title, abstract, and article screening for selecting studies.				X	
Describes the method of data extraction (e.g., independently or process for validating data from multiple reviewers).					X
Includes conceptual and operational definitions for all variables for which data were abstracted					X

Describes methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level).					X
States the principal summary measures (e.g., risk ratio, difference in means).					X
Describe the method of combining results of studies including quality, quantity, and consistency of evidence.					X
Specifies assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).					X
Describes appraisal procedure and conflict resolution.					X
Provides number of studies screened, assessed for eligibility, and included in the review, with reasons for exclusion at each stage, ideally with a flow diagram.					X
For each study, presents characteristics for which data were extracted (e.g., study size, design, method, follow-up period) and provides citations.	X				
Presents data on risk of bias of each study and, if available, any outcome-level assessment.					X
For all outcomes considered (benefit or harms), include a table with summary data for each intervention group, effect estimates, and confidence intervals, ideally with a forest plot.	X				
Summarizes the main findings including the strength of evidence for each main outcome; considering their relevance to key groups (health care providers, users, policy makers).					X
Discusses limitations at study and outcome level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified research, reporting bias).					X
Provides a general interpretation of the results in the context of other evidence, and implications for further research, practice, or policy changes.					X
Validity of Implementation (i.e., well-done project)					
Purpose of project flows from evidence synthesis					X
Stakeholders (active & passive) are identified and communication with them is described					X
Implementation protocol is congruent with evidence synthesis (fidelity of the intervention)					X
Implementation protocol is sufficiently detailed to provide for replication among project participants					X

Education of project participants and other stakeholders is clearly described					X
Outcomes are measured with measures supported in the evidence synthesis					X
Reliability of Implementation Project (i.e., I can learn from or implement project results)					
Data are collected with sufficient rigor to be reliable for like groups to those participants of the project.					X
Results of evidence implementation are clinically meaningful (statistics are interpreted as such)					X
Application of Implementation (i.e., this project is useful for my patients)					
How feasible is the project protocol?					X
Have the project managers considered/included all outcomes that are important to my work?					X
Is implementing the project safe (i.e., low risk of harm)?					X
Summary Score	2			8	140
	Total Score:	150			

Recommendations with consideration of this type of level IV evidence:

32-64: consider evidence with extreme caution
65-128: consider evidence with caution
128-160: consider evidence with confidence

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Rapid Critical Appraisal: Article #12

For Systematic Reviews and Meta-analysis

Article Citation: Ista, E., van der Hoven, B., Kornelisse, R. F., van der Starre, C., Vos, M. C., Boersma, E., & Helder, O. K. (2016). Effectiveness of insertion and maintenance bundles to prevent central-line-associated bloodstream infections in critically ill patients of all ages: A systematic review and meta-analysis. *Lancet Infectious Diseases, 16*(6): 724-734. https://doi.org/10.1016/S1473-3099(15)00409-0

Format and Level of Evidence: Systematic review with meta-analysis (I)

VALIDITY			
Are the results of the review valid?			
Are the studies contained in the review randomized controlled trials?	YES	NO	UNK
If not, were all relevant studies included in the review?	YES	NO	UNK
Does the review include a detailed description of the search strategy?	YES	NO	UNK
Does the review describe how validity of the individual studies was assessed?	YES	NO	UNK
Were the results consistent across studies?	YES	NO	UNK
Were individual (I) patient data or aggregate (A) data used?	I	A	UNK
Does the review include a description of how studies were compared using statistical analysis?	YES	NO	UNK
RELIABILITY			
What were the results?			
How large is the intervention or treatment effect (OR, RR, effect size??	IRR 0.44		
How precise is the intervention or treatment (CI)?	95%		
APPLICABILITY			
Will the results assist me in caring for my patients?			
Are my patients similar to the ones included in the review?	YES	NO	UNK
Is it feasible to implement the findings in my practice setting?	YES	NO	UNK
Were all clinically important outcomes considered, including the risks and benefits of the treatment?	YES	NO	UNK
What is my clinical assessment of the patient- are there contraindications that would inhibit me from implementing the treatment?	YES	NO	UNK
Would you use the study results in your practice to make a difference in patient outcomes?	YES	NO	UNK

Additional Comments/Reflections	ICU settings studied only, but CVAD infection prevention strategies are relevant to infusion center patients with CVADs.
Use in body of evidence?	Yes, include in body of evidence

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Rapid Critical Appraisal: Article #13

For Evidence-based Guidelines

Article Citation: Ling, M. L., Apisarnthanarak, A., Jaggi, N., Harrington, G., Morikane, K., & Anh Thu, L. T. (2016). APSIC guide for prevention of Central Line Associated Bloodstream Infections (CLABSI). *Antimicrobial Resistance and Infection Control, 5*(16), 1-9. http://doi.org/10.1186/s13756-016-0116-5

Format and Level of Evidence: Clinical practice guideline (IV)

