PREVENTION OF PERIPHERAL INTRAVENOUS CATHETER BLOODSTREAM INFECTIONS

by

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Dedication

This project is dedicated to my mother, the most phenomenal woman I have ever known. This project would not have been possible without her inspiration and support throughout the years of research and study. This work is accomplished due to my mother's positive influence and motivation throughout my life.

Abstract

The issue of peripheral intravenous catheter bloodstream infections (PIVC-BSIs) in hospitalized patients continues to impact the health of adults, causing negative outcomes of care and potentially leading to death. PIVC-BSIs have resulted in prolonged hospitalizations and increased costs, patient pain, and nursing workload. Current literature shows hospital-acquired PIVC-BSIs can be prevented by replacing PIVCs when clinically indicated. The purpose of this project was to determine in adult hospitalized patients, how effective would implementation of an evidence-based protocol on PIVC clinically-indicated-only replacements versus PIVC replacements every 96 hours, routinely be in reducing PIVC-BSIs. A protocol for replacing PIVCs when clinically-indicated-only was implemented over a 4-week period on a 40-bed internal medicine unit. The Visual Infusion Phlebitis (VIP) scale was used to assess when PIVCs needed replacement. Adult patients admitted to the unit with a peripheral intravenous catheter inserted were included in the project. Analytical measurements utilizing the statistical *t*-test showed a PIVC-BSI rate reduction from 0.42 to 0.34 per 1,000 patient days in this project. The result of the independent samples *t*-test indicated that there were not significant differences in PIVC-BSI rates before and after implementation; however, there was a noteworthy clinically significant 8% decrease in infections per 1,000 patient days. Implications for future projects include conducting similar projects to further verify the effectiveness of the intervention.

Keywords: peripheral intravenous catheter, bloodstream infection, hospitalized adults, catheter-related bloodstream infection, clinically indicated, bloodstream infection rate

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Prevention of Peripheral Intravenous Catheter Bloodstream Infections

Chapter One: Introduction and Overview

Peripheral intravenous catheter bloodstream infection (PIVC-BSI) continues to be a serious issue in hospitalized adult patients. Clinicians lack consistent methods to reduce this type of infection which can impact the health of adults and increase hospital costs. Peripheral intravenous catheter (PIVC) placements are very common invasive procedures conducted in hospitals throughout the United States and internationally. An estimated 300 million PIVCs are placed in patients for use during hospital stays annually in the United States (Morrell, 2020). Complications from PIVC insertion can be attributed to hospital-acquired infections and a high catheter failure rate ranging from 35% to 50% (Helm et al., 2019). These failures result in increased costs, decreased quality of care, and worse outcomes.

PIVC-BSI risk may be higher than the risk for central line BSIs due to the high frequency of use in health facilities. One study of Methodist Hospitals over a 6-year period revealed a lack of adequate disinfection of intravenous connectors could increase the risk of bloodstream infections (DeVries et al., 2014). The hospitals implemented two new disinfection caps that disinfected hubs with isopropyl alcohol. After a 3-month period, results showed zero BSIs for central venous and peripheral catheters. Bloodstream infection rates dropped 43% for PIVCs and 50% in central lines, compared to the pre-intervention period (DeVries et al., 2014). Since hospitals have not been required to track PIVC infections, inattention to PIVC-BSI risk may be seen as an invisible danger that can lead to future challenges. Currently, the cost of health care is higher with hospital-acquired infections because of increased length of stay and unnecessary treatment with antibiotics. Lower patient satisfaction resulting from increased procedures and discomfort may be attributed previously to lack of focus on prevention strategies regarding this problem. The project described in this paper applied new evidence-based implementation

strategies for the prevention of PIVC-BSI in hospitalized adult patients by changing peripheral intravenous catheters only when clinically indicated versus every 72 to 96 hours as recommended by the Centers for Disease Control and Prevention (CDC, 2017).

Background of the Project

One main reason for vascular access device use such as PIVCs is to provide therapies necessary for the treatment of illness and for patient recovery, all while simultaneously preserving the integrity of the patient's vascular system (DeVries, 2019). The reduction and prevention of infections from vascular devices can help maintain a healthy vasculature. According to DeVries (2019), daily site assessment and prompt removal of unnecessary central and peripheral catheter lines when no longer medically necessary are critical to reducing the risk of BSIs. Additionally, proper hand hygiene, insertion barrier precautions, skin antisepsis, and ideal catheter site selection are other major components to help decrease catheter-related BSI risk.

High rates of peripheral intravenous (IV) failures continue to be a problem that require attention and warrant improvements in current practice. PIVC infections impact outcomes of care, and clinicians continue to lack consistent strategies to reduce peripheral IV complications such as phlebitis and bloodstream infections in hospital settings. Reducing risks and improving vascular access outcomes have significant impacts on patient satisfaction as well as hospital costs resulting from complications and prolonged hospitalizations (Morrell, 2020; Ray-Barruel et al., 2020; Ripa et al., 2018).

A hospital-acquired infection, such as a primary bloodstream infection, may result in serious patient morbidity that could result in estimated costs of $10,000 to $20,000 (Duncan et al., 2018). A mandate on hospital-acquired infections for reporting central line-associated

bloodstream infections has been in place for hospitals since 2011, with little research on PIVC-BSI until recently. One study showed peripheral venous catheters started in the emergency department lacked adequate insertion techniques due to substandard aseptic environments (Duncan et al., 2018). Other poor practices related to peripheral intravenous infections included a lack of handwashing and lack of cleaning the access caps with each use. PIVC infections are often overlooked when a central line is present along with a peripheral catheter as the main source for an infection. As suggested by Duncan et al. (2018), decreasing PIVC primary bloodstream infections can be addressed using a peripheral IV maintenance bundle approach.

Decreasing the frequency of PIVC replacement has been recognized as a significant method to reduce bloodstream infection and phlebitis. The Centers for Disease Control and Prevention guidelines for PIVC replacement require no more than every 72-to-96-hour changes. In a systematic review of routine change group (2/3733) versus the clinically-indicated peripheral venous catheter replacement group (1/3590), in seven trials evaluating catheter-related bloodstream infection, no difference between the two groups was established (Webster et al., 2019). Additionally, the review determined that PIVC failure was lower with PIVC routine changes than with the clinically-indicated replacement that also reduced costs (Webster et al., 2019).

In a narrative review of infection risks related to PIVCs, an estimated 30-80% of hospitalized patients end up with a PIVC (Zhang et al., 2016). This high rate of catheter use increases the risk for severe infections in the bloodstream and other medical complications. Studies on PIVC-associated bloodstream infections are needed to prevent and reduce infections which contribute to extended treatment and hospitalizations. Sources and routes of PIVC infections include catheter hub contamination and microbe migration down the catheter. Existing

blood infections and bacteria from catheters, which include staphylococci and *Staphylococcus aureus* from skin flora, are main sources of BSI (Zhang et al., 2016). Recommended infection prevention strategies involve education of staff on PIVC replacement, catheter management, skin disinfection, proper handwashing, as well as dressings and needleless connector decontamination (Shrestha et al., 2021; Zhang et al., 2016).

Peripheral intravenous catheter-related bloodstream infection can cause complications of a severe nature and risk of potential death as determined in a retrospective observational study in two regional teaching hospitals in Tokyo (Sato et al., 2017). The study reviewed the average time of bacteremia after catheter insertion, which was 6 days. Gram-positive, gram-negative, and polymicrobial microorganisms were the causative pathogens in infected patients. Eight of these patients died within 30 days of a positive blood culture with higher *Staphylococcus aureus* infections than those who survived (Sato et al., 2017). Some of the PIVC-BSI cases needed long-term care with antibiotic treatment. As suggested by Sato et al. (2017), PIVC-BSI *Staphylococcus aureus* bacteremia remains a problem that can result in poor outcomes of care. The implications and need for further research on the impact of PIVC-BSI on patient safety as well as hospital costs continue to be a critical area requiring further evaluation. Strategies that help resolve gaps in practice, address inconsistent clinical practice guidelines, and identify gaps in the literature are essential to improving care provided in hospitals using peripheral vascular devices to provide therapeutic intervention for recovery and treatment. The need for further assessment, monitoring, and reporting of PIVC-BSIs can provide quality improvement in the care of patients with vascular devices and prevent severe complications and death.

The effectiveness of clinically-indicated PIVC replacement was evaluated in an evidence review conducted by Morrison and Holt (2015) that considered the negative outcome

experienced by patients with PIVC. Irritation of the vein was the most common side effect; pain, tenderness, redness, warmth, and swelling were some terms describing the experience. Catheter-related bloodstream infection (CRBSI) was less frequent, and the incidence of infection was approximately "0.1% of catheters and 0.5 per 1,000 device days" (Morrison & Holt, 2015, p. 187). Additionally, Morrison and Holt (2015) presented support for efficiency of replacing PIVCs only when clinically indicated and not for routine changes every 72 to 96 hours in adult patients. In four randomized controlled trials along with two meta-analyses with 155 subjects reviewed, PIVC replacement when clinically-necessary-only was found effective without an increase in the risk of infection or vein inflammation. Unnecessary procedures as well as increased costs can be eliminated with this practice, resulting in improved patient safety (Morrison & Holt, 2015).

Statement of the Problem

The nursing practice problem investigated was PIVC-BSIs in hospitalized adult patients continue to cause negative outcomes of care. Inconsistent strategies for the prevention of PIVC-BSI exist and various PIVC bundles are in place to help reduce the number of infections; however, there is lack of a standard practice that is necessary to decrease PIVC-BSI rates and there is no oversight requirement for reporting PIVC hospital-acquired infections. The impact of PIVC-BSIs on patients can be severe and can lead to death if this problem is not adequately addressed.

According to the CDC (2017) recommendations for PIVC changes, replacements should not occur more frequently than every 72 to 96 hours. There is no recommendation to replace peripheral catheters only when clinically necessary, which remains an issue without any final guidance (CDC, 2017). This project's site, an internal medicine unit, did not currently follow the practice for replacing PIVCs only when clinically indicated. There was a need for an

organizational assessment of current practice to determine the best approach for improving this issue. The practice standards set by the Infusion Nurses Society support PIVC replacement should occur when clinically indicated, and the reason for replacement should be determined based on an assessment of the patient's condition and access site (Gorski et al., 2021).

PIVC-BSIs are hospital-acquired infections. Treating infections, particularly those with *Staphylococcus aureus* bacteremia, remains a costly and significant problem impacting patient prognosis. Timely catheter removal may help avoid complications of a hematogenous nature and prevent death. Lack of surveillance data on PIVC-BSI to assess the risk for patients in health-care facilities indicated a need for more research, data, and analysis on this problem, which will continue to be of concern (Sato et al., 2017). This project contributed to the solution for preventing PIVC-BSIs in hospitalized patients and reducing the PIVC-BSI rate by consistently implementing clear evidence-based practice guidance for PIVC replacement and educating staff on the management and documentation of PIVCs.

Purpose of the Project

The purpose of this project was to determine if implementation of an evidence-based practice guideline for the replacement of PIVCs in adult hospitalized patients would reduce the bloodstream infection rate on a single internal medicine unit to less than 0.42 per 1,000 patient days, over a 4-week period. A preliminary review of the literature supported that implementing a guideline for replacing PIVCs only when clinically indicated would result in the reduction in PIVC-BSIs on the project unit versus the current routine replacement of PIVCs every 96 hours as recommended in the CDC guideline (CDC, 2017). This quality improvement project used a before-and-after design to determine if the rate of PIVC-BSIs on the 40-bed internal medicine unit could be reduced by translating current evidence into practice guidelines. Evidence-based

guidelines for PIVC change frequency were implemented within the project site unit. PIVC-BSI infection rates were compared prior to the practice change, at 4-weeks, and 2 months following the change. To promote effective implementation of the guidelines, unit staff received education prior to such. Additionally, improved monitoring, oversight, management, and documentation of PIVCs were instituted at the time of the practice change. The overall aim of this project was to improve patient safety and care outcomes.

Peripheral vascular catheters should be assessed daily for necessity and removed promptly when no longer medically appropriate, or if signs of infection are noted. Fewer catheter replacements reduce patient discomfort and may lead to lower costs and fewer complications (Maier, 2019). Tracking of BSIs as well as the microorganisms causing the infection could improve surveillance and reporting of hospital-acquired infections, and ultimately help determine other areas needing improvement. Based on a preliminary review of the literature, the goal of this project was to improve PIVC-BSI rates and subsequent care outcomes by addressing a discrepancy between current unit practice and best-practice strategies. This improvement would also increase patient satisfaction and reduce nurse workload as well as hospital costs associated with PIVC-BSI care.

Research Question

The impact of PIVC-BSI on the health of adult hospitalized patients can be profound. To understand this issue further, the following research question was asked: Does PIVC replacement only when clinically indicated, compared to PIVC replacement every 96 hours, reduce bloodstream infection rates in hospitalized adults? A preliminary review of the literature revealed decreasing the frequency of catheter replacement when clinically indicated may have an impact

on patient care quality and safety (Stevens et al., 2018). Reducing the number of times, a patient endures a replacement PIVC insertion can also decrease the risk of bloodstream infection.

PICOT Question

The clinical question was formulated using the PICOT (population, intervention, comparison, outcome, and time model). This PICOT format promotes clarity, specificity, and searchability of research questions (Moran et al., 2019). The PICOT question developed for this project was as follows:

- (P) Population - Adult hospitalized patients within a single 40-bed internal medicine unit
- (I) Intervention – Evidence-based PIVC replacement only when clinically indicated
- (C) Comparison intervention - Compared to PIVC replacement every 96 hours, routinely
- (O) Outcome - Reduction in PIVC-BSI rate
- (T) Time – Over a 4-week period

This project asked the following clinical question: In adult hospitalized patients on an internal medicine unit, how effective is PIVC replacement only when clinically indicated versus PIVC replacement every 96 hours, routinely, in reducing PIVC-BSI rates over a 4-week period?

Theoretical Framework

This project was based on Greenhalgh's (2004) Model of Diffusion (see Figure 1) that describes a conceptual framework for the diffusion, dissemination, implementation, and sustainability of health service innovations aimed at improving health outcomes (White & Dudley-Brown, 2019). This framework provides the basis for interventions in acute care settings with interprofessional teams while providing a structure for goal-directed solutions to problems and concerns (Mateo & Foreman, 2017). This model was in alignment with the project design and applicable to the project scope and purpose. The Greenhalgh's model was used to guide and

predict this quality improvement project. The project used the theoretical framework to predict outcomes by using a formal, planned approach, with interprofessional clinical experts and change agents to help influence and sustain the practice change.

Identifying barriers and facilitators early in the project's implementation did clear obstacles to the adoption and use of new practice guidelines. Individuals who were early adopters assisted with creating a spirit of inquiry which benefited the short timeframe for implementing change. Achieving buy-in and input from stakeholders was important to promote adoption of the project intervention. The interprofessional team and stakeholders were involved in all stages of the project development and design. Greenhalgh's model was used to demonstrate how to address important issues and challenges in health care related to current and proposed practices for PIVC management.

Theoretical frameworks explain how relationships lead to specific events. Greenhalgh's model provided a framework to make predictions and manipulate variables that led to desired outcomes. Interprofessional teams may use these frameworks to guide changes in policy, practice, and systems for performance improvement. The Greenhalgh model worked well with translating knowledge from best evidence-based clinical guidelines to practice through innovation, diffusion, adoption, assimilation, and dissemination of system changes (Greenhalgh et al., 2004). During the implementation process of the project, the interprofessional team was involved in the decision making. Internal communication was key to successful outcomes. External collaboration with clinical experts and training was completed as well. Feedback on the progress of the project was essential to keeping the change momentum going and ultimately, to project success.

In this project, the Plan-Do-Study-Act (PDSA) model (see Figure 2) was used to provide a structure for repetitive cycle developing, testing, and implementing changes to continually improve the quality of care (IHI, 2022). Effective new processes implemented in health care systems require additional changes over time. The PDSA model allowed for project findings to be evaluated, changed, and improved based on complex social systems and organization specific needs. Practice guideline improvements implemented in this project may require adjustment to local environments over time and to react to unexpected challenges. Barriers and unpredictable issues that arose were addressed conducting a rapid cycle improvement process by planning, doing, studying, and acting on problems related to project implementation and outcomes.

Significance of the Project

The problem with PIVC-BSIs is a global population health issue and must be addressed to improve the safety of hospitalized adults who receive peripheral intravenous therapies. Vascular access via PIVC facilitates treatments, stabilization of conditions, and diagnostic procedures within emergency and other acute care settings. Annually, over 300 million PIVCs are placed in patients for use during hospitalization in the U.S. (Morrell, 2020). An increasing number of *Staphylococcus aureus* infections occur in the United States and internationally from PIVC-associated infections. Current CDC guidelines for PIVC routine replacement may not be the best practice based on current knowledge and research findings. New evidence on implementing PIVC clinically-indicated-only replacement guidelines support decreased risk of infection and lower hospital costs. Implementing new guidelines may result in eliminating unnecessary pain for patients from catheter insertions, decreasing excess supply use for routine PIVC changes, and improving the workload for health-care staff, all of which contribute to significant improvements in quality and safety. Additionally, studies do not show a significant

correlation between the rate of phlebitis and bloodstream infections, and the replacement time for PIVCs (Alloubani et al., 2019; Orban et al., 2018; Vendramin et al., 2020; Webster et al., 2019; Xu et al., 2017).