CREDIBILITY			
1. Who were the guideline developers?	APSIC		
2. Were the developers representative of key stakeholders in this specialty (interdisciplinary)?	YES	NO	UNK
3. Who funded the guideline development?	YES	NO	UNK
4. Were any of the guideline developers funded researchers of the reviewed studies?	YES	NO	UNK
5. Did the team have a valid development strategy?	YES	NO	UNK
6. Was an explicit (how decision were made), sensible, and impartial process used to identify, select, and combine evidence?	YES	NO	UNK
7. Did the developers carry out a comprehensive, reproducible literature review within the past 12 months of its publication/revision?	YES	NO	UNK
8. Were all important options and outcomes considered?	YES	NO	UNK
9. Is each recommendation in the guideline tagged by the level/strength of evidence upon which it is based and linked with scientific evidence?	YES	NO	UNK
10. Do the guidelines make explicit recommendations (reflecting value judgements about outcomes)?	YES	NO	UNK
11. Has the guideline been subjected to peer review and testing?	YES	NO	UNK
APPLICABILITY/GENERALIZABILITY			
12. Is the intent of use provided (e.g., national, regional, local)?	YES	NO	UNK
13. Are the recommendations clinically relevant?	YES	NO	UNK
14. Will the recommendations help me in caring for my patients?	YES	NO	UNK
15. Are the recommendations practical/feasible (e.g., resources-people and equipment- available)?	YES	NO	UNK
16. Are the recommendations a major variation from current practice?	YES	NO	UNK
17. Can the outcomes be measured through standard care?	YES	NO	UNK

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Rapid Critical Appraisal: Article #14

For Evidence-based Guidelines

Article Citation: Marschall, J., Mermel, L. A., Fakih, M., Hadawat, L., Kallen, A., O'Grady, N. P., Pettis, A. M., Rupp, M. E., Sandora, T., Maragakis, L. L., & Yokoe, D. S. (2014). Strategies to prevent central line-associated bloodstream infections in acute care hospitals. *Infection Control and Hospital Epidemiology, 35*(7): 753-771. https://doi.org/ 10.1086/676533

Format and Level of Evidence: Clinical practice guideline (IV)

CREDIBILITY			
1. Who were the guideline developers?	Society for Healthcare Epidemiology of America		
2. Were the developers representative of key stakeholders in this specialty (interdisciplinary)?	YES	NO	UNK
3. Who funded the guideline development? SHEA	YES	NO	UNK
4. Were any of the guideline developers funded researchers of the reviewed studies?	YES	NO	UNK
5. Did the team have a valid development strategy?	YES	NO	UNK
6. Was an explicit (how decisions were made), sensible, and impartial process used to identify, select, and combine evidence?	YES	NO	UNK
7. Did the developers carry out a comprehensive, reproducible literature review within the past 12 months of tits publication/revision?	YES	NO	UNK
8. Were all important options and outcomes considered?	YES	NO	UNK
9. Is each recommendation in the guideline tagged by the level/strength of evidence upon which it is based and linked with scientific evidence?	YES	NO	UNK
10. Do the guidelines make explicit recommendations (reflecting value judgements about outcomes)?	YES	NO	UNK
11. Has the guideline been subjected to peer review and testing?	YES	NO	UNK
APPLICABILITY/GENERALIZABILITY			
12. Is the intent of use provided (e.g., national, regional, local)?	YES	NO	UNK
13. Are the recommendations clinically relevant?	YES	NO	UNK
14. Will the recommendations help me in caring for my patients?	YES	NO	UNK
15. Are the recommendations practical/feasible (e.g., resources-people and equipment- available)?	YES	NO	UNK
16. Are the recommendations a major variation from current practice?	YES	NO	UNK
17. Can the outcomes be measured through standard care?	YES	NO	UNK

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Rapid Critical Appraisal: Article #16

For Qualitative Evidence

Article Citation: Morrison, T., Raffaele, J., & Brennaman, L. (2017). Impact of personalized report cards on nurses managing central lines. *American Journal of Infection Control, 45*(1): 24-28. https://doi.org/10.1016/j.ajic.2016.09.020

Format and Level of Evidence: Qualitative study (III)

VALIDITY			
Are the results of the study valid (i.e., trustworthy, and credible)?			
How were the study participants chosen? All units within the hospital managing central lines were included.			
How were accuracy and completeness of data assured? A 16 week process with thorough data collection			
How plausible/believable are the results?			
Are implication of the research stated?	YES	NO	UNK
May new insights increase sensitivity to others' needs?	YES	NO	UNK
May understandings enhance situational competence?	YES	NO	UNK
Are the results plausible and believable?	YES	NO	UNK
Is the reader imaginatively drawn into the experience?	YES	NO	UNK
RELIABILITY			
What were the results?			
Does the research approach fit the purpose of the study?	YES	NO	UNK
Does the researcher identify the study approach?	YES	NO	UNK
Are language and concepts consistent with the approach?	YES	NO	UNK
Are data collection and analysis techniques appropriate?	YES	NO	UNK
Is the significance/importance of the study explicit?	YES	NO	UNK
Does review of the literature support a need for the study?	YES	NO	UNK
Is the sampling strategy clear and guided by study needs?	YES	NO	UNK
Does the researcher control selection of the sample?	YES	NO	UNK
Do sample composition and size reflect study needs?	YES	NO	UNK
Is the phenomenon (human experience) clearly identified?			
Are data collection procedures clear?	YES	NO	UNK
Are sources and means or verifying data explicit?	YES	NO	UNK
Are researcher roles and activities explained?	YES	NO	UNK
Are data analysis procedures described?	YES	NO	UNK
Does analysis guide direction of sampling and when it ends?	YES	NO	UNK
Are data management processes described?	YES	NO	UNK
What are the reported results (description or interpretation)?			
Is the presentation of findings logical, consistent, and easy to follow?	YES	NO	UNK
Do quotes fit the findings they are intended to illustrate?	YES	NO	UNK
How are the overall results presented?			
Are meanings derived from data described in context?	YES	NO	UNK
Does the writing effectively promote understanding?	YES	NO	UNK

APPLICABILITY			
Will the results help me in caring for my patients?			
Are the results relevant to persons in similar situations?	YES	NO	UNK
Are the results relevant to patient values and/or circumstances?	YES	NO	UNK
May the results be applied in clinical practice?	YES	NO	UNK
Would you use the study results in your practice to make a difference in patient outcomes?	YES	NO	UNK

Additional Comments/Reflections	Nurse specific reports card could be considered if unit wide analysis is not successful in CVAD surveillance.
Use in body of evidence?	Yes, include in body of evidence (as lower-level evidence)

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Rapid Critical Appraisal: Article #17

For Cohort Studies

Article Citation: Richardson, A., Melling, A., Straughan, C., Simms, L., Coulter, C., Elliot, Y., Reji, S., Wilson, N., Bryne, R., Desmond, C., & Wright, S. E. (2015). Central venous catheter dressing durability: an evaluation. *Journal of Infection Prevention, 16*(6), 256-261. http://doi.org/10.1177/1757177415594246

Format and Level of Evidence: Prospective cohort study (III)

VALIDITY			
Are the results of the study valid?			
Was there a representative and well-defined sample of patients at a similar point in the course of the disease?	YES	NO	UNK
Was follow-up sufficiently long and complete?	YES	NO	UNK
Were objective and unbiased outcome criteria used?	YES	NO	UNK
Did the analysis adjust for important prognostic risk factors and confounding variables?	YES	NO	UNK
RELIABILITY			
What are the results?			
What is the magnitude of the relationship between predictors (prognostic indicators) and targeted outcome?	Closely related		
How likely is the outcome event(s) in a specified period of time?	Very likely		
How precise are the study estimates?	Unknown		
APPLICABILITY			
Will the results help me in caring for my patients?			
Were the study patient similar to my own?	YES	NO	UNK
Will the results lead directly to selecting or avoiding therapy?	YES	NO	UNK
Are the results useful for reassuring or counseling patients?	YES	NO	UNK
Would you use the study results in your practice to make a difference in patient outcomes?	YES	NO	UNK

Additional Comments/Reflections	Total of 1,229 dressing changes studied. Data was collective prospectively over a 12-month period in 5 nursing units. Secondary analysis with subgroups was used to control for variables (non-adherence, clammy skin, bleeding) which improved the strength of the study findings.
Use in body of evidence?	Yes, include in body of evidence

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Rapid Critical Appraisal: Article #18

For Evidence-based Guidelines

Article Citation: Wasserman, S. & Messina, A. (2018). Guide to infection control in the healthcare setting: Bundles in infection prevention and safety. *International Society for Infectious Diseases*. https://isid.org/guide/infectionprevention/bundles/

Format and Level of Evidence: Clinical practice guideline (IV)

CREDIBILITY			
1. Who were the guideline developers?			
2. Were the developers representative of key stakeholders in this specialty (interdisciplinary)?	YES	NO	UNK
3. Who funded the guideline development?	YES	NO	UNK
4. Were any of the guideline developers funded researchers of the reviewed studies?	YES	NO	UNK
5. Did the team have a valid development strategy?	YES	NO	UNK
6. Was an explicit (how decision were made), sensible, and impartial process used to identify, select, and combine evidence?	YES	NO	UNK
7. Did the developers carry out a comprehensive, reproducible literature review within the past 12 months of tits publication/revision?	YES	NO	UNK
8. Were all important options and outcomes considered?	YES	NO	UNK
9. Is each recommendation in the guideline tagged by the level/strength of evidence upon which it is based and linked with scientific evidence?	YES	NO	UNK
10. Do the guidelines make explicit recommendations (reflecting value judgements about outcomes)?	YES	NO	UNK
11. Has the guideline been subjected to peer review and testing?	YES	NO	UNK
APPLICABILITY/GENERALIZABILITY			
12. Is the intent of use provided (e.g., national, regional, local)?	YES	NO	UNK
13. Are the recommendations clinically relevant?	YES	NO	UNK
14. Will the recommendations help me in caring for my patients?	YES	NO	UNK
15. Are the recommendations practical/feasible (e.g., resources-people and equipment- available)?	YES	NO	UNK
16. Are the recommendations a major variation from current practice?	YES	NO	UNK
17. Can the outcomes be measured through standard care?	YES	NO	UNK