There were gaps in the literature on PIVC-BSIs and there were no requirements for health- care organizations to report these infection rates. Inconsistency in the application of current PIVC guidelines for replacement needed to be addressed. An evidence-based guideline for PIVC-BSI prevention is now available for implementation within any other health-care organization with the completion of this project. This project's implementation, evaluation, and dissemination of findings did address the current lack of standard guidelines for PIVC replacement which reflect current evidence. Evidence was conflicting and studies have shown no difference in health-care-associated infections between routine PIVC replacement every 96 hours and only changing PIVCs when clinically indicated. This project contributed to the body of evidence by clarifying and documenting outcomes within a setting that has increased PIVC-BSI rates over the last year. Since PIVC-BSI prevention strategies were based on current evidence, patients did benefit directly from this project with improved quality and safety outcomes. This project also informed future improvement efforts by adding to the knowledge base. Future research may build upon this project’s findings to further evaluate and develop an effective PIVC-BSI prevention protocol. These strategies could potentially be implemented worldwide to reduce infection rates, decrease associated care costs and complications, improve patient satisfaction, and reduce care demands.

Definition of Terms

The terms used in this project clarify how concepts were operationalized for the project. Key terms helped to determine essential words for use in conducting a review of the literature.

The terms represented main concepts of this project topic and helped to identify search terms important to answering the research question. The definition of terms used in the project question were:

Hospitalized adults: Adults 18 years and older in the hospital.

Peripheral intravenous catheter: A thin flexible tube that is inserted into a vein.

Bloodstream infection: The presence of viable bacterial or fungal microorganisms in the bloodstream. A laboratory confirmed positive blood culture that is not secondary to an infection at another body site (CDC, 2023).

Catheter-related bloodstream infection: The presence of bacteremia originating from an intravenous catheter. Requires specific laboratory testing that identifies the catheter as the source (CDC, 2017).

Clinically indicated: Clinical criteria for PIVC replacement that is documented in the electronic health record.

Bloodstream infection rate: The ratio of the number of viable bacteremia in the bloodstream originating from a PIVC per 1,000 patient days.

Nature, Scope, and Limitation of the Project

This project used a before-and-after design to determine if the rate of PIVC-BSIs on a 40-bed internal medicine unit at a large medical center could be reduced by translating current evidence into practice guidelines. The Visual Infusion Phlebitis (VIP) Scale (see Figure 3) to determine phlebitis score and PIVC change frequency was implemented within the entire unit. PIVC-BSI infection rates were compared prior to the practice change, at 4 weeks, and 2 months following the change. To promote effective implementation of the guidelines, unit staff received education prior to such. Improved monitoring, oversight, management, and documentation of

PIVCs were instituted at the time of the practice change. The overall aim of this project was to improve patient safety and care outcomes. The difference between the measurements from pre- and post-intervention were analyzed and the impact of the intervention evaluated for future implications.

The scope of the project included all adult patients admitted to the internal medicine unit with a peripheral intravenous catheter inserted during their hospital stay. While on the unit, all patient PIVCs were only replaced when clinically indicated. PIVC sites were assessed daily for signs and symptoms of infection. Unit-level PIVC-BSI rates were assessed at 4 weeks and 2 months following the implementation of the new guideline. This data was compared to pre-implementation rates to evaluate the impact of this practice change.

The project limitations included access to patients on one unit with limited historical PIVC-BSI and phlebitis data. The medical center did not collect phlebitis data, so historical data from 2021 was not available for comparison. The project design type impacted the level of evidence due to a small sample size and no exact comparison group. Additionally, there was limited research on PIVC-BSI rates in hospital settings and this was not a commonly reported rate in hospital settings. Finally, the timeline for data collection was short, and longer data collection periods may result in different outcomes. Outcomes from this project were also influenced by uncontrolled variables. Further research may be needed using different design methodologies to confirm correlation. This project provided insight into the potential effect of implementing the practice change.

The delimitations for this project included what was not studied in this project. Central line bloodstream infections were not studied, and patients with midline catheters were not included in the participant pool. There was one project coordinator for this project and key

stakeholders participated in supporting the project through documentation in the electronic record and reporting any variances that occurred outside of the weekly audit reviews. This project did not adjust findings to account for possible differences in age, condition, or immune function (and subsequent risk for infection). This project simply evaluated PIVC-BSI rate changes prior to and following the practice change, and incidence of phlebitis. Assessment and documentation were performed by several practitioners. Pre- and post-implementation nursing staff education was provided to reduce practice variance and improve knowledge levels.

Proposed Doctor of Nursing Practice Essentials

The Doctor of Nursing Practice (DNP) Essentials is a model for advanced practice nursing, and provides the core foundational competencies for students, faculty, and DNPs to accomplish the highest level of practice (Zaccagnini & Pechacek, 2021). There are eight Association of Colleges of Nursing (AACN) Essentials of Doctoral Education for advanced practice nursing in this model. The DNP Essentials were incorporated in this project and used to structure the DNP project by evaluating, translating, and disseminating research into practice. The DNP Essentials anticipated from the implementation of this project were as follows:

- Essential I: Scientific Underpinnings for Practice – The study of historical as well as current gaps in knowledge and best practice on the topic of prevention of PIVC-BSIs in adult hospitalized patients will lead to quality improvement outcomes. Implementing a standard evidence-based protocol for replacement of PIVCs when clinically indicated will impact care quality and safety.
- Essential II: Organizational and Systems Leadership for Quality Improvement and Systems Thinking – This DNP project incorporated organizational leadership by using a systematic approach to improving PIVC-BSI rates. Developing a structured plan for

project implementation based on evidence and leading the interprofessional team in the implementation will result in decreased PIVC-BSI rates in patients on the project unit. Additionally, this project utilized organizational policy to support individual patient care.

- Essential III: Clinical Scholarship and Analytical Methods for Evidence-Based Practice Research and scholarship along with use of analytical methods for evidence-based practice is vital to doctoral education. This project demonstrated the alignment of theory, research, and practice to decrease the rate of PIVC-BSIs in a single internal medicine unit. Translating knowledge to make a clinical practice change from replacing PIVCs routinely every 96 hours to only when clinically indicated will produce positive changes in practice.
- Essential VI: Interprofessional Collaboration for Improving Patient and Population Health – The importance of interprofessional collaboration was key to this project. Utilizing a framework to guide this project that involves the interprofessional team in the project implementation will increase success. Collaboration with clinical experts as well as including patient preferences can help provide support as well as participation in the project.
- Essential VII: Clinical Prevention and Population Health for Improving Patient and Population Health Outcomes – Implementing this project to prevent PIVC-BSI rates can improve patient outcomes and decrease hospital-associated infections. This project impacted quality outcomes by decreasing PIVC infections, decreasing nursing time, and lowering health-care costs. This project can be expanded to other units to improve patient outcomes of care throughout the system and in any other health-care organization. The

widespread use of PIVCs in hospital settings makes this project relevant to a large population.

Conclusion

PIVC-BSIs have a major impact on the health of hospitalized adults. A high number, 42%, of PIVCs resulted in unplanned removal, increasing the risk of morbidity and mortality (Blanco-Mavillard et al., 2019). An estimated 30-80% of PIVC use in hospitalized patients increases the risk for severe infections in the bloodstream as well as other medical complications. Clinicians continue to lack consistent methods to prevent this type of infection that is acquired in hospital settings. Health-care leaders must address this growing trend and provide oversight and attention to resolving this issue utilizing the best evidence. This project showed the effects of implementing an evidence-based practice to reduce PIVC-BSIs within an internal medicine unit with increased PIVC-BSI rates over the prior year. Additionally, this project addressed the current evidence-based practice gap related to the frequency of PIVC changes and subsequent risk for infection. An evidence-based guideline was developed and implemented to evaluate the impact of on the PIVC-related BSI rate of hospitalized adults. The findings of this project could potentially be applied worldwide to prevent PIVC-BSIs and associated care costs, complications, care demands, and patient dissatisfaction. An analysis of the best evidence follows and provides a review of the overall scholarly knowledge available on preventing PIVC-BSIs in hospital settings.

Chapter 2: Literature Review

Peripheral intravenous catheter-related bloodstream infections have been acknowledged as a major problem in the past decade due to outbreaks of catheter-related bloodstream infections in health-care settings across the world. The CDC has recommended guidelines for hospital-acquired infections that address several strategies to reduce the risk of these hospital-acquired BSIs, including the timing of PIVC site replacement and removal. The current guideline by the CDC is to routinely change PIVCs every 72-96 hours (CDC, 2017). More recent knowledge and research studies provide evidence to support PIVC replacement by clinical indication. Even with this evidence, clinicians remain inconsistent in clinical practice initiatives and lack routine surveillance on PIVC-related BSIs and complications.

Many health-care organizations have adopted the clinical practice recommendation of replacement of PIVCs when clinically indicated. Studies have shown this practice results in decreased infections, saves nursing time, and reduces hospital costs (Morrison & Holt, 2015; Stevens, 2018; Webster et al., 2019). There remain gaps in the literature to support this recommendation, and conflicting evidence exists on whether routine PIVC replacement is better than clinically-indicated replacement. There has been a lag putting the latter into practice. Additionally, hesitancy in developing policy, guidelines, and surveillance processes at local levels still exists. Since there is no regulatory oversight for reporting PIVC-related BSIs, hospitals do not provide the attention necessary to improve care quality and safety for the huge number of patients who receive PIVCs in health care settings.

There are documented major complications and risks for patients who receive PIVCs during their hospital stay. CDC (2017) guidelines have addressed the need to replace PIVCs only when clinically indicated in children, though have not resolved the issue in adult patients. In the

United States, over 300 million peripheral venous catheters are placed in patients during hospital stays (Morrell, 2020). As suggested by Helm et al. (2019), PIVC insertion failures and infections such as phlebitis and bloodstream infections can be attributed to insertion failure rates ranging from 35% to 50% within hospitals. The rate of hospital-acquired PIVC-related BSIs for the project's 40-bed internal medicine unit was 0.42 per 1,000 patient days. Implementation of current evidence-based guidelines to replace PIVCs only when clinically indicated did improve this rate.

A review of the literature was conducted to identify best practices for replacement frequency of PIVCs. ProQuest, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, and Google Scholar databases were included in the search for this project. Individual professional journals were searched separately. The following keywords were used: *peripheral intravenous catheter*, *bloodstream infections*, *adult*, and *hospitalized patients*. Boolean operators AND as well as OR were used to help narrow the search. Results were limited to peer-reviewed sources published within the last 5 years. ProQuest yielded 49 results, of which 13 articles were relevant to the topic. A modified search in ProQuest adding "clinically indicated replacement versus routine replacement" to the original search resulted in 49 articles. A search in CINAHL resulted in three articles, only one of which was substantive. PubMed yielded 45 results that were relevant. A manual search and scanning through the cited references of other sources resulted in additional relevant and current articles. There were seven articles in PubMed that were duplicates and were found on Google Scholar as well. Searches in professional journals yielded current evidence on the topic. Articles were excluded if the topic did not relate to PIVC-BSIs or if the article was focused on pediatric patients and other irrelevant information. A total of 35 articles were selected as relevant evidence for this project (see Appendix A).

Relevant variables in this project involved PIVCs in adult hospital patients that required replacement during their hospital stay. The controversy was whether a protocol for replacing PIVCs when clinically indicated would reduce PIVC-related bloodstream infections even if this increased catheter dwell time. There were fewer insertions for patients, which would decrease patient pain and discomfort, therefore improving satisfaction. Assessing and documenting the PIVC site in the electronic record daily was required to ensure that the PIVC line was functioning properly and there were no signs and symptoms of phlebitis or infections. A protocol for determining if a PIVC catheter needs removal and replacement was put in place to provide standardized guidelines for staff to follow.

The current practice at the project medical center was to replace PIVCs every 96 hours. This caused increased discomfort to patients and may be unnecessary. There was evidence that increased dwell time due to changing PIVCs when clinically-indicated does not increase bloodstream infections or related complications (Webster et al., 2019). Additional evidence showed that changing PIVCs every 72-96 hours and clinically-indicated PIVC replacements had no significant difference in clinical outcomes (Xu et al., 2017); however, related studies showed a wealth of evidence to describe how clinically-indicated-only replacements were better for patient outcomes and safety. The PIVC-BSI rate on the project's designated unit was steadily increasing, and more patients were acquiring infections from *Staphylococcus aureus* which could lead to severe complications and death. Secondary outcomes from a protocol change included a decrease in equipment and supply use as well as decreased extended hospital stays due to PIVC-BSIs. These are incentives for hospitals to change clinical practice; however, the focus of this project was to provide a better patient experience and improved outcomes of care by implementing clinically-indicated-only PIVC replacement.

Conceptual Framework

The conceptual theory used to support this project was Greenhalgh's (2004) Model of Diffusion (illustrated in Figure 1). This framework is a strong model for health-care settings to use to guide, predict, and improve health outcomes (Moran et al., 2019; White et al., 2019). This model was appropriate to describe the new innovative practice of clinically-indicated-only PIVC replacements that was implemented on the internal medicine unit, and potentially could be spread throughout the medical center. There have been protocols for adopting clinically-indicated removal of PIVCs globally; however, the local medical center site and other facilities across the nation have not included the change in practice guidelines (Takashima et al., 2020).

Greenhalgh's model provided a guide for implementing clinical innovations into practice, as well as adopting new procedure and policy changes. Additionally, the model provided a systematic process to ask questions and explore relationships as well as phenomena. The framework was congruent with this project which is a quality improvement (QI) before-and-after design. Comparing the PIVC-BSI rate of 0.42 per 1,000 patient days pre-implementation, to the rate post-implementation of a clinically indicated replacement guideline was critical to support the effectiveness of the project methodology. Linkages in the conceptual model included innovation characteristics, system antecedents, system readiness, adoption/assimilation, implementation process, consequences, diffusion, dissemination, and the sustainability of practice innovations (Greenhalgh et al., 2004; Moran et al., 2019; White et al., 2019). A clear structure and process was put in place to educate staff on the new practice for changing PIVCs only when clinically indicated. Local leadership, the interprofessional team, and key stakeholder involvement through decision making and dissemination in the planning and implementation phases helped build on the strong relationships that existed. Additionally, this assisted in

spreading and sustaining project outcomes. Reviewing current practice, communicating with the team, and obtaining feedback on the project was essential to successfully influencing stakeholders. Planned regular meetings were established to discuss and disseminate information regarding the progress during the implementation process.

The next step was to provide evidence regarding the practice change to replace PIVCs when clinically indicated using the Visual Infusion Phlebitis scale, a supporting protocol for decision making. Ensuring staff understood the new protocol was important to ensure staff readiness for the innovation. This was important for the adoption, assimilation, and implementation processes. Aligning the protocol with the mission of the organization and targeted quality patient care outcomes allowed for an easier transition to the innovative process. Providing information on the consequences of not making the planned changes supported the reason and need for innovation. Developing an evaluation and audit system was key to ensuring the practice change would be sustained. Sharing and disseminating the project results were part of the project's overarching goals for improving health outcomes.

Related Studies

Systematic reviews, randomized controlled trials (RCTs), quality improvement projects, and evidence reviews were examined related to routine versus selective PIVC replacement, dwell time, and bloodstream infections or complications. Existing literature focused on the following aspects of this project: efficacy of routine versus selective PIVC replacement, incidence of PIVC-related bacteremia, and prevention of PIVC-related complications and failures. These major themes provided a body of evidence for the design and basis of this quality improvement project. Numerous related studies found no significant association between the rate of bloodstream infections and PIVC clinically-indicated replacement practices (Alloubani et al.,

2019; Apel et al., 2021; Orban et al., 2018; Vendramin et al., 2020; Webster et al., 2019; Xu et al., 2017).

Efficacy of Routine Versus Selective PIVC Replacement

In a systematic review by Webster et al. (2019), 7,323 patients in seven randomized clinical trials were reviewed for comparison of clinically-indicated PIVC replacement versus routine replacement. The study results showed no significant difference in clinical outcomes. Only one BSI was observed in 2,365 patients with PIVC replacement by clinical indication, and 1 in 2,441 in the routine replacement group. A study by Blanco-Mavillard et al. (2020) involving a three-hospital, prospective multicenter observational study of PIVC clinical practice guideline adherence and PIVC removal/replacement showed a wide gap in compliance to the guideline, between knowledge and optimal practice, to prevent PIVC failure.

Some of the complications from PIVCs may originate from idle PIVCs that staff fail to remove in a timely fashion. PIVC-associated *Staphylococcus aureus* bacteremia (SAB) is a common cause of SAB (Blauw et al., 2019). According to Blauw et al. (2019), decreased incidence of SAB can be attained by avoiding PIVC sites in the antecubital area and minimizing the length of dwell time for a PIVC. In a retrospective cross-sectional study by Lim et al. (2019), of discharged patients in the United States, 2% of 10,354 patients with PIVCs had evidence of a PIVC-associated complication. These patients spent an average of 2 additional days in the hospital, costing over $3,000 compared to those without a PIVC complication (Lim et al., 2019).

A project study by Dao (2016) comparing PIVC catheter indwelling time and complication prevalence after changing from a 96-hour routine PIVC replacement standard, showed no significant difference in complication rates. The results showed an increased number of device days for the clinically indicated replacement group and did not reveal any increase in

BSI (Dao, 2016). A study in Tokyo, with 62 patients, observed clinical manifestations in patients with positive PIVC-BSI cultures. Five of 14 patients with *Staphylococcus aureus* died within 30 days of PIVC-BSI diagnosis (Sato et al., 2017). A lack of regular surveillance regarding causative organisms of PIVC-BSI remains an issue.