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Rapid Critical Appraisal: Article #19

For Evidence-based Practice Implementation or Quality Improvement Projects

Article Citation: Wilder, K. A., Wall, B., Haggard, D., & Epperson, T. (2016). CLABSI reduction strategy: A systematic central line quality improvement initiative integrating line-rounding principles and a team approach. *Advanced Neonatal Care, 16*(3):170-177. https://doi.org/10.1097/ANC.0000000000000259

Format and Level of Evidence: Quality improvement (IV)

Table Scoring Key
1: no, 2: a little, 3: somewhat, 4: quite a bit, 5: very much

Validity of Evidence Synthesis (i.e., good methodology) 1- No, 2- A little, 3- Somewhat, 4- Quite a bit, 5- Very	**1**	**2**	**3**	**4**	**5**
The title of the publication identifies the report/project as an evidence-based practice implementation or quality improvement project.					X
The project report provides a structured summary that includes, as applicable: data to establish the existent and background of the clinical issue, inclusion and exclusion criteria and source(s) of evidence, evidence synthesis, objective(s) and setting of the EBP or QI project, project limitations, results/outcomes, recommendation, and implications for policy.					X
Report includes existing internal evidence to adequately describe the clinical issue					X
Provides an explicit statement of the question being addressed with reference to participants or population/ intervention/ comparison/ outcome (PICO).		X			
Explicitly describes the search method, inclusion and exclusion criteria, and rationale for search strategy limits.					X
Describes multiple information sources (e.g., databases, contact with study authors to identify additional studies, or any other additional search strategies) included in the search strategy, and date.					X
States the process for title, abstract, and article screening for selecting studies.		X			
Describes the method of data extraction (e.g., independently or process for validating data from multiple reviewers).					X
Includes conceptual and operational definitions for all variables for which data were abstracted					X

Describes methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level).					X
States the principal summary measures (e.g., risk ratio, difference in means).					X
Describe the method of combining results of studies including quality, quantity, and consistency of evidence.					X
Specifies assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).					X
Describes appraisal procedure and conflict resolution.				X	
Provides number of studies screened, assessed for eligibility, and included in the review, with reasons for exclusion at each stage, ideally with a flow diagram.	X				
For each study, presents characteristics for which data were extracted (e.g., study size, design, method, follow-up period) and provides citations.	X				
Presents data on risk of bias of each study and, if available, any outcome-level assessment.	X				
For all outcomes considered (benefit or harms), include a table with summary data for each intervention group, effect estimates, and confidence intervals, ideally with a forest plot.	X				
Summarizes the main findings including the strength of evidence for each main outcome; considering their relevance to key groups (health care providers, users, policy makers).					X
Discusses limitations at study and outcome level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified research, reporting bias).			X		
Provides a general interpretation of the results in the context of other evidence, and implications for further research, practice or policy changes.					X
Validity of Implementation (i.e., well-done project)					
Purpose of project flows from evidence synthesis					X
Stakeholders (active & passive) are identified and communication with them is described					X
Implementation protocol is congruent with evidence synthesis (fidelity of the intervention)					X
Implementation protocol is sufficiently detailed to provide for replication among project participants				X	

Education of project participants and other stakeholders is clearly described				X	
Outcomes are measured with measures supported in the evidence synthesis					X
Reliability of Implementation Project (i.e., I can learn from or implement project results)					
Data are collected with sufficient rigor to be reliable for like groups to those participants of the project.				X	
Results of evidence implementation are clinically meaningful (statistics are interpreted as such)		X			
Application of Implementation (i.e., this project is useful for my patients)					
How feasible is the project protocol?					X
Have the project managers considered/included all outcomes that are important to my work?					X
Is implementing the project safe (i.e., low risk of harm)?					X
Summary Score	4	4	3	16	100
Total Score:	127				

Recommendations with consideration of this type of level IV evidence:

32-64: consider evidence with extreme caution
65-128: consider evidence with caution
128-160: consider evidence with confidence

Note. Reprinted from *Evidence-based practice in nursing & healthcare: A guide to best practice* (pp. 717-719), by Melnyk, B. M., & Fineout-Overholt, E, 2019, Wolters Kluwer Health.

Appendix F

Central Line Maintenance Checklist

Patient Initials: _____ Date: _____

Nurse Completing Form: _____

Date injection caps last changed: _____

Date dressing last changed: _____

Critical Steps	Yes	No	N/A	Notes/Comments
Necessity assessed				
Caps changed today				
Insertion site without evidence of infection				
Dressing intact and labeled properly				
Dressing changed today				

Created by Sarah Christiana, BSN, RN. (2022).
Adapted from: The Joint Commission. (2013). *Preventing Central Line–Associated Bloodstream Infections: Useful Tools, An International Perspective*.
http://www.jointcommission.org/CLABSIToolkit

Appendix G

Joint Commission Central Line Maintenance Template

Patient Name/ID#: _____ **Unit:** _____ **Room/Bed:** _____

Date: _____

Person Completing Form: Name _____

Date of initial line placement: _____

Date implanted port accessed: _____

Date injection caps last changed: _____

Date administration set and add-on devices last changed: _____

Set used for: Continuous Infusion ☐ Intermittent Infusion ☐

Date dressing last changed: _____ **Dressing type**: Gauze ☐ Clear ☐

Critical Steps	Yes	No	N/A	Notes/Comments
Necessity assessed If no longer necessary, remove, indicating details of removal in the records (including date, location, and signature and name of operator undertaking removal).				
Injection sites are covered by caps or valved connectors				
Caps changed today				
Implanted ports newly accessed today				
Accessed with (indicate type and size of needle)				
Insertion site without evidence of infection				
Dressing intact and labeled properly				
Dressing changed today				
Catheter stabilized/no tension on line				
Administration set replaced and labeled this time?				

Procedural Reminders

Suspected Infection
- If central venous catheter infection is strongly suspected, replace catheter and all intravenous fluids, tubing, and caps.

Hand Hygiene
- Clean hands immediately before and after each episode of patient contact using the correct hand hygiene technique. (Use World Health Organization "My 5 Moments for Hand Hygiene".)

Cap Changes
- Sanitize caps with 2%chlorhexidine gluconate in 70% isopropyl alcohol before and after each use ("Scrub the Hub").
- Change caps when necessary using sterile gloves and mask, that is, after administering blood and if there is visual observation of blood in the caps.
- Change caps no more often than 72 hours (or according to the manufacturer's recommendations and whenever the administration set is changed).

Tubing Changes
- Replace administration sets and add-on devices no more frequently than every 96 hours, and at least every 7 days, after initiation of use, unless contamination occurs.
- Replace set and add-on devices within 24 hours of start of infusion if fluids that enhance microbial growth are infused (for example, fat emulsions combined with amino acids and glucose in three-in-one admixture or blood products infused separately).
- Change needleless components as often as the administration set and no more often than 72 hours.

Dressing Changes
- Change gauze dressing every 2 days, clear dressings every 7 days, unless dressing becomes damp, loosened, or visibly soiled then change.
- Use sterile gauze or sterile, transparent, semipermeable dressings.
- Perform catheter site care using 2% chlorhexidine gluconate in 70% isopropyl alcohol to clean the insertion site during dressing changes.

Appendix H

Poster Presentation

DR. SUSAN L. DAVIS, R.N., & RICHARD J. HENLEY COLLEGE OF NURSING
Sacred Heart University

Implementation of a Daily Central Line Maintenance Audit Form in an Outpatient Infusion Center: A Quality Improvement Project

DNP Student: Sarah Harvey Christiana, BSN, RN, CRNI
Project Advisor: Sharon Bradley, DNP, MSN, RN, CCM, CPHQ, NE-BC

BACKGROUND AND SIGNIFICANCE

- At an infusion center in a small community hospital in New England, patients receive daily outpatient antimicrobial therapy via central venous access devices (CVADs).
- Best evidence supports that CVAD dressing changes occur every 7 days, sooner if clinically indicated.
- Nurses must appropriately maintain and change CVAD dressings according to evidence-based protocols to reduce the risk of central line-associated bloodstream infection (CLABSI).
- CLABSIs, associated with increased morbidity, mortality, and health care costs, are largely preventable through proper CVAD maintenance.
- At the project site, an EMR review identified that dressing changes were often occurring beyond 7 days.
- Documentation and surveillance processes were identified as potential opportunities for improvement. The Joint Commission's daily CVAD maintenance audit form (modified) was chosen for implementation.
- This quality improvement (QI) project is consistent with Quadruple Aim criteria, as its outcomes focus on patient care, health, cost, and meaningfulness.

PURPOSE AND GOALS

- Identify rates of delayed CVAD dressing changes (longer than 7 days) at the project site over a recent 3-month period (May 1st, 2022 though August 1st, 2022).
- Promote adherence to timely dressing change protocol through the implementation of a CVAD maintenance audit form for a 3-month period (October 10th, 2023 through January 10th, 2023).
- Improve CVAD dressing change surveillance and documentation processes at the project site.
- Evaluate the effectiveness and utility of the CVAD maintenance audit form by comparing both timely and delayed dressing changes pre- and post-implementation.

SETTING AND PARTICIPANTS

- **Setting:** An outpatient infusion center at a Magnet-designated community hospital in New England.
- **Participants:** Adult patients with CVADS used for daily outpatient antimicrobial treatment.