In the United States, a clinical guideline was developed for intravascular catheter removal if patients develop signs of phlebitis, warmth, tenderness, erythema, palpable venous cord, infection, or a catheter malfunction. This effort aimed to prevent infections with central venous catheters and PIVCs in adults (O'Grady et al., 2017). In a study in Japan, results showed that PIVCs are not safer than CVCs with respect to BSIs, citing the necessity to use similar precautions for CVC in order avoid unnecessary use of PIVCs (Tatsuno et al., 2019). According to Xu et al. (2017), in a study in China comparing 645 patients with PIVCs replaced only when clinically indicated, and 553 patients whose PIVCs were routinely changed every 72-96 hours, there was no difference in incidence of phlebitis or BSI. Conclusions in the study included supporting the practice of PIVC replacement when clinically indicated.

In a randomized controlled non-blinded trial in Brazil, a multi-center study showed using the "RESPECT" program of replacing PIVC according to clinical signs, versus every 96 hours, showed no difference in the risk for developing phlebitis (Vendramin et al., 2020). In a quality improvement project in a 38-bed medical unit, 469 patients with 1,033 PIVCs were evaluated for clinically-indicated PIVC replacement over two periods. Results showed PIVC placement decreased from 34% to 3%. Dwell time had no impact on phlebitis or BSI, according to the study (Oh et al., 2019). In a quality improvement project on a 29-bed unit in a community hospital, comparison of short peripheral catheters (SPCs) replaced when clinically indicated and every 96

hours, resulted in no SPC infections during the 3-month post-intervention period, and a phlebitis rate below the benchmark of 5% (Stevens et al., 2018).

An evidence-based practice project by Apel et al. (2021) evaluated how routine replacement of PIVCs causes decreased patient satisfaction, poor use of nursing time, and increased costs. The project resulted in similar outcomes in phlebitis rates between changing PIVCs every 72-96 hours versus when clinically indicated (Apel et al., 2021). Additionally, cost savings were noted with the change to clinically indicated PIVC replacements, and fewer requests for IV replacements were made. An evidence-based project that compared pre-and post-intervention of replacing short peripheral catheters (SPCs) when clinically indicated showed short peripheral catheter SPC supply use rate decreased by 14.2% post-intervention (Stevens et al., 2018). Short peripheral catheters are peripheral intravenous catheters that are generally placed in superficial veins. A multi-site randomized control trial RCT, which is a study that measures the effectiveness of a new intervention, was conducted in three hospitals in China, and investigated clinically indicated PIVC versus 96-hour replacement groups. There were no differences in phlebitis rates per 1,000 catheter days, BSI, and mortality; however, the risk of infiltration was shown to increase in the clinically indicated replacement group (Li et al., 2021).

Incidence of PIVC-Related Bacteremia

A large observational study in Switzerland showed PIVC-BSI incidence rates during two periods, one after routine replacement for 1 month and clinically indicated PIVC replacement when clinically indicated for 6 months. There were 11 PIVC-BSIs at baseline and four during the reversion period (Buetti et al., 2021). In a study on 10 units in one hospital, with 600 patients, comparison of BSI with clinically indicated replacement versus routine over a 3-month period showed incidence of phlebitis, occlusion, infiltration, and more pain in the clinically indicated

replacement group (Lu et al., 2021). While most studies show minor or no differences in the two replacement types, this study was different. An evidence review of a systematic review involving two studies conducted by Alloubani et al. (2019) resulted in no evidence to support routine changing of PIVCs every 3-4 days. This review supported the clinically indicated protocol as superior, more cost-effective, and minimizing multiple catheter replacements. A retrospective study that was conducted over 7 years, by Ruiz-Giardin et al. (2019), found an increase in the incidence of PIVC bacteremia in recent years. In a systematic review of 63 studies evaluating short PIVC-related BSI incidence and all nosocomial catheter-related BSIs, a mean incidence of 19% *Staphylococcus aureus* PIVC infections were due to PIVC infections (Mermel, 2017). The high incidence of PIVC-associated BSIs supports the need to provide surveillance of PIVC-related infections in health-care settings to prevent hospital-acquired infections as well as PIVC-BSIs. This in an area where surveillance is not currently required by any regulatory body; however, *Staphylococcus aureus* PIVC-related BSIs can lead to increased morbidity and mortality. Improvement in this area by health-care leaders is needed.

Prevention of PIVC-Related Complications and Failures

Several identified studies support the use of clinically-indicated-only PIVC replacements compared to routinely changing PIVCs every 72-96 hours to prevent PIVC complications. A quality improvement study also showed a reduction of SPC replacements, catheter failures, and BSIs when education and practice change to clinically indicated replacements was implemented (Kollar, 2021). A QI project at a university hospital studied 227 episodes of patients with PIVC-related BSIs. Surveillance implemented from January, 2003, to December, 2016, with PIVC-BSI prevention measures produced a reduction in *Staphylococcus aureus* infection from 30, in 2003, to 8, in 2016 (Saliba et al., 2018). According to Marsh (2018), a hospital in Australia

studying 1,000 medical and surgical patients, showed high rates of catheter failure at 32% with routine removal of PIVC by 72 hours. Phlebitis, occlusion, infiltration, and dislodgement were reported as reasons for the catheter failures. There are common threads in the literature of decreased phlebitis and infections, decreased hospital costs, decreased nursing care time, and better patient comfort that support the change in practice to improve health-care outcomes. Translating evidence-based knowledge into practice can lead to better outcomes and improvements in quality and safety.

Methodological Framework

This project was based on Greenhalgh's (2004) model which describes a conceptual framework consisting of nine components for the diffusion of innovation: innovation characteristics, adoption, assimilation, dissemination, system antecedents, system readiness, collaboration, implementation; and the linkages among the components (White et al., 2019). This framework provides the basis for interventions in acute care settings with interprofessional teams while providing a structure for goal-directed solutions to problems and concerns (Mateo & Foreman, 2017). The model was in alignment with the project design and applicable to the project scope and purpose. The Greenhalgh's model was used to guide and predict this quality improvement project.

The project used a before-and-after nonexperimental design with one group of patients on a 40-bed internal medicine unit. The main intervention in the project involved implementing a clinically-indicated-only replacement protocol for PIVCs. This was a change from the current practice of replacement every 96 hours and required a systematic approach and methodology. The improved protocol was implemented over a 4-week period. An additional 2-month

post-implementation data collection period for PIVC-BSIs was continued and tracked by the medical center infection preventionist. Adults over the age of 18 with a PIVC were eligible for participation.

The weaknesses or limitations of the methodology in previous studies included a lack of randomized controlled studies. There were limited hospitals that did surveillance for PIVC-BSI, so large studies over long periods need to be explored. More comparative studies need to be investigated as well. This project built upon the quality improvement studies that have been conducted to strengthen the literature to support a change in clinical practice to improve safety and quality in hospitalized adult patients.

Conclusion

A systematic review of the literature was important to provide the best evidence available on preventing PIVC-related bloodstream infections in hospital settings. Gaps in the literature still exist and there was a lack of standard practice for replacing PIVCs to improve PIVC-associated BSI rates. The efficacy of routine versus selective PIVC replacement when clinically indicated, incidence of PIVC related bacteremia, and prevention of PIVC-related complications and failures were key areas reviewed in the literature. There was strong evidence to support PIVC replacement only when clinically indicated. *Staphylococcus aureus* PIVC-related BSIs can lead to increased morbidity and mortality. Improvement in this area by health-care leaders is vital. Studies revealed no difference in PIVC-related BSIs between routine and clinically-indicated groups. Additionally, various studies supported changing practice to clinically-indicated-only replacement, citing the following associated benefits: cost savings, improved comfort for patients, and reduced nursing time. A comprehensive synthesis of existing knowledge provided a foundation for evaluating the best evidence for this project. A description

of this project's design and methodology follows in Chapter 3, along with the rationale for the design related to the purpose of this project to prevent PIVC-related bloodstream infections.

Chapter 3: Methodology

The purpose of this quality improvement project was to determine if implementation of an evidence-based practice guideline for the replacement of PIVCs in adult hospitalized patients would reduce the bloodstream infection rate on a 40-bed internal medicine unit. The goal was to reduce the PIV catheter-related BSI rate from the current rate of 0.42 per 1,000 patient days, within 4 weeks and 2 months post-intervention implementation. Baseline data was compiled from the prior year, 2021, and was compared to post-intervention results. BSI data on the project unit had not been collected prior to 2021; therefore, historical data was unavailable.

As part of the methodology for this project, the VIP scale was used to assess clinically indicated PIVC change frequency and was implemented to improve clinical care within the entire unit. The VIP scale with a VIP score was developed by Andrew Jackson (1998) who provided permission to use this instrument in the project (see Appendix B). Gorski et al. (2021) from the Infusion Nurses Society gave permission to use the VIP scale as well (see Appendix C). Staff on a single internal medicine unit were required to replace PIVCs only when clinically indicated versus every 72-96 hours as indicated by current CDC (2017) guidelines. A tool for collecting PIVC clinically-indicated replacement data was utilized for this project (see Figure 4). A staff questionnaire was provided before receiving the PIVC clinically-indicated replacement guideline education and after the intervention phase to assess staff knowledge of the PIVC replacement protocol (see Appendix D). Additionally, staff education was provided to decrease staff variability in interpreting the protocol criteria and examined pre- and post-intervention to evaluate differences in knowledge (see Appendix E). PIV catheter-related BSI rates were compared prior to the practice change, at 4 weeks, and 2 months following the change. Improved monitoring, oversight, management, and documentation of PIVCs were instituted at the time of

the practice change as well. The overall aim of this project was to improve patient safety and care outcomes.

A discrepancy between current practice for PIVC changes and best practice existed on a 40-bed internal medicine unit. The current policy on the unit was to change PIVCs every 96 hours, routinely. An increase in the number of PIV catheter-related BSIs had been observed over the past year. Changing the frequency of PIVC replacement to clinically-indicated-only has been shown to reduce PIV catheter-related BSIs (Olivier et al., 2021; Webster et al., 2019). Reducing the BSI rate has also been associated with improving patient satisfaction, reducing nurse workload, and decreasing hospital costs related to PIVC-BSI-associated care expenses (Morrell, 2020).

The Plan-Do-Study-Act project management model is a rapid cycle performance improvement approach that was utilized as the basis for project planning, testing, studying, and determining any necessary modifications (AHRQ, 2020; IHI, 2022; White et al., 2019). Steps involved in project planning included conducting an organizational assessment, identifying key stakeholders, and outlining project timelines. Additional steps involved developing a project evaluation process and making changes when needed to sustain project compliance. For this project, the PDSA model was implemented starting with the project planning and a needs assessment was conducted as well. The needs assessment indicated a need for evidence-based practice guidelines for PIVC replacement, and staff training to effectively implement such. The project was implemented with the following steps:

- Plan - A plan had been identified based on the needs assessment conducted to test the implementation of a PIVC clinically-indicated-only replacement guideline to reduce PIVC-BSI rates on a 40-bed internal medicine unit.

- Do - Implementation of the VIP scale evidence-based guideline for clinically indicated PIVC replacement and staff education.
- Study - Implementation of the practice change was investigated; collection of data was completed, and data analyzed.
- Act – The PIVC replacement guideline based on clinically-indicated criteria was evaluated for policy and practice changes that may be spread throughout the medical center.

Project timelines were estimated for obtaining institutional review board (IRB) approval, implementing a practice guideline for PIVC replacement, collecting data, conducting data analysis, documenting, and disseminating project results (see Appendix F).

An evidence-based practice change was essential to reducing PIV catheter-related BSIs within the internal medicine unit setting. Greenhalgh's model was the theoretical framework that did underlie this project. This model of diffusion is used in health care to help spread and sustain innovations in service delivery, such as this project designed to improve care. Planned and coordinated actions that involve organizational process, context, as well as culture, need to be in alignment with knowledge-based approaches to innovations. According to Greenhalgh et al. (2004), the conceptual model encompasses a systematic method for addressing complex issues and to translate research into practice. To ensure successful translation of research into practice, this model addressed complex human behavior that must be included in the implementation for long-term adoption of changes and sustained innovative clinical practice.

This project was an evidence-based quality improvement project that used a before-and-after project design to compare pre-implementation PIV catheter-related BSI rates with post-implementation results. The design showed the effect of a practice change on PIV catheter-

related bloodstream infection rates prior to and upon completion of the intervention implementation phase. The scope of the project included all adult patients admitted to the 40-bed internal medicine unit with a peripheral intravenous catheter inserted during their hospital stay. This was the accessible population admitted in the location on the unit where data was gathered. Data was collected over a 4-week period for this project. Patients who developed PIVC bloodstream infections at least 2 days after admission to the unit, during the 4-week implementation period, and 2 days after the end of the 4-week implementation period were included in the PIVC-BSI rate for the unit. The National Healthcare Safety Network (NHSN) date of event for hospital-associated infections include infections diagnosed per NHSN site-specific infection criteria on or after the third calendar day of admission to an inpatient unit (CDC, 2022). Data analysis was completed at 1 month and 2 months post-implementation. PIV catheter-related BSI rates were analyzed for comparison before and following the practice change. The project limitations included access to the group of patients on one unit only. The medical center did not collect PIV catheter-related BSI data, so historical PIVC-BSI rates from previous years before 2021 were not available for comparison. The type of methods used in this project, sampling strategy, data collection, and analysis methods are delineated further in this chapter.

Project Design

The quantitative project used a before-and-after design to determine if the rate of PIVC-BSIs on a 40-bed internal medicine unit at a large medical center could be reduced by translating current evidence into practice guidelines. This nonexperimental design compared changes in PIV catheter-related BSI rates with the targeted outcome of the intervention before and after the intervention. A before-and-after design may lack controls for organizational and environmental

changes which may also influence the outcomes, though is still a useful design for single-site studies with changes in QI practices (Mormer & Stevans, 2019). The benefit of this design was the ability to identify changes from the effect of the intervention, and that the design did not require randomization of samples.

As suggested by Moran et al. (2020), DNP project design choices for implementation of an innovative new model of care delivery or changes using a practice improvement intervention may involve a quality improvement or research method. The rationale for the quality improvement approach was to improve innovation in healthcare outcomes or workflow processes. The PDSA cycle was part of the quality improvement process evaluation to further evaluate outcomes and offer a mechanism for making changes when needed. In quality improvement practice, protocols may require repeated modifications over time as desired changes engage local systems, patterns, and context (Mormer & Stevans, 2019). The interprofessional team was an important part of this process. The interprofessional team for this project was comprised of nurses on the unit, unit management, a clinical nurse specialist, the infection preventionist, physicians, and the unit nurse educator. Institutional review board approval of this project was completed through the medical center and Aspen University.

The utilization of the VIP scale guideline for replacing PIVCs did affect the reduction of PIV catheter-related BSI rates by significantly reducing the number of times PIVCs were replaced during hospitalization. All PIVC replacements and removals were tracked within the entire unit. PIV catheter-related bloodstream infection rates were compared prior to the practice change and 4 weeks following the change. PIVC-BSI rates were collected 2 months post-intervention as well.

During hospitalization, all PIVCs were only replaced when clinically indicated. PIVC sites were assessed through daily observations for signs and symptoms of infections. The clinical indications for replacement were communicated through staff meetings and staff education to ensure awareness. Documentation in the medical record was required for all PIVC assessments as well as replacements which were performed by several practitioners. Additionally, the clinically-indicated replacement date, time, and reason for the PIVC replacement were documented each time a replacement PIVC had been inserted or removed. Weekly reviews of all PIVC replacements were conducted, with documentation audited and reviewed by me.

Sample and Setting

The project sample involved a target population of all adult inpatients admitted to a 40-bed internal medicine unit with a PIVC inserted during the data collection period. All patients admitted to the internal medicine unit, receiving a PIV during the 4-week intervention period, were included in the project. The sample was determined by a nonprobability sampling type, which is a convenience sampling method. Adult patients (18 years or older) admitted to the internal medicine unit, who had a minimum of one PIVC in position during the project implementation period, were included in the sample. The population sampled included a comparative group from the previous year (n= 345) and an implementation group (n=315). The comparative sample was comprised of patients who received PIVC standard care using the 96-hour routine replacement protocol prior to the project (January-December, 2021). The implementation sample was comprised of patients who received PIVC standard care using the PIVC clinically-indicated replacement protocol during the post-implementation period (October-December, 2022). Patients who had both a PIVC and a CVC were excluded. Patients with other vascular access lines such as CVCs, midlines, and those used for hemodialysis and parenteral

nutrition were excluded as well. All other units, diagnostic areas, and operating room areas in the medical center where patients may have a PIVC were excluded from the sample.

Statistical power is the probability of not committing a type II error when finding a significant difference in a study. Power analysis is affected by the significance criterion, the sample size, the magnitude of the effect, and the study design (Mateo & Foreman, 2017). The higher the power effect, the smaller the sample size needs to be to detect the effect of the intervention. The desired power level is 0.80 probability so there will not be a type II error. According to the Rule of 30, a minimum of 60 subjects was needed to detect adequate effect of this intervention. The number of patients admitted to the unit with PIVCs during the 3-month study period determined the final number included in the project. Since all eligible patients were included in the sample for this project, an independent sample *t*-test analysis was conducted following the intervention.