SUPPORTING EVIDENCE

Levels of Evidence Synthesis Table

Article Citation	Design	Evidence Level
Bell & O'Grady, 2017	Clinical practice guideline	IV
Carey et al., 2017	Expert committee report	V
Chopra et al., 2013	Systematic review with meta-analysis	I
DeVries, 2019	Expert opinion	V
Duffy et al., 2015	Quality improvement	IV
Flodgren et al., 2013	Systematic review	I
Foka et al., 2021	Systematic review	I
Gavin et al., 2016	Systematic review	I
Gorski et al., 2021	Clinical practice guideline	IV
Hicks & Lopez, 2022	Staff education	V
Hugo et al., 2022	Quality improvement	IV
Ista et al., 2016	Systematic review with meta-analysis	I
Ling et al., 2016	Clinical practice guideline	IV
Marschall et al., 2014	Clinical practice guideline	IV
Matey & Camp-Sorrell, 2016	Expert commentary	V
Morrison, 2017	Qualitative improvement	IV
Richardson et al., 2015	Prospective study	III
Wasserman & Messina, 2018	Clinical practice guideline	IV
Wilder et al., 2016	Quality improvement	IV

Evidence Based Recommendations

Recommendation	Supporting Evidence
CVAD dressings should be changed every 5-7 days, or sooner if clinically indicated.	Duffy et al., 2015; Flodgren et al., 2013; Gorski et al., 2021; Hicks & Lopez, 2022; Joint Commission, 2013; Ling et al., 2016; Marschall et al., 2014; Matey & Camp-Sorrell, 2016; Richardson et al., 2015; Wasserman & Messina, 2018; Wilder et al., 2016
Dressing changes should be done with sterile technique using chlorhexidine-based products.	Bell & O'Grady, 2017; Carey et al., 2017; DeVries et al., 2019; Duffy et al., 2015; Foka et al., 2021; Gorski et al., 2021; Hicks & Lopez, 2022; Hugo et al., 2022; Joint Commission, 2013; Ling et al., 2016; Marschall et al., 2014; Matey & Camp-Sorrell, 2016; Morrison et al., 2017; Richardson et al., 2015; Wasserman & Messina, 2018; Wilder et al., 2016
Dressing change documentation and surveillance is a priority in the care of patients with CVADs.	Carey et al., 2017; Chopra et al., 2013; DeVries et al., 2019; Flodgren et al., 2013; Foka et al., 2021; Gorski et al., 2021; Ista et al., 2016; Joint Commission, 2013; Ling et al., 2016; Marschall et al., 2014; Matey & Camp-Sorrell, 2016; Morrison et al., 2017; Wasserman & Messina, 2018; Duffy et al., 2015
Proper dressing change technique, intervals, and surveillance methods decrease the incidence of CLABSIs.	Bell & O'Grady, 2017; Carey et al., 2017; Chopra et al., 2013; DeVries et al., 2019; Flodgren et al., 2013; Foka et al., 2021; Gavin et al., 2016; Gorski et al., 2021; Hicks & Lopez, 2022; Hugo et al., 2022; Ista et al., 2016; Joint Commission, 2013; Ling et al., 2016; Marschall et al., 2014; Matey & Camp-Sorrell, 2016; Morrison et al., 2017; Richardson et al., 2015; Wasserman & Messina, 2018; Wilder et al., 2016; Duffy et al., 2015
Multidisciplinary approach is important to reduce CLABSIs.	Carey et al., 2017; Chopra et al., 2013; DeVries et al., 2019; Flodgren et al., 2013; Foka et al., 2021; Gavin et al., 2016; Gorski et al., 2021; Hugo et al., 2022; Ista et al., 2016; Joint Commission, 2013; Marschall et al., 2014; Matey & Camp-Sorrell, 2016; Morrison et al., 2017; Wasserman & Messina, 2018; Wilder et al., 2016; Duffy et al., 2015

INTERVENTIONS

The Model for Improvement including the Plan-Do-Study-Act cycle was utilized. Lewin's Theory of Planned Change was used to guide project progression.

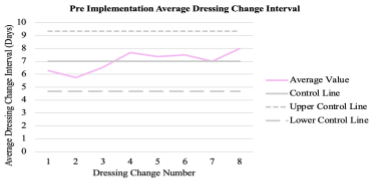
- **Unfreezing:** Query infusion staff on current practice. Identify EBP gaps and opportunities to improve EBP.
- **Moving:** Educate staff about QI project rationale and process followed by 3-month implementation period.
- **Refreezing:** Work with QI team at site to incorporate new CVAD documentation process in the EMR.

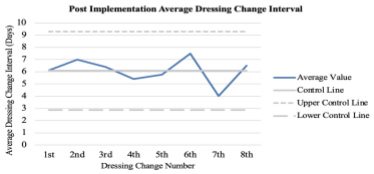
OUTCOMES

Rates of CVAD dressing change before and after implementation were analyzed using descriptive statistics. Length of change intervals ranged from 1-11 days pre-implementation and 1-10 days post-implementation. Pre-implementation, the mean, mode, and median were each 7 days. Post-implementation, the mean, mode, and median were 6.1, 7, and 7 days.

EVALUATION

As depicted by the line charts below, more dressing changes post-implementation were completed at appropriate intervals (7 days). During the evaluation phase, staff nurses identified that several outliers occurred in the post-implementation phase (dressing changes at 9, 10, or 11 days) due to factors beyond nurse control. Factors included patient non-attendance and refusal of dressing changes. Pre-implementation, these delayed changes resulted from nurse mistakes. This should be considered when interpreting results.