The setting for this project was a large medical center, located in Colorado, which is part of a larger multi-state health-care system. The 40-bed internal medical unit had a high turnover of patients with short length of stays. The medical center immersion site authorization was approved by the chief medical officer. The project design was approved through the medical center and Aspen University's IRB application authorization process.

Instrumentation

The VIP scale for assessing PIVC replacement when clinically indicated was used to guide staff in identifying the need for PIVC replacement, and how to document such. Each PIVC replacement was documented in the electronic health record (EHR). This guideline measured clinical indication criteria for replacing a PIVC. The VIP scale is a valid visual tool used to determine the VIP score and captures the symptoms of phlebitis and potential bloodstream

infections related to the PIVC replacement (Gorski et al., 2021). Any clinical symptoms related to PIVC replacement noted throughout the project window required documentation in the EHR. The symptoms of phlebitis and potential bloodstream infections related to PIVCs were listed on the VIP scale to ensure standardized assessment, documentation, and data collection. Criteria for PIVC replacement included redness or erythema, swelling, induration, palpable cord or thrombus, and/or pain at the insertion site (Gorski, et al., 2021; Stevens et al., 2018). Documentation of clinical indication as the rationale for PIVC removal was required. PIVCs replaced for other reasons were documented as well.

Data Collection

Data collection was completed by using a third party to de-identify all patient data. The de-identified data was transferred by me to a coded Microsoft Excel spreadsheet developed for documentation of results. The aim of this project was to reduce PIV catheter-related BSIs by standardizing PIVC replacements to only when clinically indicated. As such, unit BSI rates were collected by the infection preventionist before and after the 4-week intervention period for comparison and analysis. Specifically, the PIVC-BSI rate, which included the number of patients with PIVC-BSIs per 1,000 patient days was collected for analysis. Central line-associated bloodstream infections were excluded from the unit BSI rates. I accessed the PIVC clinically-indicated-only replacement and VIP scale data through a third party. Only the de-identified PIVC documentation data was accessed. I did not access or record any further patient information and no personal identifying information was recorded. Patient data was coded by assigning a number for each patient, along with the PIVC replacement criteria, PIVC-BSI, and incidence of phlebitis data. Data was collected weekly during the 4-week intervention period. I provided feedback to the staff weekly to promote timely communication on the progress of the project. Weekly

meetings were held with staff during the 4-week data collection period to provide oversight and monitoring of de-identified documentation results. PIVC-BSIs were collected for the following 2 months by the infection preventionist.

Clinical data and de-identified information provided by the third party on the data collection tool were audited at the project site. Approval for the collection of data was authorized by Dr. Steven Brown, Vice President and Chief Medical Officer, IRB site authority. Activities approved in the site permission letter included conducting meetings and educational sessions with clinical and management staff, working with the infection preventionist to gather de-identified BSI data and accessing de-identified client data specific to the project's quality improvement measurable outcome (see Appendix G). Data protection, security, and management were described in the IRB application. Informed consent was not required since this was a quality improvement project, there was no more than minimal risk, and no personal identifiable data was collected. The intervention itself falls into the category of expected, reasonable care within this care environment; thus, facility consent to be treated did suffice. Permission was sought and granted through the site and university IRB application processes to conduct the project without obtaining informed consent.

Data Analysis Methods

Descriptive statistics were examined for the demographic data from pre-intervention PIVC replacements every 96 hours and post-intervention clinically-indicated (CI) replacements. Frequency distributions were utilized for gender and means were presented for age. To evaluate for differences in PIVC-BSI rates between 2021 and 2022, an independent sample *t*-test was conducted. The independent variable corresponded to year - 2021 (January-December) and 2022 (October-December). The dependent variable corresponded to PIVC-BSI rates. Descriptive

statistics were used to examine for the presence of PIVC infection (phlebitis) among the 24 patients in the post-intervention CI replacement group. Frequencies of VIP scores, prevalence of site appearance, and reasons for replacement or removal were presented. A two-proportion *z*-test was used to examine for differences in knowledge of PIVC replacement protocol before and after the intervention. The proportion of correct responses was compared between pre-test and post-test. A statistician was consulted on the statistical analysis for this project.

Data Management Methods

Establishing a data management plan prior to the implementation of research was key to protecting the privacy and confidentiality of information obtained while conducting research. Data in this project was handled securely from data collection to destruction. All data was tracked through weekly audits by me. The use of coding protected data during collection, transfer to tracking spreadsheets, analysis, and interpretation. A project log was used to document issues that came up and any decisions made during the project implementation. Data collected was locked in a password-protected laptop or storage device owned by me and secured in a locked drawer at my residence. Data must be maintained for 5 years after the project completion. Additionally, data must be destroyed by cross-cut shredding and deleting per university and medical center policy.

Ethical Considerations

This quality improvement project received institutional review board oversight and approval. Procedures for the protection of human participants were adhered to per institutional policy. This project involved no more than minimal risk to participants and the extent of harm or discomfort anticipated was not greater than any ordinarily encountered in daily life or during routine physical or psychological examinations. The project involved only what was normal and

expected care for patients within the unit. The project simply introduced an evidence-based strategy for improving current practices. Participants were anonymous, confidentiality and privacy were protected, and there was no coercion for patients to participate. This was a quality improvement project which used aggregate data. Additionally, there was no potential conflict of interest.

Internal and External Validity

Research design and implementation can affect the project validity. Internal validity measures the level of confidence in the changes noted in a dependent variable that is an outcome of an independent variable (Mateo & Foreman, 2017). There was a potential threat of selection bias with this project implementation since all patients on the unit with PIVCs were included in the project. The project design involved a nonrandom group assignment which did not analyze the differences between groups. Factors that affect external validity threats included difficulty in generalizing nonexperimental settings if the effect was attributable to the practice change. The project design involved a before-and-after design and did not control for organizational trends which could have influenced the outcomes independent of the intervention (Mormer & Stevans, 2019). Outcomes resulting from this project were influenced by uncontrolled variables. The project design did impact the level of evidence due to no prior year phlebitis comparison data. Further research is needed using different design methodologies to confirm correlation.

Conclusion

For this project, an evidence-based guideline for PIVC change frequency was implemented to improve clinical care within an entire unit. This project was a quality improvement project with a before-and-after design. There was a potential threat of selection bias with this project implementation since all patients on the unit with PIVCs were included in

the project. Staff on the single 40-bed internal medicine unit were required to replace PIVCs only when clinically indicated versus every 96 hours as indicated by current CDC (2017) guidelines. PIVC-related BSI rates that occurred during the implementation period were compared prior to the practice change, at 4 weeks, and 2 months following the change. Greenhalgh's model was the theoretical framework used to underlie this project. A PIVC clinically-indicated replacement VIP scale was utilized to determine the signs and incidence of phlebitis or BSI. In addition, staff education was provided to ensure compliance to the clinically-indicated replacement protocol. Data security and privacy were ensured throughout the collection and analysis phases and will be maintained for 5 years following project completion. After the 5-year storage period, all data will be permanently destroyed. This project's results, discussion of findings, and implications for nursing practice will follow in Chapter 4.

Chapter 4: Results and Discussion of Findings

The nursing practice problem investigated in this project was preventing peripheral intravenous catheter-related bloodstream infections in adult hospitalized patients. The clinical question was the following: In adult hospitalized patients on an internal medicine unit, how effective is PIVC replacement only when clinically indicated versus PIVC replacement every 96 hours, routinely, in reducing PIVC-BSI rates over a 4-week period? Inconsistent standards for changing PIVCs on the project unit and an increase in the number of PIVC-BSIs were noted prior to the project implementation. Additionally, there was no oversight requirement for reporting PIVC-related hospital-acquired infections.

Preventable hospital-acquired PIVC-BSIs have resulted in prolonged hospitalizations, increased costs, patient discomfort, and increased nursing workload (Morell, 2020). PIVC-BSI implications for patients can lead to increased morbidity and risk of death. Treating serious infections that are caused by *Staphylococcus aureus* bacteremia continue to pose significant challenges affecting hospital length of stays and costly antibiotic use. Removing catheters promptly when necessary can prevent clinical problems from a bloodstream infection and more serious consequences (Sato et al., 2017).

PIVC-BSIs can result in negative outcomes in adult hospitalized patients. One study by Blanco-Mavillard et al. (2019) showed 42% of PIVCs inserted ended up with removal that was unanticipated, therefore causing a higher risk for complications and potentially death. A study conducted by Kollar (2021) resulted in a reduction of PIVC replacements and BSIs when a practice change to clinically indicated replacements and planned education were put into action. In a different study by Saliba et al. (2018) after new practices for PIVC-BSI prevention were

implemented, PIVC-BSIs caused by *Staphylococcus aureus* bacteremia decreased from 30 infections in 2003, downward to 8, several years later in 2016.

Data collected during the DNP project included PIVC-BSI rates and incidence of phlebitis. The nursing questionnaire data was collected on the PIVC replacement protocol as well. This project prevented PIVC-BSIs and informed the larger conceptual framework surrounding the investigation by demonstrating how Greenhalgh's Model of Diffusion supported the quality improvement project. The project was based on Greenhalgh's (2004) Model of Diffusion which involved a theoretical framework provided mainly for health care services innovative quality improvement practice translation. This model was in alignment with the project before-and-after design and was applicable to the project purpose. The Greenhalgh model worked successfully with this project by providing guidance to diffuse, adopt, assimilate, and disseminate clinical practice changes (Greenhalgh et al., 2004). In this chapter the results of the project's findings and interpretation will be presented along with the analytical methodology, sample and setting characteristics, and conclusions from the DNP project as they relate to the prevention of PIVC-BSIs in hospitalized adults. In addition, a summary of the project results as well as implications for nursing practice and the broader health care community will be provided.

The aim of the project was to determine in adult hospitalized patients, how effective would implementation of an evidence-based protocol on PIVC clinically-indicated replacements versus PIVC replacements every 96 hours, routinely, be in reducing bloodstream infections within a single 40-bed internal medicine unit. Strong evidence provided data to support implementing the protocol for PIVC clinically-indicated replacements. This was a change from the current replacement of PIVCs every 96 hours, routinely, that was advised in the CDC (2017)

recommended guideline for PIVC replacements. Current literature provided evidence to support PIVC replacement by clinical indication as a major prevention strategy. There were six Level-I sources included in the total of 35 articles reviewed for this project. A review of the literature was conducted to identify the best evidence for PIVC replacement frequency practices, efficacy, and complications of PIVCs. Random controlled trials (RCTS), evidence reviews, systematic reviews, evidence-based practice projects, and meta-analyses were included in the critical appraisal evaluation. Study results reviewed were limited to peer-reviewed sources published within the last 5 years.

According to Webster et al. (2019), there is evidence that increased PIVC dwell time does not cause an increase in complications and bloodstream infection. In this project, the PIVC-BSI rate (0.42 per 1,000 patient days) in 2021 was compared prior to the practice change, at 4 weeks following the change, and 2 months post-implementation (October-December, 2022). The unit protocol pre-intervention was to change PIVCs every 96 hours, routinely. As part of the project implementation plan, nursing staff received education (n=40) before the project start date. The project focus included preventing PIVC-BSIs, improving patient safety, and enhancing care outcomes. The results indicated that PIVC clinically-indicated-only replacement was effective in decreasing the PIVC-BSI rate.

The project used a before-and-after design. This nonexperimental design compared changes in PIV catheter-related BSI rates with the targeted outcome of the intervention before and after the intervention. Quantitative assessment and observations were performed to measure outcomes. Data was collected over a 4-week period targeting patients who developed PIVC bloodstream infections at least 2 days after admission and 2 days after the end of the 4-week

implementation period. Additionally, PIVC-BSI data was collected for 2 months post-implementation.

The methodology of the project involved use of the Visual Infusion Phlebitis scale to determine the need for clinically indicated PIVC replacements. The VIP scale was developed by Andrew Jackson who provided permission to use this instrument in the project (Jackson, 1998). This tool was used for early recognition of signs and symptoms of phlebitis that could prompt a PIVC replacement and prevent a potential PIVC-related bloodstream infection from developing. The scale has been validated and shown to be reliable in research studies. For this project, PIVC replacement or removal was based on the Visual Infusion Phlebitis score. The VIP scale has a score for each symptom of phlebitis. A score of 0-1 determined the PIVC site remained healthy and benign. All PIVCs with VIP scores of 2 or greater were replaced or removed. Criteria for PIVC replacement included redness or erythema, swelling, palpable cord or thrombus, and/or pain at the insertion site (Stevens et al., 2018). The reason for replacement based on clinical indication was documented on the data collection tool and in the electronic health record. Staff on the project unit were informed to replace PIVCs only when clinically indicated. The PIVC Data Collection Tool (n=24) was used for collecting PIVC clinically-indicated replacement data with the VIP scale on each PIVC changed during the project implementation. Staff education was provided pre-implementation to improve staff compliance in assessing PIVC sites and the need to provide clinically-indicated replacements. In this project, the infection preventionist was responsible for collecting the project unit's PIVC-BSIs and tracking the BSI rate. The project site's procedure for reporting BSIs involved an electronic alert sent from the laboratory that would prompt a review of positive blood cultures by the infection preventionist to determine the source of a bloodstream infection.

Summary of Methods and Procedures

The analytic methods used in this project included descriptive statistics which were examined for the demographic data from pre-intervention PIVC replacements every 96 hours and post-intervention CI replacements. Frequency distributions were utilized for gender and means were presented for age. To evaluate for differences in infection rates between 2021 and 2022, an independent sample *t*-test was conducted. The independent variable corresponded to years 2021 (January-December) and 2022 (October-December). The dependent variable corresponded to PIVC-BSI rates. A Cohen's *d* effect size was used to compare before and after rates or the difference in groups based on the practice change and to evaluate the magnitude of the intervention effect. Descriptive statistics were used to examine for the presence of PIVC infection (phlebitis) among the 24 patients in the post-intervention CI replacement group. Frequencies of VIP scores, prevalence of site appearance, and reasons for replacement or removal were presented. A two-proportion *z*-test was used to examine for differences in knowledge of PIVC replacement protocol before and after the intervention. The proportion of correct responses was compared between pre-test and post-test. This additional analysis was conducted to examine staff knowledge of the PIVC replacement protocol which impacted the project goal of preventing PIVC-BSIs. There were no special observations from the data set. The statistical analysis was completed in consultation with a statistician and Intellectus Statistics Software was used for the data analysis (Intellectus Statistics, 2022). A consultation with a statistician was completed to review methods and procedures as well.

Summary of Sample and Setting Characteristics

The non-probability convenience sampling was used with an accessible population for this project and included all adult patients admitted to a single 40-bed internal medicine unit

during the 4-week implementation period. The population sampled included a comparative group from the previous year (n= 345) and an implementation group (n=315). The comparative sample was comprised of patients who received PIVC standard care using the 96-hour routine replacement protocol prior to the project (January-December, 2021). The implementation sample was comprised of patients who received PIVC standard care using the PIVC clinically-indicated replacement protocol during the post-implementation period (October-December, 2022). Demographic data was obtained from the infection preventionist and involved a comparison of pre- and post-implementation data from November, 2021, and October, 2022. Descriptive statistics was used to examine the descriptive data from pre-intervention PIVC replacements every 96 hours and post-intervention CI replacements. Frequencies and percentages were used to examine the distribution of gender. For the November, 2021, 96-hour replacement protocol, there were 169 females (48.99%) and 176 males (51.01%). For the October, 2022, CI replacement protocol, there were 150 females (47.62%) and 165 males (52.38%) (see Table 1). Age for the November, 2021, 96-hour protocol, ranged from 20 to 101 years, with M = 66.72 years and SD = 17.39. Age for the October, 2022, CI protocol ranged from 18 to 100 years, with M = 65.38 years and SD = 18.18 (see Table 2).

Results

The project results showed no PIVC-BSIs were observed or reported during the 4-week implementation period. The project outcome was patients who were admitted to the internal medicine unit and had PIVCs managed by a clinically-indicated replacement protocol did not develop a PIVC-related bloodstream infection except one PIVC-BSI was reported 2 months post-intervention in December, 2022. The impact of using PIVC clinically-indicated-only replacement guidelines has been shown to reduce PIVC-BSIs (Olivier et al., 2021; Webster et al., 2019).

An independent sample *t*-test was conducted to examine for differences in PIVC-BSI rates between 2021 (January-December) and 2022 (October-December). The result of the independent samples *t*-test was not statistically significant, $t(13) = 0.24$, $p = .812$, indicating that there were not significant differences in PIVC-BSI rates between 2021 (January-December) and 2022 (October-December), so we cannot reject the null hypothesis. The Cohen's *d* value was 0.15, indicating a relatively small effect. However, there was a clinical significance noted from an approximately 8% decrease in infections per 1,000 patient days (see Table 3).

Of the 315 patients admitted during the intervention, 24 (8%) required PIVC replacements for clinically-indicated symptoms of phlebitis (n=11) and other reasons (n=13) which were due to leaking, patients pulling out the PIVC, or requesting the PIVC be removed. Descriptive statistics for the CI replacement protocol post-intervention indicated a total of 11 patients out of 24 patients (45.83%) had phlebitis. Eleven patients had a VIP score greater than or equal to "2" ($n = 11$, 48.83%). Ten of the patients (41.67%) were identified as healthy site appearance. The most prevalent symptoms of phlebitis were pain ($n = 11$, 45.83%) and swelling ($n = 7$, 29.17%). The most common reasons for replacement or removal were phlebitis ($n = 11$, 45.83%) or leaking ($n = 8$, 33.33%). The frequencies and percentages for the CI PIVC replacements post-intervention are displayed in Table 4. A pie chart for the VIP scale symptoms of phlebitis post-intervention is noted in Figure 5.

As part of the project implementation plan, nursing staff (n=40) who placed PIVC catheters were educated on assessing clinical indications for the clinical signs of phlebitis using the Visual Infusion Phlebitis scale standardized tool before the project start date. A nursing staff PIVC-BSI questionnaire was given pre-intervention (n=40) and post-intervention (n=27). The questionnaire assessed staff knowledge of the PIVC replacement practice before and after the

intervention. A two-proportion *z*-test was utilized to examine for differences in knowledge of PIVC replacement protocol before and after the intervention. The result of the two-proportion *z*-test was statistically significant, $z = -4.77$, $p < .001$, indicating that there were significant differences in the proportions of correct responses to the PIVC replacement protocol. The percentage of correct responses increased from 55% (pre-test) to 96% (post-test). The proportion of correct responses was compared between pre-test and post-test (see Table 5). The results showed improved knowledge of the unit PIVC protocol, clinically-indicated-only replacement practice as well as PIVC assessment for symptoms of phlebitis, PIVC site documentation, and the implications of PIVC bloodstream infections. A study conducted by Kollar (2021) resulted in a reduction of PIVC replacements and BSIs when practice change to clinically indicated replacements and planned staff education were implemented. Early identification of signs and symptoms of phlebitis using the VIP scale tool helped to avoid more serious bloodstream infections.

Samples of data collected involved PIVC-BSIs and incidence of phlebitis that were noted using the clinically-indicated replacement protocol during the project implementation (see Appendix H). Additionally, the PIVC-BSI rate sample data from 2021(January - December) and 2022 (October - December) were collected to examine the differences in PIVC-BSI rates pre-intervention (see Table 6) and post-intervention (see Table 7). Data was compiled from the staff questionnaires collected on staff knowledge of the 96-hour and CI protocols pre-education (see Appendix I) and post-education (see Appendix J), and a clinically significant difference increase ($p < .001$) in knowledge of the CI protocol was attained.

Implications for Nursing Practice

The project results demonstrated that implementing a PIVC clinically-indicated-only replacement evidence-based practice guideline utilizing a standardized VIP scale tool for assessing the need to replace PIVCs was effective in reducing PIVC-BSI rates. This practice could be translated and applied to similar inpatient areas of nursing practice. This project showed how the utilization of standardized evidence-based protocols to guide nursing practice can improve quality and safety outcomes. For clinical areas lacking such or subject to inconsistent practice, this approach can be adopted to gain similar improvement. This quality improvement project incorporated efforts that strive to improve health care services for the future.

Conclusion

The PIVC-BSI rate of 0.42 per 1,000 patient days from the previous year prompted the PICOT question. The question was developed to determine if implementing a new evidence-based practice change to PIVC replacements only when clinically indicated would be effective in preventing PIVC-BSIs. The project practice change was implemented on a single internal medicine unit and the results showed no PIVC-BSIs were observed or reported during the 4-week implementation period. Additionally, the significance of the results showed that even though a statistically significant difference between pre-and post-implementation PIVC bloodstream infection rates did not occur, there was an 8% decrease in PIVC-BSIs from 0.42 per 1,000 patient days pre-implementation in 2021 (January-December) to 0.34 per 1,000 patient days post-implementation in 2022 (October-December). This was a clinically significant finding after the PIVC clinically-indicated-only protocol implementation. Nursing staff knowledge pre- and post-intervention resulted in statistically significant differences $p < .001$, indicating significant differences in proportions of correct responses to the PIVC replacement protocol

question. Greenhalgh's model provided a framework for practice based on research that proved successful. This project informs future projects by contributing to the evidence base. Potential projects, policy, and research can build upon this project's findings for the development of an applicable PIVC health care-associated infection prevention practice guideline. In addition, this project adds to the body of literature supporting PIVC clinically-indicated-only replacements as a viable and effective practice for improving outcomes in hospitalized adult patients. Finally, this project positively impacts the focus areas of improvement which include timely, efficient, safe, effective, patient-centered, and equitable care. In Chapter 5, a discussion of the findings and best practices and recommendations for future projects will be presented.

Chapter 5: Discussions and Conclusion

Peripheral intravenous catheter-related bloodstream infections are hospital-acquired and preventable (Helm et al., 2019). Evidence-based guidelines for replacing PIVCs when clinically indicated can reduce PIVC-BSIs; however, lack of consistent clinical practices can result in prolonged hospitalization, increased costs, and patient discomfort from pain (Apel et al., 2021; Maier, 2019; Stevens et al., 2018). An increase in nursing workload and time has been identified in other studies when changing PIVCs every 72-96 hours routinely (Apel et al., 2021). The impact of PIVC-BSIs on patients can be severe and can lead to death (Sato et al., 2017). The purpose of this project was to determine if implementation of an evidence-based practice guideline for the replacement of PIVCs in adult hospitalized patients would reduce the bloodstream infection rate on a single internal medicine unit.

The primary outcome of the project was 315 patients who were admitted to the internal medicine unit and 24 of those who had PIVCs managed by clinically-indicated replacement did not develop a PIVC-related bloodstream infection. A clinically significant finding of an approximately 8% decrease in infections per 1,000 patient days was attained. Altering how often PIVCs are replaced using only clinically-indicated guidelines has been proven to reduce PIVC-BSIs (Olivier et al., 2021; Webster et al., 2019). Only 24 patients were documented to have clinically-indicated replacements during the 4-week intervention period. Preventing BSIs has been associated with improving the quality of patient care linked to reducing related care expenses as well (Morrell, 2020).

To promote effective implementation of the new guideline, nurses who placed PIVC catheters were educated on using the VIP scale standardized tool to identify clinical indications for replacement. Phlebitis symptoms were identified in 11 of the 24 (46%) patients that received

PIVC clinically-indicated replacements. Other reasons for PIVC replacement involved eight (33%) PIVCs that were leaking and five (21%) in which the patient pulled the PIVC out or requested removal. The timely identification of signs and symptoms of phlebitis which could lead to more serious bloodstream infections was effective and could be considered a secondary outcome of the project. An additional outcome was derived from evaluating nursing staff (n=40) knowledge of the PIVC replacement policy, documentation of PIVC site assessments, and PIVC-BSI implications. Staff PIVC-BSI questionnaires were completed pre-intervention (n=40) and completed post-intervention (n=27) resulted in a statistically significant $p < .001$ increase in knowledge level on the correct PIVC replacement protocol question.

Discussion of Findings and Best Practices

This DNP project was a quality improvement project developed to assess and promote a new practice guideline adherence using a framework of Greenhalgh's Model of Diffusion as well as a test of change with the Plan-Do-Study-Act method. The large multi-site health care system in which the project was conducted had inconsistent PIVC replacement clinical guidelines for each medical center site. The project medical center pre-implementation guideline was to change PIVCs every 96 hours, while other medical centers changed PIVCs when clinically indicated or every 96 hours as well. The project site internal medicine unit had increased PIVC-BSIs during the previous year resulting in a PIVC-BSI rate of 0.42 per 1,000 patient days. This unit had five PIVC-BSIs and was a high outlier in comparison to other units in the medical center.

The findings of the literature review showed efficacy of routine versus selective PIVC replacement when clinically indicated, incidence of PIVC related bacteremia, and prevention of PIVC-related complications and failures as major themes to support the project. There was strong evidence to support PIVC clinically-indicated-only replacements. Various studies

supported changing practice to clinically-indicated-only replacement, citing the following associated benefits: cost savings, improved comfort for patients, and reduced nursing time. In addition, several studies revealed no difference in PIVC-related BSIs between routine and clinically-indicated groups.

The objective for the project was to evaluate whether an evidence-based practice guideline for PIVC replacements when clinically indicated would reduce the PIVC-BSI rate in adult patients admitted to an inpatient internal medicine unit during a 4-week period. The PIVC clinically-indicated-only replacement guideline using the VIP scale was successfully implemented and resulted in a reduction in the PIVC-BSI rate pre-intervention from M=0.42 per 1,000 patient days to M=0.34 per 1,000 patient days during the project 4-week data collection period and 2 months post-intervention. A noteworthy 8% decrease in PIVC infections per 1,000 patient days resulted as well. This was a clinically significant finding that impacted care outcomes. A total of 24 PIVCs were replaced and of those, 46% (n=11) showed phlebitis as the reason for replacing the PIVCs. Seven (33%) were replaced due to leaking and six (21%) for other reasons. Phlebitis was noted in 11 (46%) of the patients with PIVC replacements and 13 (54%) of the total PIVC replacements were due to clinical issues and other reasons.

Nursing staff adherence to the clinical guideline and the methodology utilized resulted in the projected patient outcomes. The PDSA method demonstrated success in implementing a new guideline for assessing PIVC sites using the VIP scale. This new guideline implementation contributed to a reduced number of hospital-acquired PIVC-related bloodstream infections. The problem with PIVC-BSIs is a global population health issue and must be addressed to improve the safety of hospitalized adults who receive peripheral intravenous therapies. Greenhalgh's Model of Diffusion framework was transposed into the project's concepts by providing guidance

and addressing the project site innovation characteristics, system antecedents, system readiness, adoption/assimilation, implementation process, consequences, diffusion, dissemination, and the sustainability of the practice change (Greenhalgh et al., 2004). This model contributed to the successful outcomes of the project.

Annually, over 300 million PIVCs are placed in patients for use during hospitalization in the United States (Morrell, 2020). An increasing number of *Staphylococcus aureus* infections occur in the United States and internationally from PIVC-associated infections. Implementing PIVC clinically-indicated-only replacement guidelines supported decreased risk of infection and potentially lower hospital costs. Utilizing evidence-based guidelines resulted in decreased unnecessary pain for patients from catheter insertions, decreased excess supply use for routine PIVC changes, and improved the workload for health-care staff, all of which contribute to significant improvements in quality and safety.

Of the 315 patients in this project who were admitted to the internal medicine unit, 24 had PIVCs managed by clinically-indicated replacement with no PIVC-related bloodstream infections reported during the 4-week implementation period. A clinically significant 8% decrease in PIVC infections per 1,000 patient days was found post-implementation. The nursing staff knowledge levels of the correct PIVC replacement protocol improved from pre-intervention to post-intervention levels as well.

Implication for Practice and Future Projects

Implications of the project include an evidence-based practice guideline using the VIP scale can provide early recognition and intervention of phlebitis and prevention of PIVC-BSIs. Improvements in care outcomes are associated with consistent guidelines for replacing PIVCs only when clinically indicated. This quality improvement project helps toward improving the

safety and quality outcomes for adult patients with PIVCs inserted during hospitalization. The use of this practice guideline to identify symptoms of phlebitis and prevent further development to bloodstream infections is recommended as a strategy for evaluating and documenting PIVC site nursing assessments. The identified clinical practice strategies may be used to implement a similar practice worldwide to prevent bloodstream infections, reduce associated care costs, and reduce nursing workload. DNP projects can be used as a foundation for future scholarly practice (Anderson et al., 2014). These findings could inform a standardized practice approach across all medical centers within the project health care system. A new mandate for hospitals to report a hospital-onset bacteremia and fungemia outcome measure has been proposed by the Centers for Medicare and Medicaid Services (CMS) under the surveillance of CDC to inform potential future policy development (CMS, 2022). The organization can prepare to meet emerging CMS requirements by expanding the clinically-indicated guidelines to all the remaining medical center sites and to start surveillance and reporting of PIVC-BSIs as a quality performance measure.

Plan for Dissemination

Describing the DNP project results, findings, conclusions, and recommendations is important to the dissemination of scholarly knowledge to the nursing profession. An outcome-focused type of practice scholarship is valuable in developing knowledge that impacts critical changes to the healthcare system and is essential for the improvement of care outcomes (Moran et al., 2019). The conclusions in this project will help to present various aspects of the DNP Essentials that did result in measurable improvements.

Dissemination plans for this project include publishing the project findings in a professional peer-reviewed journal. This DNP project will be submitted for publication to the *American Journal of Nursing*. The journal's mission is to promote excellence in nursing and

health care through the dissemination of evidence-based, peer-reviewed clinical information and original research and promotion of nursing perspective to the health care community and the public. The intent is for the project to be duplicated to provide more evidence for the use of a standardized VIP scale for assessing, documenting, and replacing PIVCs when clinically indicated to prevent PIVC-BSIs. Sharing the project recommendations for future projects is important to address health care issues such as PIVC hospital-acquired bloodstream infections that are preventable and need to be addressed globally.

Sustaining Change

The plan for sustaining the project change is for nursing staff to continue using the VIP scale for PIVC clinically-indicated-only replacements and to expand the practice to all units in the project medical center. Documentation on the VIP scale is recommended to be uploaded to the EHR and the infection preventionist should continue to track PIVC-related BSIs. In the short-term, the clinical practice change of replacing PIVC when clinically-indicated was continued within the project unit for 2 additional months. The plan is for the practice change to be evaluated in 1 year by the interprofessional team led by the infection preventionist. Greenhalgh's Model of Diffusion addresses complex human behavior that must be involved in the project implementation for long-term adoption of changes and sustained innovative clinical practice to ensure successful translation of research into practice (Greenhalgh et al., 2004). Long-term initiatives include the medical center vascular nurse leader to coordinate the education for the remaining units' nursing staff on the practice of PIVC clinically-indicated-only replacements using the VIP scale which will duplicate the project aim with some modifications.

Recommendations for Future Projects and Practice

The long-term benefits of the practice change of no longer providing unnecessary PIVC replacements is significant. Reduction of PIVC-BSIs is dependent on staff adherence to the PIVC clinically-indicated practice guideline for PIVC replacement insertions and infection prevention. Further quality improvement and evidence-based practice projects along with scientific research are recommended that may influence the advancement of PIVC clinically-indicated replacements and hospital-acquired infection prevention. The results of this project showed that developing and implementing a practice change on clinically-indicated replacements for PIVCs resulted in a significant decrease in PIVC insertions. Of 315 admissions to the unit, only 24 PIVC replacements were required for clinical indication during the 4-week intervention period. Implementation of this project can decrease nursing workload and increase cost savings for the medical center as well as other health care organizations. A policy is recommended to be implemented to reflect a PIVC clinically-indicated replacement practice change along with staff education on the prevention of PIVC-BSIs and the implications for continued improvement in care outcomes.

The VIP scale should be uploaded and available for daily PIVC site assessment in the EHR for improved PIVC documentation. This will facilitate documenting PIVC replacements and clinical symptoms of phlebitis. Utilizing information technology to document on the VIP scale in the EHR could enhance documentation and provide easier access to the assessment tool. An additional recommendation is to expand the practice change of PIVC clinically-indicated replacements to the rest of the medical center and the larger health care system. Increasing the time for implementation of this project from 4-weeks to 6 months would provide more evidence to support the findings. The time frame for pre-implementation education for staff on the VIP

scale tool should be taken into consideration due to the complexity and variety of hospital work schedules. The various shifts staff work presented a challenge to ensuring nursing staff had the opportunity to complete the pre-and post-implementation questionnaires in a timely manner.

For future studies, a larger sample size in a replicated project could strengthen the supporting statistical analysis. In addition, this could help to further evaluate patient satisfaction with less pain and discomfort due to a reduced number of PIVC insertions during a hospital stay. One area for a future project may include comparison of two randomized controlled groups to investigate one group receiving routine PIVC replacement every 96 hours and the second group receiving PIVC clinically-indicated-only replacements to control factors not under the direct control of a study.

Other areas that need additional projects and were not addressed in the focus of this project were identified. One area involves investigating the cost savings for implementing PIVC clinically-indicated-only replacements versus PIVC replacements every 96 hours, routinely. The cost of supplies for each PIVC insertion could be computed to find the total annual costs for changing PIVCs routinely. The annual number of admissions to the project internal medicine unit can range from 3,000 to 3,500 per year with most of those admissions receiving at least one PIVC during hospitalization. This could result in a huge amount of annual savings if PIVC replacements were significantly decreased. One evidence-based project that compared pre-and post-intervention of replacing short peripheral catheters (SPCs) when clinically indicated showed short peripheral catheter supply use rate decreased by 14.2% post-intervention (Stevens et al., 2018). Investigating the average cost for PIVC insertions per total number of insertions should show a cost savings resulting from the reduction of unnecessary PIVC replacements.

Additionally, the cost of reducing PIVC-BSIs could be a project to show how much cost a health care facility would avoid by reducing health care-associated PIVC-BSIs. A hospital-acquired infection such as a primary bloodstream infection may result in serious patient morbidity that could result in estimated costs of $10,000 to $20,000 (Duncan et al., 2018). In a retrospective cross-sectional study by Lim et al. (2019), of discharged patients in the United States, 2% of 10,354 patients with PIVCs had evidence of a PIVC-associated complication. These patients spent an average of 2 additional days in the hospital, costing over $3,000 compared to those without a PIVC complication (Lim et al., 2019). The cost of providing treatment with antibiotics for PIVC-BSIs can be included in the cost-savings when preventing PIVC-BSIs. Other related areas involved in cost savings from implementing clinically-indicated replacements may include a reduction in equipment and supplies used as well as decreased extended hospital stays due to PIVC-BSIs. The overall savings in all these areas can contribute to improved quality, safety, and efficiency for hospitalized patients. These projects should be studied to support other areas that did not pertain to the focus of the original project.