DISCUSSION

Although statistical improvements in this pilot study were modest, results indicate that impactful change could be made over time. Each CLABSI prevented saves hospitals an estimated $45,000 per case, making even modest improvements significant. Adopting a CVAD maintenance audit form will improve documentation and surveillance measures to support the goal of reducing CLABSI rates. To make this intervention most effective and economical in accordance with Quadruple Aim, it is recommended that the form be incorporated into the EMR.

For information, please contact: harveys5@mail.sacredheart.edu

Appendix I

Executive Summary

At a 144-bed community hospital in rural New England, patients are seen daily for outpatient antimicrobial treatment for the treatment of infections. These patients frequently have a central venous access device (CVAD) in place for medication administration. Current best evidence supports that CVAD dressing changes occur every 7 days, more frequently if clinically indicated. However, at the project site, dressing changes are often delayed past 7 days related to lack of effective documentation and surveillance processes. This practice increases the risk of the incidence of CLABSI (central line associated bloodstream infection). This organization is Magnet recognized and prides itself on quality improvement and evidence-based practice implementation, both of which are supported by this project.

A CLABSI is defined as an infection that develops in a patient with a central line that is not related to an infection at another site. CLABSIs are directly associated with increased morbidity, mortality, and health care costs. However, CLABSIs are largely preventable through the utilization of evidence-based guidelines for proper insertion and maintenance of CVADs. One useful tool to support compliance with best practice is to implement a daily central line maintenance audit form published by the Joint Commission. The purpose of this quality improvement (QI) project is to implement a daily central line maintenance audit form with the goal of improving adherence to CLABSI prevention protocol and support quality nursing documentation of CVAD maintenance. Project goals included improving both adherence to CLABSI prevention protocols and quality of nursing documentation of CVAD maintenance.

Participants in this study included adult patients with CVADS for daily outpatient antimicrobial treatment. The Model for Improvement including the Plan-Do-Study-Act cycle

was utilized. Lewin's Theory of Planned Change was utilized to guide project progression. At the conclusion of data collection, rates of CVAD dressing change over a 3-month period before and after implementation were analyzed using descriptive statistics. The length of change intervals ranged from 1-11 days pre-implementation and 1-10 days post-implementation. Pre-implementation, the mean, mode, and median were each 7 days. Post-implementation, the mean, mode, and median were 6.1, 7, and 7 days, respectively, indicating a modest but meaningful improvement in protocol adherence.

To make this intervention most economical in accordance with Quadruple Aim (Bodenheimer, 2014), it is recommended that the form be incorporated into the existing EMR. This project will yield a high level of return on investment due to its inexpensive implementation (EMR) and lead ultimately to a reduction in hospital CLABSI costs. Each CLABSI costs a hospital an estimated $45,000, evidencing the importance of this intervention. This project is easily sustainable as it will be implemented into the EMR for daily use. The results of this QI study support that adoption of a daily CVAD maintenance audit form to improve documentation and surveillance measures, with the goal of reducing rates of CLABSI rates.

Appendix J

SHU Institutional Review Board Exemption Form

Investigator(s): Sarah Christiana, Student
Department: Doctor of Nursing Practice, Family Nurse Practitioner
Email Address: harveys5@mail.sacredheart.edu
Faculty advisor: Dr. Sharon Bradley
Advisor/chair approval: Yes

Exempt Category:
6.1.4 Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

How is this justified?
The data used in this QI project will come from the electronic medical record at RRMC which already exists. Data will be used and recorded without the use of any patient identifiers to maintain confidentiality. Documentation from the implementation phase will also be recorded without the use of patient identifiers. Further justification for this project's IRB exemption status can be found in the QI vs Research tool below.

Quality improvement vs. research tool.

Article Citation	Y	N
Is the project designed to bring about immediate improvement in patient care?	X	
Is the purpose of the project to bring new knowledge to daily practice?	X	
Is the project designed to sustain the improvement?	X	
Are findings specific to this hospital?	X	
Are all patients who participate in the project expected to benefit?	X	
Is the intervention at least as safe as routine care?	X	
Will all participants receive at least usual care?	X	
Do you intend to gather just enough data to learn and complete the cycle?	X	
Do you intend to limit time for data collection to accelerate the rate of improvement?	X	
Is the project intended to test a novel hypothesis or replicate one?		X
Does the project involve withholding any usual care?		X
Does the project involve testing interventions/practices that are not standard of care?		X
Will any of the 18 identifiers according to the HIPAA Privacy Rule be included?		X
Is the purpose to measure the effect of a process change on delivery of care?	X	

Note. Adapted from "Differentiating Quality Improvement and Research Activities", by Foster, J., (2013). Retrieved from https://doi.org/10.1097/NUR.0b013e3182776db5

Description of Research Protocol

Purpose of the Study:
At Rutland Regional Medical Center (RRMC), a small community hospital in Rutland, Vermont, patients are seen daily for antimicrobial treatment for the treatment of infections. Patients who

are receiving daily antimicrobial therapy for infections often have a central venous access device (CVAD) in place for medication administration. Infusion nurses are responsible for the care and maintenance of CVADs. It is important that nurses adequately maintain the CVAD dressing according to evidence-based protocols to reduce the risk of central line-associated bloodstream infection (CLABSI). Current best evidence supports that CVAD dressing changes occur every 7 days, more frequently if clinically indicated. However, at RRMC, dressing changes are often delayed past 7 days related to lack of effective documentation and surveillance processes. One useful tool to support compliance with best practice is to implement a daily central line maintenance audit form published by The Joint Commission (2013). The purpose of this quality improvement (QI) project is to implement a daily central line maintenance audit form with the goal of improving adherence to CLABSI prevention protocol and support quality nursing documentation of CVAD maintenance.