During the 2022 Spring Conference of the Society for Healthcare Epidemiology of America (SHEA), a proposal was presented that all hospital-onset bacteremia (HOB) and fungemia be considered as a new measure to track HAIs not presently under surveillance by the Centers for Disease Control and Prevention, National Healthcare Safety Network (NHSN) (CMS, 2022). These HAIs involve hospital onset bacteremia and fungemia and would include PIVC-BSIs. Tracking new infections with a minimal data collection burden was identified as a method to address patient safety outcomes in hospital settings. Requests for public comments have been submitted on the proposed change to CMS for changes in the regulations. According to DeVries (2022), multiple studies are being investigated and subject matter experts from SHEA

support an HOB quality metric either as a single metric alone or in combination with reporting central line-associated bloodstream infections. Additionally, CMS published proposed rule changes for the fiscal year 2023 Inpatient Prospective Payment System to potentially adopt two digital NHSN measures, including the NHSN Hospital-Onset Bacteremia outcome measure in the Hospital-Acquired Condition Reduction Program (CMS, 2022). This DNP project goal is timely, relevant, and in alignment with the proposed CMS changes.

Actual DNP Essentials Met

The DNP Essentials incorporated in the project helped guide the implementation, interpretation, and evaluation of evidence-based practice into clinical practice (Zaccagnini & Pechacek, 2021). These core competencies provided a foundation for future practice scholarship. In the process of implementing the project, the actual DNP Essentials met were as follows:

- Essential I: Scientific Underpinnings for Practice was met by addressing the previous gap in best practice for the prevention of PIVC-BSIs in inpatient adults. Evaluating scholarly knowledge for practice and implementing a standard evidence-based protocol for replacement of PIVCs when clinically indicated positively impacted care quality and safety.
- Essential II: Organizational and Systems Leadership for Quality Improvement was met by incorporating organizational leadership strategies and systems thinking in leading organizational change to improve PIVC-BSI rates. A structured plan was used for the project implementation based on evidence which resulted in decreased PIVC-BSIs. Additionally, this project informed organizational policy to support and improve individual patient care.

- Essential III: Clinical Scholarship and Analytical Methods for Evidence-Based Practice was met by utilizing scholarship and analytical methods to implement change, translate knowledge, analyze data, and interpret findings to improve clinical practice. Translating evidence to change clinical practice from replacing PIVCs routinely every 96 hours to only when clinically indicated produced positive changes in care outcomes.
- Essential VI: Interprofessional Collaboration for Improving Patient and Population Health Outcomes was met by collaborating with the project interprofessional team of nursing, medicine, infection preventionist, other clinical staff, as well as clinical experts and resulted in improved patient and population outcomes.
- Essential VII: Clinical Prevention and Population Health for Improving the Nation's Health was met by addressing patient outcomes of care and safety through preventing PIVC-BSIs, decreasing nursing workload, and reducing health care costs. The creation of innovative evidence-based guidelines for PIVC replacements when clinically indicated for the prevention of hospital-acquired infections as well as the improvement of population health in hospital settings made this project relevant to a large population. A clinically significant outcome of an 8% decrease in PIVC-BSIs was attained with the PIVC clinically-indicated protocol and staff education on the PIVC evidence-based replacement guideline.
- Essential VIII: Advanced Nursing Practice was met by the application of knowledge to develop, implement, and evaluate an evidence-based PIVC clinically-indicated-only replacement intervention that improved population health as well as contributed to nursing knowledge and advancement of the profession.

Conclusion

Hospital-acquired PIVC-BSIs are a global problem that must be addressed to improve peripheral intravenous therapies in hospitalized patients. Over 300 million PIVCs are inserted in patients for use during hospitalization annually (Morrell, 2020). The current CDC guideline on PIVC replacement for the prevention of hospital-acquired infections is not the most effective practice based on project findings. This DNP project's evidence-based best practice protocol addressed inconsistent standards for PIVC replacement. This project clarified best clinical practice and documented care outcomes on a unit with escalating PIVC-BSI rates during the previous year. Additionally, the project supported changing practice to clinically-indicated-only replacement for PIVCs in adult hospitalized patients for the prevention of PIVC-BSIs. There was an 8% decrease in PIVC-BSIs from 0.42 per 1,000 patient days pre-implementation, 2021 (January-December), to 0.34 per 1,000 patient days post-implementation, 2022 (October-December). Educating staff on a standard protocol for replacing PIVCs resulted in a statistically significant difference in pre- and post-intervention knowledge levels $p < .001$. Prevention strategies for PIVC-BSI in this project were based on current knowledge and evidence; therefore, patients benefited directly from this project with improved quality and safety outcomes. This project contributed to the solution for preventing PIVC-BSIs in hospitalized patients and reducing the PIVC-BSI rate by consistently implementing clear evidence-based practice guidance for PIVC replacement and educating staff on the management and documentation of PIVCs. The project positively impacted the focus areas of improvement which include timely, efficient, safe, effective, patient-centered, and equitable care.

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Table 1

Frequency Table for Nominal Variables

Variable	November 2021 - 96 Hour		October 2022 - CI	
	n	%	*n*	%
Gender				
Female	169	48.99	150	47.62
Male	176	51.01	165	52.38

Note: Age for November 2021 – 96-hour ranged from 20 to 101 years, with M = 66.72 years and SD = 17.39. Age for October 2022 – CI ranged from 18 to 100 years, with M = 65.38 years and SD = 18.18.

Table 2

Summary Statistics Table for Interval and Ratio Variables

Variable		*M*	*SD*	*n*	Min	Max
Age						
	November 2021 – 96-Hour	66.72	17.39	345	20.00	101.00
	October 2022 - CI	65.38	18.18	315	18.00	100.00

Table 3

Independent Samples t-Test for PIVC-BSI Rates by 2021 (January-December) and 2022 (October-December)

	2021		2022				
Variable	*M*	*SD*	*M*	*SD*	*t*(13)	*p*	*Cohen's d*
Rate	0.42	0.52	0.34	0.58	0.24	.812	0.15

Note: Rates correspond to infections per 1,000 patient days.

Table 4

Frequency Table for Nominal Variables

Variable	*n*	%
Presence of PIVC infection (phlebitis)		
Yes	11	45.83
No	13	54.17
VIP score		
0	10	41.67
1	3	12.50
2	7	29.17
3	3	12.50
4	1	4.17
Site appearance		
Healthy	10	41.67
Pain	3	12.50
Pain and swelling	3	12.51
Redness, pain, swelling, induration	1	4.17
Redness, pain, swelling, erythema	1	4.17
Redness and pain	1	4.17
Palpable venous cord	1	4.17
Pain, obstructed	1	4.17
Redness, pain, swelling	1	4.17
Bleeding and leaking	1	4.17
Induration, swelling	1	4.17
Pain		
Yes	11	45.83
No	13	54.17
Redness		
Yes	4	16.67
No	20	83.33
Swelling		
Yes	7	29.17
No	17	70.83
Induration		
Yes	2	8.33
No	22	91.67
Other		

Yes	4	16.67
No	20	83.33
Reason for replacement or removal		
Phlebitis	11	45.83
Leaking	8	33.33
Patient pulled IV out	2	8.33
Patient asked to change	1	4.17
Patient request to remove	1	4.17
Patient pulled out	1	4.17

Table 5

Two Proportions z-Test for the Differences in Knowledge of PIVC Replacement Protocol Before and After Intervention

Samples	Correct Responses	Total Sample Size	Proportion of Correct Responses
Pre-test	22	40	.55
Post-test	26	27	.96

Note: $z = -4.77$, $p < .001$

Table 6

PIVC BSI Rates Pre-Implementation Data

Month	# of Infections	Pt Days	Rate
January 2021	0	924	0.00
February 2021	0	812	0.00
March 2021	1	922	1.08
April 2021	1	956	1.05
May 2021	1	915	1.09
June 2021	0	962	0.00
July 2021	0	998	0.00
August 2021	1	1103	0.91
September 2021	0	1058	0.00
October 2021	0	1114	0.00
November 2021	1	1098	0.91
December 2021	0	1132	0.00
	# of Infections	Pt Days	Rate
Total	5	11,994	0.42

Table 7

PIVC BSI Rates Post-Implementation Data

Month	# of Infections	Pt Days	Rate
October 2022	0	999	0.00
November 2022	0	1021	0.00
December 2022	1	992	1.01
	# of Infections	Pt Days	Rate
Total	1	3012	0.34

Figure 1

Greenhalgh's Conceptual Model of Diffusion

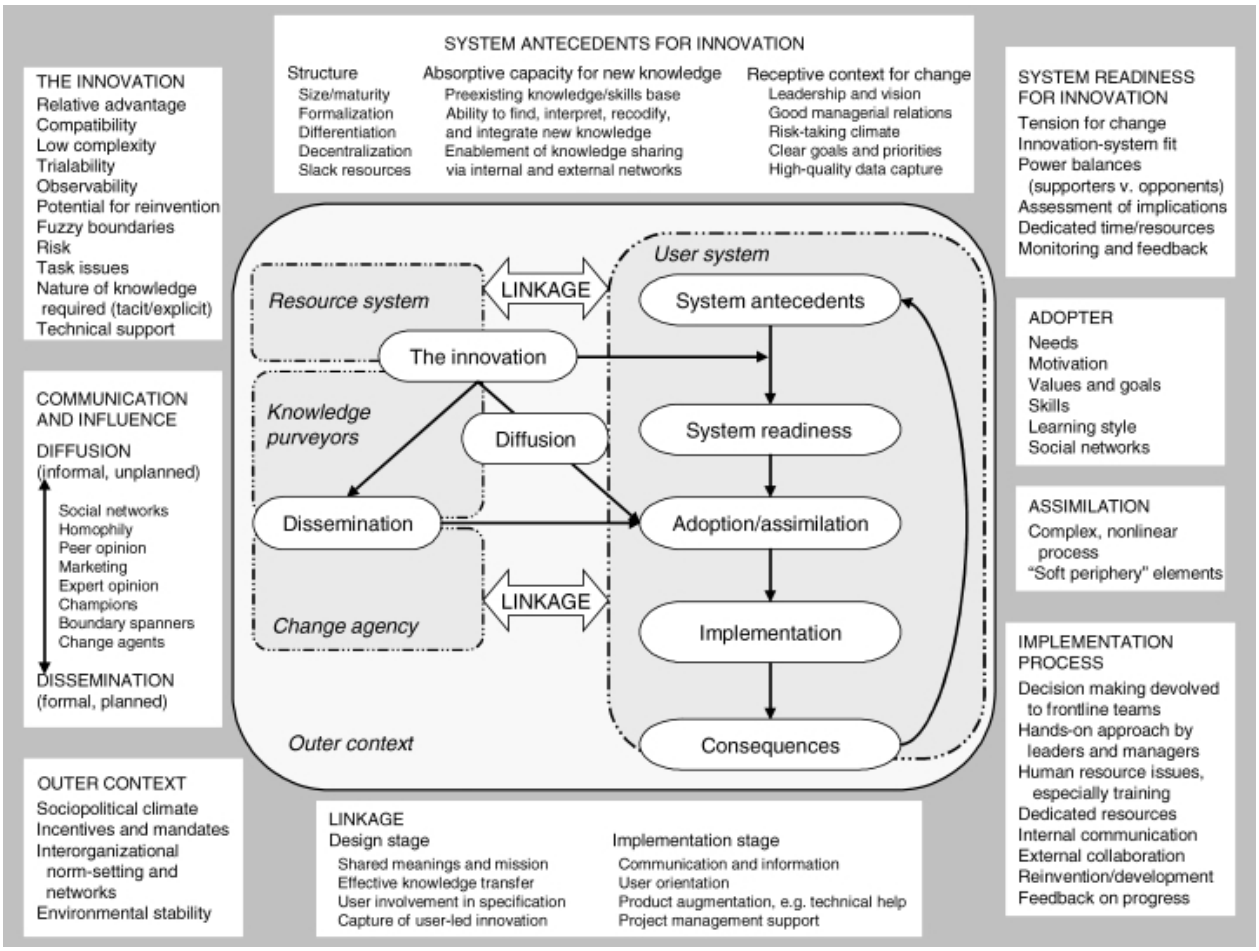


Figure 2

Plan-Do-Study-Act Model for Improvement

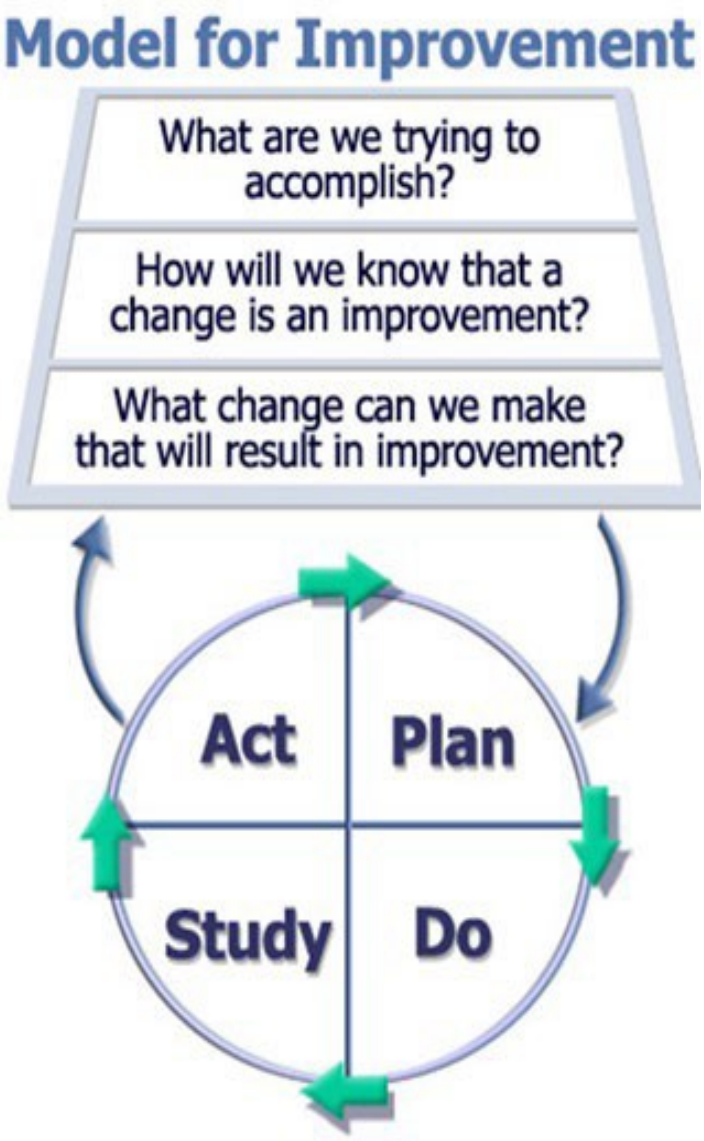
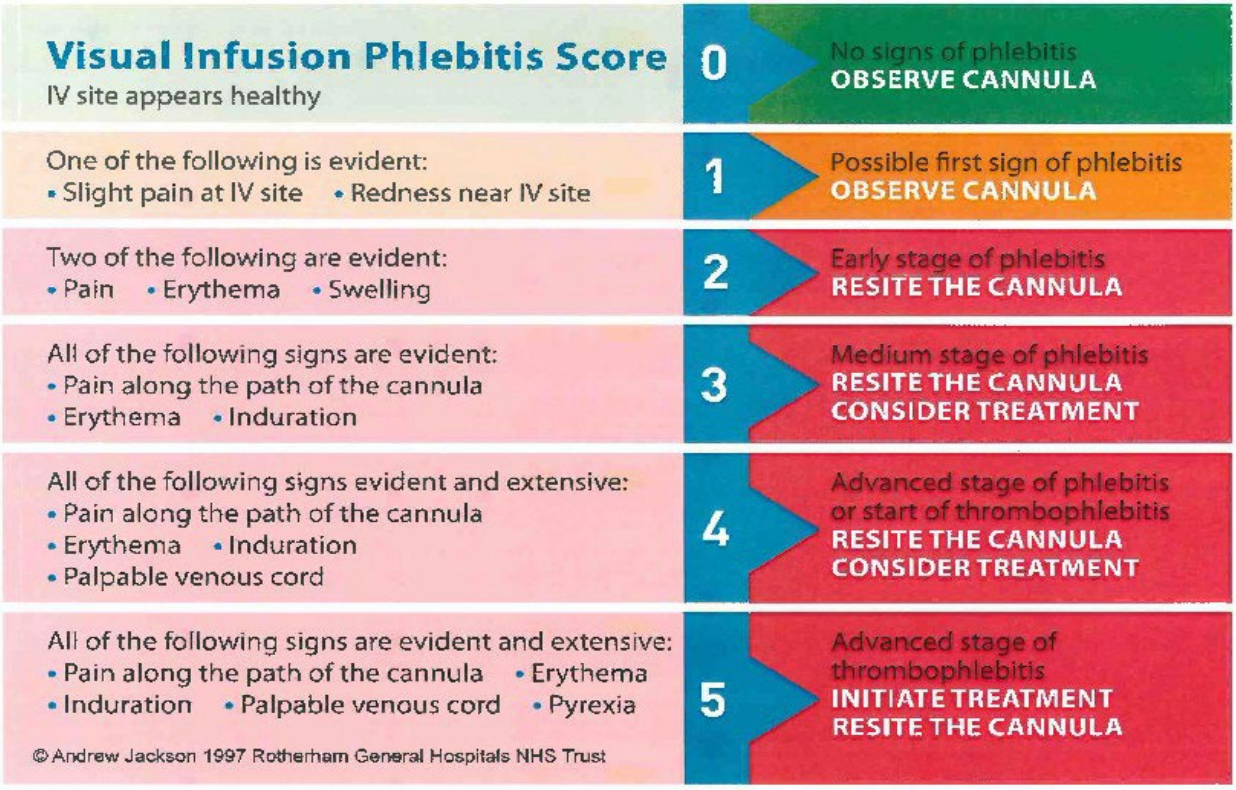


Figure 3

Visual Infusion Phlebitis Scale



Reprinted with permission from: Jackson, A. (1998). Infection control–a battle in vein: infusion phlebitis. *Nursing Times, 94*(4):68 -71

Note: This figure demonstrates a Visual Infusion Phlebitis (VIP) Scale for determining PIVC clinically-indicated-only-replacement. This tool is used to assess signs and symptoms of phlebitis and PIVC-related bloodstream infections. PIVC replacement or removal is based on visual infusion phlebitis score.

Figure 4

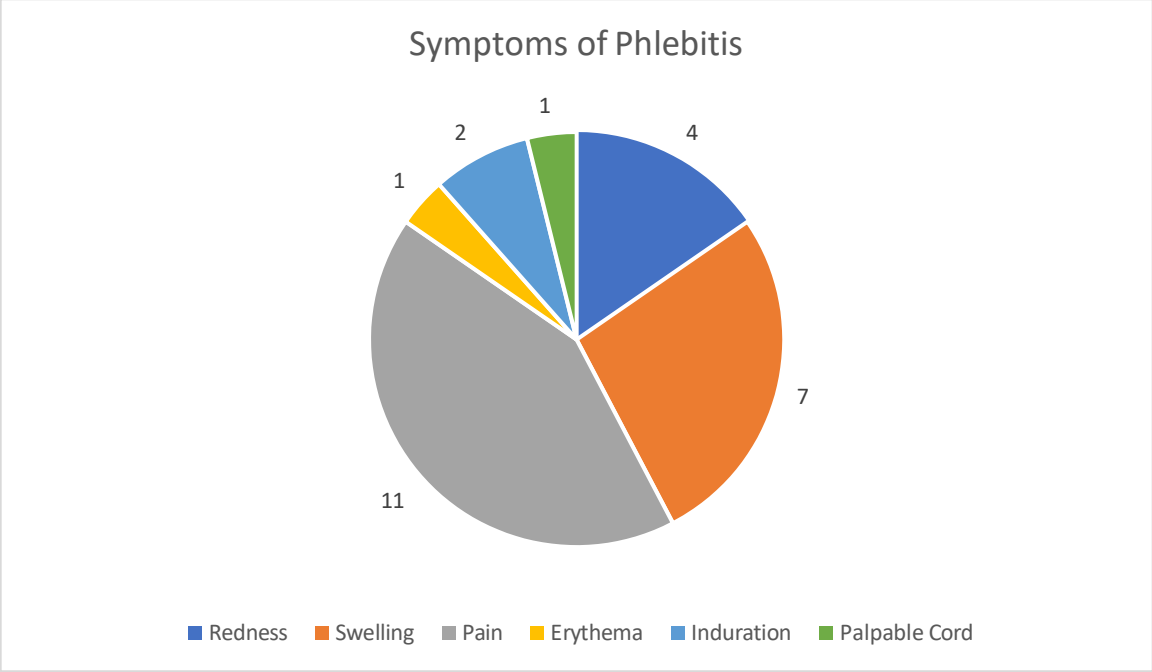
PIVC Replacement Data Collection Tool

Peripheral Intravenous Catheter Replacement Clinically-Indicated-Only Tool	
Date and Time of PIV Catheter Change	**Reason for PIV Catheter Change**
Date: **MM/DD/YYYY** _____ **Time:** **hh:mm am/pm** _____ **VIP Score:** _____	**Select all that apply:** ☐ **Redness** ☐ **Pain** ☐ **Erythema** ☐ **Swelling** ☐ **Induration** ☐ **Palpable venous cord or thrombus** **Two or more signs, excluding redness, indicate the need to resite the cannula**

Note: This figure demonstrates a PIVC clinically-indicated-only-replacement data collection tool modified from Stevens et al. (2018) SPC Data Collection Tool. This tool is used to document signs and symptoms of phlebitis and PIVC-related bloodstream infections. PIVC replacement or removal is based on Visual Infusion Phlebitis (VIP) score.

Figure 5

VIP Scale-Symptoms of Phlebitis Post-Intervention



Phlebitis Symptoms Post-Intervention

Appendix A

Table of Evidence

First Author (Year)	Design/ Method	Sample/Setting	Major Variables	Measure-ment	Data Analysis	Findings	Appraisal: Worth to Practice
1 Alloubani (2019)	Evidence review of RCTs, guidelines, and systematic reviews	21 Studies Healthcare settings hospitals, clinics, and nursing homes Adult and pediatric patients	PIVC replacement when clinically indicated versus routine replacement every 72-96 hours		Narrative	No evidence to support changing PIVC every 3-4 days Clinically-indicated replacement is superior, more cost-effective compared to routine, and minimizes several catheter replacements. No difference in phlebitis rates PIVCs replaced routinely and those clinically indicated	Provides evidence base for influencing quality and lower costs

2 Apel (2021)	Evidence-based practice project	A large hospital in the U.S. 29 bed unit	Replace short peripheral catheters (SPC) when clinically indicated vs every 96 hours	Compare over 6 months	Descriptive	The average dwell time increased $10,375 SPC-related insertion kit cost savings after change Phlebitis rate showed no significant difference before and after change	Provides evidence for influencing quality care
3 Blanco-Mavillard (2019)	Prospective, observational study	3 medical units, 1 surgical unit, emergency department, critical care unit, and operating room	Incidence of PIVC failure and variability between microbiological data and clinical signs and symptoms	Comparison from Dec 2017 – Jan 2018 Rate and incidence of PIVC failure	Descriptive	The PIVC failure rate density-adjusted incidence for hospital length of stay (HLOS) was 226.2 PIVC failure/1000 HLOS. 5.8% 41/711) tips yielded positive isolates, with most frequent microorganism *S. aureus*	Provides evidence for influencing care quality and safety evidence on the importance to remove unnecessary PIVCs to prevent catheter-related bloodstream infection (CRBSI)

						(*S. epidermidis* 29/41,70.7%, *S. aureus* 1/41, 2.9%), 42% PIVCs resulted in unplanned removal increasing the risk of morbidity and mortality	
4 Blanco-Mavillard (2020)	Prospective, multicenter observational study Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)	3 hospitals in Spain 624 adult patients	Prevention of PIVC failure and clinical practice guideline (CPG) adherence Included catheter removal and replacement strategies	From Dec 2017-April 2018 74 (11.5%) had adverse events reflecting phlebitis	Descriptive Statistical analysis	Clinical outcome indicators from CPG care were moderate Adherence to CPG was showed a wide gap between knowledge and optimal clinical practice	Provides quality improvement and patient safety
5 Blauw (2019)	Retrospective, case-control study	537-bed hospital	Incidence rates, risk factors and outcomes related to PVC *S. aureus* bacteremia (SAB)	A point prevalence survey	Descriptive	PVC-associated SAB is a common cause of SAB	Provides evidence base for influencing quality and safety

						PVC antecubital area and line duration should be minimized to reduce HO SAB 205 *S. aureus* bacteremia episodes, 45 were hospital-onset (HO) Incidence of HO associated SAB was 0.15 per 1,000 PVC days	
6 Buetti (2021)	Observational, cohort study	Large university-affiliated hospital in Switzerland 10 sites Adult patients with PIVC	Incidence of PVC-BSI after policy change of routine replacement to clinically-indicated replacement for six months	Compare from January 2016 to February 2020 PVC-BSI rates and PVC-BSI incidence rate ratios during two periods	Descriptive Kruskal-Wallis tests IRR for intervention and reversion periods Logistical regression model	11 PVC-BSIs at baseline 46 PVC-BSIs at intervention 4 PVC-BSIs at reversion Increased risk of BSI with clinically-indicated replacement	Evidence for influencing quality and safety

7 CDC (2017)	PIVC Guidelines for prevention of catheter-related infections in adult patients	Healthcare settings			Narrative	Recommend replacing PIVC every 72 to 96 hours routinely.	Provides evidence base for influencing quality of care and patient safety
8 Dao (2016)	Retrospective quantitative and comparative design	127 patients in an Intensive Care Unit at a hospital in California	PIV catheter replacement every 96-hours routinely or when clinically indicated. PIV catheter device days, complication rate and indications for removal	Comparison of PIVC catheter indwelling time and complication prevalence, after changing from a 96-hour routine PIVC replacement standard over a six-month period	Unpaired two-sample test Chi-square test of complication rates Bonferreoni correction to determine differences in clinical indications for removal of PIV catheters	No significant difference in complication rates was found but increased device days with clinically-indicated PIVC replacement Changing to clinically indicated did not cause any increase in BSI Decreased patient pain, complication, nursing workload, and costs	Provides evidence base for influencing care quality and safety

9 DeVries (2019)	A two-year follow-up prevalence point review of clinical indication removal policies for short peripheral catheters	Community hospital Patients with SPC on day of survey	No comparison data from previous years	2 Point prevalence surveys Tracked complication rates	Descriptive	20% of SPC remained functional for more than 7 days and 35% more than 5 days. Supports longer dwell time.	Provides evidence for influencing quality
10 Duncan (2018)	Quasi-Experimental, quality improvement project	1 hospital Patients with CVC and PIVC lines	Test the effect of a PIV maintenance bundle on BSI rates	A point prevalence audit September 2015 to October 2015 1 day audit at 3 and 6 months	Control charts Chi-square tests Fisher's exact test	Compliance rate of 90% with use of disinfecting caps and tips Using a PIV bundle decreased PIVC-BSI from 0.57 per 1,000 patient days to 0.11 infections per 1000 patient days Reduction of SPC replacements	Provides some evidence base for quality care improvement

11 Kollar (2021)	Quality improvement project Observational, descriptive cohort	Rural Midwestern hospital Convenience sample of 405 patients	Tested engineered securement device, education, and changing practice to clinically indicated SPC replacements	6 phases between Sept 2019 to March 2020	Descriptive	Catheter failures decreased from 24% to 13% PIVR-BSI (0.26 per 1,000 catheter days to 0.0)	Provides some evidence base for influencing safety and quality care
12 Li (2021)	Multi-site, randomized controlled trial	3 hospitals in China 3,050 patients	Clinically indicated vs routine 96-hour replacement group	CONSORT Checklist Compared 2 groups	Descriptive Chi-square T-Tests Cox proportional hazards model	No difference in phlebitis per 1,000 catheter days, BSI, and mortality	Provides some evidence for influencing quality care
13 Lim (2019)	Retrospective, cross-sectional analysis of hospital discharge records in the U.S.	Premier Healthcare database Hospital admissions with PIV-associated complications	Prevalence of PIVC patients with complications compared to patients without a PIVC-BSI	Quantified rates of selected PIV-associated complications and health care costs July 2013-June 2015	Descriptive Multi-variate analysis to compare LOS, costs, admission to ICU, and discharge status	2% of patients had PIV-associated complications and most were BSIs An average of 2 additional hospital days that cost over	Provides evidence base for influencing care quality, safety, and costs

		Most common complication was BSI				$3,000 compared to those without complications	
14 Lu (2021)	Prospective, single-blind randomized controlled trial	10 nursing units in a single hospital 600 patients with a PIVC	60 patients from each unit 30 patients in the clinically-indicated replacement group and 30 in the routine replacement group	Compared incidence of BSI in both groups from September to October 2019	Descriptive Kaplan-Meier analysis	Incidence of phlebitis was higher in the clinically-indicated replacement group vs the routine replacement group	Provides evidence for influencing quality and safety
15 Maier (2019)	Quality improvement project	528-bed tertiary hospital 3 units	Complication rates with 96-hours vs clinical indication SPC removal	Compared pre- and post-rates over 30 days VIP scale	Descriptive Chi-square tests Mann-Whitney U test	Fewer complications with clinical indication SPC replacements	Provides evidence for influencing quality and safety
16 Marsh (2018)	Single, prospective cohort study	A tertiary hospital in Australia 1,000 medical and surgical patients with PIV	PIVC failure Catheter removal by 72 hours policy	Compared PIVC failure rates with baseline data	Descriptive Kaplan-Meier Multi-variable regression	Catheter failure rate of 32% 136 per 1,000 catheter days Failure due to phlebitis	Provides evidence for influencing quality care and safety

					confidence intervals	risk factors modifiable to improve PIV insertion	
17 Mermel (2017)	Systematic review	63 studies Adult patients	Short PVC-BSI incidence All nosocomial catheter-related BSIs	Compare short PVC nosocomial BSIs incidence	Descriptive PRISMA guidelines	PIVC-BSI incidence 0.18% of 85,063 PVCs 19% *S. aureus* BSIs due to PIVC infections	Provides evidence for influencing quality and safety
18 Morrell (2020)	Quality improvement project	5 hospitals in 1 healthcare system	Short PIVC Safety IV catheter used pre-intervention Closed catheter system used post-intervention	Comparison of PIVC insertion 1st attempts over 6-year period Compared PIVC dwell time	Descriptive Comparison to previous years data	Vascular access management program to improve 1st attempts Increased from 15% to 68% Dwell time increased by 36 hours	Provides evidence base for improving quality and safety
19 O'Grady (2017)	Clinical guideline for intravascular devices	Health-care setting		Removal of PVC with signs of phlebitis, infection, or malfunction		Guidelines for preventing intravascular catheter-related infections with CVCs /PVCs	Evidence for practice guidelines to improve quality care

20 Oh (2019)	Quality improvement project	38-bed medical unit 469 inpatients 1,033 PIVCs	Clinically-indicated PIVC replacement guideline practice change	Pre-and post-test Compared clinically-indicated replacements and routine	Descriptive Logistic regression to measure dwell time on routine PIVC removals Mid-p exact test Survey	Routine PIVC replacement decreased from 34% to 3% Dwell time increased with no increase in phlebitis or BSIs Nurses workflow improvement	Provides evidence for influencing quality care and safety
21 Olivier (2021)	Quantitative, retrospective review	A hospital in Southern California 473 adult patient records CCU, step-down and oncology units	Catheter dwell time, phlebitis, BSI, skin tears, and costs	Comparison of pre-and post-intervention of clinically-indicated PIVC replacement	Descriptive	PIVC dwell time average 7 days 3% phlebitis rate No PIV-BSIs Cost savings – $17,100 for supplies	Provides evidence for influencing quality care
22 Orban (2018)	Prospective, observational study	1 general internal medicine unit and 1infectious disease unit A single hospital in Belgian 140 patients	Complications from IVD, dwell time, and complication rates	Reason for IVD removals complication rates Dwell time	Descriptive Chi-squared test Fisher's exact test	PVC dwell time no different in PVC with or without a complication	Provides evidence base for influencing quality care

23 Ray-Barruel (2020)	Prospective, multicenter observational study	3 hospitals in Australia 7 medical-surgical wards	Prevalence of redundant PIVCs Complications, dressings, BSI rates and device utilization rates	Comparison pre-intervention and post-intervention I-DECIDED tool for PIVC assessment effectiveness	SQUIRE guidelines Statistical comparison of outcomes across 8 points before and after intervention	Evidence-based decision tool is valid and reliable for PIVC assessment and to reduce risk of BSIs	Provides evidence base for influencing quality care and safety
24 Ripa (2018)	Prospective, observational study	700-bed hospital in Barcelona	PIVC-BSI factors associated with Gram-negative bacteria etiology	Comparison over 25 years 1992-2016	Chi-square test Univariate logistic regression analysis	Gram-negative PVC-related BSI increased from 0.06 to 0.13 episodes per 1,000 patient days	Provides evidence for influencing quality care and patient safety
25 Ruiz-Giardin (2019)	Retrospective, populational study	1 large hospital in Spain All BSI in patients over 15 years old 285 catheter-related bacteremia patients	Incidence of PVC and CVC related bacteremia	Comparison over 7 years of CVC and PVC-BSIs	Quantitative data as the mean and standard deviation Chi-squared test Confidence interval for odds ratio	Increase in incidence of PIV bacteremia from 0.106 per 1,000 patient days	Evidence for influencing quality care and safety

26 Saliba (2018)	Quality improvement project	A university hospital Patients with PVCR-BSI	PVCR-BSI prevention measures Surveillance PIVC assessment	Surveillance of PVCR-BSI from January 2003-December 2016	Descriptive Poisson regression model	*S. aureus* 115 episodes (50.7%) After intervention PVCR-BSI decreased from 30 in 2003 to 8 in 2016 1.17 to 0.36 per 10,000 patient days	Provides evidence base for influencing quality care and safety
27 Sato (2017)	Retrospective, observational study	2 hospitals in Tokyo 62 patients	Clinical manifestation in patients with PVC-BSI by positive blood culture	Comparison from June 2010 to April 2015	Descriptive Two-sample t-test Chi-squared test or Fisher's exact test	5 of 14 patients with Staph aureus died within 30 days of PVC-BSI diagnosis PVC-BSI may be prevented by catheter removal Lack of surveillance data regarding causative organism of PVC-BSI	Provides evidence for influencing quality care and safety