PICOT question: In the care of adult outpatient infusion center patients with CVADs, how does the implementation of a Daily Central Line Maintenance Audit Form compared with current documentation protocol affect the rates of timely dressing changes over a 3-month period?

Project goals:

- Identify rates of delayed CVAD dressing changes (longer than 7 days) at RRMC over a 3-month period in collaboration with internal EMR staff.
- Improve adherence to CVAD dressing changes, an element of CLABSI prevention protocol, through the implementation of a central line maintenance audit form as a surveillance measure and evaluation of data for 3 months post-implementation.
- Improve and standardize CVAD dressing change documentation in an infusion center within 6 months.
- Evaluate the effectiveness and utility of the central line maintenance audit form by comparing timely dressing change rates before and after implementation.

Characteristics of subject population:

Study participants will include only adult patients in the outpatient infusion center with a CVAD. Specifically, these patients have a (peripherally inserted central catheter) PICC for the administration of frequent intravenous hydration or daily antimicrobial treatment for serious infections. Pediatric patients and pregnant women will be excluded. There will be no restrictions for selection based on sex, physical, mental, or health restrictions.

Methods and procedures applied to human subjects:

The daily central line maintenance checklist that will be used in data collection for this QI project is included below. This form was adapted from The Joint Commission's Daily Central Line Maintenance Checklist Template. The Joint Commission states that the form may be adapted for internal use. Rates of timely and delayed dressing changes from a baseline 3-month period will be obtained through retrospective review of relevant documentation in the EMR. The DNP student will educate the infusion department nursing staff on the project plans, purpose, goals, and use of the audit tool. Rates of timely and untimely dressing changes will be tracked concurrently by the DNP student through weekly analysis during the implementation phase of the project. The implementation phase will last for 3 months.

Central Line Maintenance Checklist

Patient Initials: _____ Date: _____
Nurse Completing Form: _____
Date injection caps last changed: _____
Date dressing last changed: _____

Critical Steps	Yes	No	N/A	Notes/Comments
Necessity assessed				
Caps changed today				
Insertion site without evidence of infection				
Dressing intact and labeled properly				
Dressing changed today				

Created by Sarah Christiana, BSN, RN. (2022). Adapted from: The Joint Commission. (2013). *Preventing Central Line–Associated Bloodstream Infections: Useful Tools, An International Perspective*. http://www.jointcommission.org/CLABSIToolkit

Risks to the Subject: No
If subjects will be at risk, assess the probability, severity, potential duration, and reversibility of each risk. Indicate protective measures to be utilized. **N/A**

Benefits: Yes
Each individual study participant will not gain anything directly from this project. It is anticipated that future patients will benefit from the project through improved patient care and improved adherence to CLABSI prevention protocol.

Information Purposely Withheld: No
State any information purposely withheld from the subject and justify this non-disclosure. **N/A**

Confidentiality: Yes
The project is a quality improvement project without human subject intervention and has a single site focus. Patient respect and privacy will be maintained in accordance with HIPAA and HITECH requirements during chart searches/review, data collection and reporting. No patient identifiers will be used. Weekly analysis will be done by reviewing the daily central line maintenance audit form. These forms will be in the infusion center nurses station in a binder stored in a secure file drawer. Project data will be entered into a password protected spreadsheet. No individually identifying patient data will be collected or documented. The project has been submitted to the RRMC IRB Review Board and has been deemed as QI and approved for exemption.

Signature of Investigator: Sarah Christiana, BSN, RN DNP Student
Date: 07/21/2022

Appendix K

Project Site Institutional Review Board Exemption

Rutland Regional Medical Center

CLINICAL QUALITY IMPROVEMENT ASSESSMENT CHECKLIST

DATE: July 7th, 2022

DEPARTMENT: Diagnostic Imaging

PROJECT LEADER: Ginger Gillette-Kent, APRN

PROJECT TITLE: Implementation of a Daily Central Line Maintenance Audit Form in an Outpatient Infusion Center

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Instructions: Answer **YES** or **NO** to each of the following statements for your project and submit this form to the IRB Coordinator named on the organization's Research site along with the **QI Project Application.**

The aim(s) of the project is to improve the process or	YES	NO
There is no intention of using the data for research purposes	YES	NO
The specific aim is to improve performance on a specific service or program in the organization and is part of usual care. All participants will receive standard of ca	YES	NO
The project does **NOT** follow a research design (e.g., hypothesis testing or group comparison (randomization, control groups, prospective comparison groups, cross-sectional, case-control)	YES	NO