28 Shrestha (2021)	Observational, cross-sectional quantitative study	Tertiary care hospital in Nepal 390 patients	PIVC quality; dwell time, insertion site, dressing, and documentation	6-week study period from February to March 2020 PIVC-miniQ questionnaire to describe PIVC quality	Descriptive Scott's pi and sum score	PIVC-miniQ was found to be a feasible tool to measure PIVC quality improvements Gaps in quality may be improved with transparent PIVC dressings	Provides evidence for improving quality care and safety
29 Stevens (2018)	Quality improvement project	Community hospital 29-bed unit	Replacement of SPCs when clinically indicated vs replacing SPCs every 96 hours	Compare pre and post implementation SPCs and BSI rates over 3 months	Descriptive	SPC use decreased by 14.2% No SPC infections Cost savings $2,100 over 3 months	Evidence for the need to improve PIVC-BSIs
30 Takashima (2020)	Evidence review		Clinically-indicated PIVC catheter removal	Compare BSIs dwell time	Consolidated Framework for Implement-ation Research-(CFIR)	Decreased PIVC-BSIs, decreased costs, and clinical hours	Provides evidence base for influencing quality care

31 Tatsuno (2019)	Retrospective, observational cohort study	University hospital in Tokyo, Japan Adult patients with PVC and CVC-BSIs more than 2 days after admission	Compared clinical characteristics and prognoses of CVC-BSI with PVC-BSI	Comparison from April 2011-March 2013	Descriptive T-test, U test, Chi-square test, Fisher's exact test Kaplan-Meier analysis and log-rank test	All-cause mortality does not differ between the two groups PVCs are not safer than CVCs related to BSIs Need to use similar precautions to avoid unnecessary use of PVCs	Provides evidence for influencing safety and quality care
32 Vendramin (2020)	Randomized controlled, non-blinded, non-inferiority trial	Multi-center trial in 2 hospitals in Brazil 1,319 patients	REplacement of PEripheral intravenous CaTheters (RESPECT) according to clinical signs or every 96 hours	Compared phlebitis, indwelling time, and catheter failures	Descriptive	Clinically-indicated PIVC replacement was not inferior to routine replacement No difference of developing phlebitis	Provides evidence base for improving patient experience and satisfaction
33 Webster (2019)	Systematic review RCTs	7323 patients in 7 trials for CRBSI review	Clinically-indicated replacement versus routine replacement of PIVCs	Comparison of clinical indication replacement to changing	Risk Ratio with 95% confidence interval	No significant difference in clinically indicated versus routine replacement	Provides evidence for influencing quality care

				PIVCs routinely		No support for changing PIVC every 72-96 hours	
34 Xu (2017)	Nonblinded, cluster randomized trial	Teaching hospital in China 10 internal wards and 10 surgery wards 1,198 patients	PIVCs replaced only when clinically indicated 645 patients in control group PIVCs routinely changed every 72-96 hours in experimental group of 553 patients	Comparison of patients in clinically - indicated replacement group vs patients in the routine change group	Pre-protocol analysis and intention-to-treat analysis	No difference in incidence of phlebitis or BSI between clinically indicated and routine replacement groups Clinically indicated replacement is feasible May reduce nursing time, and patient discomfort	Provides evidence for influencing quality care and safety
35 Yasuda (2021)	Prospective, multicenter cohort study	23 ICUs in Japan 2,741 adult patients	Epidemiology of the use of PIVCs, incidence of phlebitis, and complications	PIVC-related phlebitis Incidence rate of CRBSI and catheter failures from	Descriptive Two-tailed test Wilson score interval	PIVC phlebitis occurred in 7.5% of catheters Incidence of rate of CRBSI-0.18%	Provides evidence for influencing safety and quality care

				Jan-March 2018		Catheter failure incidence per 100 catheter days-21%	

Note: First author: 1, Alloubani (2019); 2, Apel (2021); 3, Blanco-Mavillard (2019); 4, Blanco-Mavillard (2020); 5, Blauw (2019); 6, Buetti (2021); 7, CDC (2017); 8, Dao (2016); 9, DeVries (2019); 10, Duncan (2018); 11, Kollar (2021); 12, Li (2021); 13, Lim (2019); 14, Lu (2021); 15, Maier (2019); 16, Marsh (2018); 17, Mermel (2017); 18, Morrell (2020); 19, O'Grady (2017); 20, Oh (2019); 21, Olivier (2021); 22, Orban (2018); 23, Ray-Barruel (2020); 24, Ripa (2020); 25, Ruiz-Giardin (2019); 26, Saliba (2018); 27 Sato (2017); 28, Shrestha (2021); 29, Stevens (2018); 30, Takashima (2020); 31, Tatsuno (2019); 32, Vendramin (2020); 33, Webster (2019); 34, Xu (2017); 35, Yasuda (2021).

Appendix B

VIP Score Permission Letter

From: Andrew Jackson <andrew@ivteam.com>
Subject: Re: How to Get Permission Granted to Use VIP Score
Date: July 14, 2022 at 3:47:15 PM MDT
To: Sharon Devine <devineshar2@icloud.com>

Dear Sharon

Thank you for your email and your interest in the VIP Score. Please accept this email as permission to use the VIP score.

We wish you well with your project.

Best wishes

Andrew

Andrew Jackson

+44 07905259165
andrew@ivteam.com
ivteam.com
IVTEAM Ltd - Edwinstowe House - High Street - Edwinstowe - NG21 9PR - UK

On 14 Jul 2022, at 18:50, Sharon Devine <devineshar2@icloud.com> wrote:

Hello,
My name is Sharon Devine. I am a Doctoral Candidate at Aspen University writing my dissertation on peripheral intravenous catheter bloodstream infections. I would like permission to use the Visual Infusion Phlebitis Score for my project. This is a copyrighted scale. If you are not the person who can grant permission, please let me know who to contact, and how I may contact them to use the tool as soon as possible. I appreciate any help you may be able to provide.

Appendix C

VIP Scale Permission Letter

Sharon Devine <devineshar@gmail.com>

Visual Phlebitis Scale Permission
1 message

Dawn Berndt <dawn.berndt@ins1.org> Tue, Jul 12, 2022 at 7:39 AM
To: "devineshar2@icloud.com" <devineshar2@icloud.com>, "devineshar@gmail.com" <devineshar@gmail.com>
Cc: Susan Richberg <Susan.Richberg@ins1.org>

Hello Sharon,

INS grants permission for you to use the Visual Phlebitis Scale as presented in the *Infusion Therapy Standards of Practice* 8th Edition.

Good luck with your DNP completion.

Please reference appropriately.

Gorski LA, Hadaway L, Hagle ME, et al. Infusion therapy standards of practice. *J Infus Nurs*. 2021;44(suppl 1):S1-S224. doi:10.1097/NAN.0000000000000396

Dawn Berndt, DNP, RN, CRNI • Director of Publications and Educational Design

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Appendix D

Nursing Peripheral Intravenous Catheter Replacement Questionnaire

Please answer the following questions regarding peripheral intravenous catheter (PIVC) replacement to change a site or discontinue a PIVC.

1. How often are PIVCs changed on this unit?

2. How do you determine when PIVC catheters need to be changed?

3. How do you assess the PIVC site for signs of phlebitis or infection?

4. Where is the PIVC site assessment documented?

5. What is included in the PIVC documentation for replacing a PIVC?

6. What are the implications of PIVC-related bloodstream infections?

Appendix E

Peripheral Intravenous Catheter Clinically-Indicated-Only Replacement DNP Project Education

Purpose: To safely replace or remove a PIVC when clinically indicated only to prevent peripheral intravenous catheter-related bloodstream infection (PIVC-BSI).

Project Start Date: October 3, 2022
Completion Date: November 2, 2022
Inclusion Criteria: All adult patients admitted to the unit during the project period with a PIVC inserted.
Exclusion Criteria: Patients with a midline or central venous catheter (CVC) will be excluded.

Protocol:

1. Peripheral Intravenous Catheter (PIVC) site replacements or removals will be changed when clinically indicated only.

2. The ***Visual Infusion Phlebitis (VIP) Scale*** will be used to assess all PIVC site changes to determine the clinical indication for PIVC replacements.

3. The ***VIP score*** on the VIP Scale is a decision tool for assessing signs and symptoms of phlebitis and bloodstream infections.

4. PIVC replacements will be documented in the **electronic health record** and on the ***PIVC Data Collection Tool***. Documentation will include:
    - Site assessment
    - VIP score
    - Reason for the PIVC change or removal

5. Implications of PIVC-related bloodstream infections include but are not limited to the following:
    - Increased morbidity and risk of death
    - Prolonged hospitalization, antibiotic treatment, and hospital costs
    - Increased patient discomfort and pain
    - Increased nursing workload

References:

Gorski L. A., Hadaway, L., Hagle, 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*(4), S1-S224. https://doi.org/doi:10.1097/ NAN.0000000000000396

Appendix F

Project Timeline

1. Identify the problem or gap that exists
2. Develop a PICOT question to narrow the focus of the project
3. Define project goals, purpose, and significance
4. Conduct a literature search
5. Identify theoretical framework
6. Conduct an organizational assessment - Evaluate current PIVC-BSI rate and need for practice change
7. Identify key stakeholders - leadership, infection control, educators, managers, and clinicians
8. Develop project methodology and design
9. Develop documentation and audit process
10. Complete project approval process
11. Complete IRB approval process
12. Communicate problem statement to stakeholders
13. Set up meetings with leadership, key stakeholders, and unit staff
14. Conduct pre-test staff knowledge and understanding of the protocol
15. Educate staff on practice change
16. Conduct post-test staff knowledge measurement
17. Implement practice change over a 4-week period
18. Monitor and document compliance weekly
19. Conduct data collection for 4 weeks
20. Develop unit plan to collect data for 3 months and reassess program goals in 1 year
21. Conduct statistics and data analysis post-implementation
22. Evaluate, interpret, and report findings
23. Document results and share with leadership, stakeholders, and staff
24. Disseminate project findings through publication in a professional journal

Appendix G

Site Permission Letter

SCL Health
LUTHERAN

Date: July 6, 2022

Dear IRB Administrator,

I have granted authorization for Sharon Devine, Doctoral Candidate to conduct their project titled: "Prevention of Peripheral Intravenous Catheter Infections" at our Intermountain Healthcare Lutheran Medical Center, and I attest that I have the authority to grant such permission. I understand the purpose of the project is to determine if implementation of an evidence-based practice guideline for the replacement of peripheral intravenous catheters (PIVCs) in adult hospitalized patients will reduce the peripheral intravenous catheter related bloodstream infection rate on a single 41-bed internal medicine unit. The practice change is replacing PIVCs only when clinically indicated on the project unit versus the current routine replacement of PIVCs every 96 hours. The goal is to reduce the current bloodstream infection rate to less than 0.42 per 1000 patient days over a 4-week period.

Intermountain Healthcare Lutheran Medical Center will allow the following over the duration of the project:

- Assess knowledge of the unit staff and medical center guidelines on peripheral intravenous catheter vascular access devices as a quality improvement initiative for staff/providers/participants related to a new evidence-based intervention on one internal medicine unit.
- Work with the infection preventionist or quality department to gather de-identified patient data specific to the measurable patient outcome.
- Sharon Devine is required to follow all HIPAA and all Personal Health Information (PHI) policy and procedures related to obtaining, storing, and destroying of HIPAA and PHI protected data.
- Meet with employees to provide education on the new practice change.
- Access to de-identified client data and Sharon Devine will be required to submit a copy of their final dissertation manuscript.

If the IRB has any concerns about the permission being granted by this letter, please contact me by email at Steven.Brown@sclhealth.org

Sincerely,

Steven Brown, MD

Vice President and Chief Medical Officer
303-603-9929
Steven.Brown@sclhealth.org
8300 West 38th Ave.
Wheat Ridge, CO 80033

Appendix H

Clinically-Indicated-Only Peripheral Intravenous Catheter Replacements Protocol Post-Intervention Data Spreadsheet

	Presence of PIVC infection	Site Appearance	VIP Score	Reason for Replacement or Removal	Insertion Date	Replacement Date	Removal Date
PT01	No	Healthy	0	Leaking	10-7-22	10-8-22	10-8-22
PT02	No	Healthy	0	Leaking	10-3-22	10-6-22	10-6-22
PT03	No	Pain	1	Leaking	10-4-22	10-6-22	10-6-22
PT04	No	Healthy	0	Patient pulled IV out	10-5-22	10-5-22	10-5-22
PT05	No	Pain	1	Leaking	10-2-22	10-6-22	10-6-22
PT06	No	Healthy	0	Patient pulled IV out	10-3-22	10-5-22	10-5-22
PT07	No	Pain	1	Patient asked to change	10-3-22	10-4-22	10-4-22
PT08	No	Healthy	0	Leaking	10-6-22	10-3-22	10-3-22
*PT09	Yes	Pain and swelling	2	Phlebitis	10-2-22	10-3-22	10-3-22
*PT10	Yes	Redness, pain, swelling, induration	3	Phlebitis	10-3-22	10-3-22	10-3-22
*PT11	Yes	Redness, pain, swelling, erythema	3	Phlebitis	10-6-22	10-9-22	10-9-22
*PT12	Yes	Redness and pain	2	Phlebitis	10-7-22	10-13-22	10-13-22
*PT13	Yes	Palpable venous cord	4	Phlebitis	10-11-22	10-12-22	10-12-22
PT14	No	Healthy	0	Patient request to remove	10-9-22	10-11-22	10-11-22
PT15	No	Healthy	0	Patient pulled out	10-10-22	10-12-22	10-12-22
*PT16	Yes	Pain, obstructed	2	Phlebitis	10-11-22	10-11-22	10-11-22
*PT17	Yes	Redness, pain, swelling	2	Phlebitis	10-14-22	10-14-22	10-14-22
*PT18	Yes	Pain, Swelling	2	Phlebitis	10-13-22	10-15-22	10-15-22
*PT19	Yes	Pain, swelling	2	Phlebitis	10-19-22	10-20-22	10-20-22
PT20	No	Healthy	0	Leaking	10-20-22	10-21-22	10-21-22
PT21	No	Healthy	0	Leaking	10-19-22	10-21-22	10-21-22
*PT22	Yes	Bleeding and leaking	2	Phlebitis	10-27-22	10-28-22	10-28-22
*PT23	Yes	Induration, swelling	3	Phlebitis	10-26-22	10-26-22	10-26-22
PT24	No	Healthy	0	Leaking	10-24-22	10-26-22	10-26-22
PT25							
PT26							
PT27							
PT28							
PT29							
PT30							

Weeks: 1-4 Data Collection Dates: From: 10-3-22 To: 11-2-22

Note: *Phlebitis = 11.

Appendix I

Pre- Implementation Staff Questionnaire Data

ID	Pre-Education How often are PIVCS changed on this unit?
1.	4 days stat lock, 3 days Tegaderm dressing
2.	Q 4 days, prn
3.	Q 4 days
4.	When clinically indicated
5.	3 days Opsite, 4 days Stat lock dressing
6.	Q 96 hours
7.	4 days (Stat lock) or 3 days (Tegaderm) depends on dressing type
8.	Q 3 days
9.	Q 96 hours, prn
10.	96 hours, stat lock
11.	96 hours, prn
12.	96 hours
13.	96 hours or 4 days
14	4 days, 96 hours
15.	5 days
16.	3 days
17.	Frequently
18.	4 days, 96 hours
19.	72 hours Tegaderm, 96 hours secure dressing
20.	Q 3 days transparent, 4 days with securing device
21.	Weekly?
22.	96 hours
23.	Q 4 days
24.	Q 96 hours
25.	Q 4 days
26.	Q72 hours
27.	4 days, prn
28.	Q 72-96 hours depending on dressing
29.	Q 3 days
30.	96 hours, prn
31.	96 hours, prn
32.	72 hours, prn
33.	Q 96 hours
34.	Q 4 days, prn
35.	Q 72-96 hours
36.	Q 96 hours unless order to keep in
37.	Q 96 hours
38.	3 days if plastic dressing, 4-5 days id fabric covering
39.	4 days
40.	Q 3 days, prn

Note: Pre-education – Correct answer 22/40 = 55%.

Appendix J

Post-Implementation Staff Questionnaire Data

ID	Post-Education How often are PIVCs changed on this unit?
1.	Clinically-indicated
2.	When clinically-indicated
3.	When clinically-indicated
4.	When clinically-indicated
5.	Every 72 hours
6.	When clinically-indicated
7.	When needed due to phlebitis/infiltration
8.	When clinically-indicated
9.	When clinically-indicated
10.	Only when clinically-indicated
11.	Change if signs of phlebitis
12.	When clinically-indicated
13.	As needed for IV failure, phlebitis, infiltrate, pulled out
14.	As clinically-indicated
15.	As needed or when phlebitis
16.	Only when clinically indicated
17.	When clinically needed
18.	When clinically indicated
19.	When clinically indicated
20.	As needed – clinical indicated
21.	When clinically indicated
22.	When not working or signs of infection or infiltration
23.	When clinically indicated
24.	When clinically indicated
25.	Only when clinically indicated
26.	When adverse issues occur – redness, drainage, pain, swelling
27.	When clinically indicated

Note: Post-education – Correct answer 26/27 = 96%.