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Enhancing Peripheral Intravenous Line Maintenance Practices Among Nurses in a Critical Care

Setting: A Quality Improvement Project

DEMN Program, University of New Hampshire

CNL Scholarly Project

Jaylene Velasquez

Beth Evans, DNP, RN, CNL

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Abstract

Background: One of the major risks of infection lies in a patient's intravenous (IV) access. On a cardiac intensive unit, a Level II trauma center, preventing adverse events (i.e. infections, sepsis, etc.) is essential within this unit due to the nature of these health conditions. To ensure patient safety, nurses must abide by evidence-based practices and facility guidelines regarding intravenous line management. This quality improvement (QI) project implemented interventions to enhance nursing practices for peripheral intravenous therapy.

Methods: This project included statistical analysis and audits to measure the impact of the interventions. The variables being observed in this project are the number of IV fluids, disinfection cap use, proper labelling of tubing, and proper disposal of administration sets.

Results: Findings suggest that there continues to be a gap in proper peripheral intravenous (PIV) line maintenance practices among nurses in a critical care unit. One of the top concerns was nursing compliance to the proposed interventions and time constraints for the duration of the project. Statistical analysis identified the need for further education and training, ensuring nursing compliance, and piloting new quality improvement projects to explore nurses' knowledge on best practices for PIV maintenance practices.

Conclusion: While there are various benefits to enhancing peripheral intravenous line maintenance practices in critical care settings, it can be challenging to implement due to the various factors at the microsystem and macrosystem level. Healthcare teams must continue to address these barriers in order to foster an environment that leads with safety and improving quality of care.

Keywords: *peripheral intravenous lines, intravenous lines, critical care, nursing, quality improvement*

Introduction

Background

Although there have been vast improvements in enhancing quality of care, healthcare-associated infections (HAIs) remain prevalent within the United States. According to the Centers for Disease Control and Prevention (CDC), 1 in 25 patients are diagnosed with at least one infection related to the hospital setting. Many of the HAIs are caused by resistant bacteria that can ultimately lead to sepsis or death. While there are infection prevention protocols in place, HAIs remains an issue across healthcare settings. In a critical care setting, the risk of infection is prominent and must be contained due to the nature of patient's complex health conditions. One of the major risks of infection lies in a patient's intravenous access (IV) access.

The Institute for Safe Medication Practices (ISMP) has identified that there are two common practices that continue to put patients at risk for infections including 1) failure to place a sterile cap on the end of a reusable intravenous (IV) administration set that has been removed from a saline lock or IV catheter hub and 2) failure to properly disinfect the IV port when accessing IV sets. The port should be disinfected before and after use because of the high risk of potential contaminants entering the patient's IV line and causing unintended consequences. Based on recent research, it appears that healthcare professionals are not practicing safe practice recommendations by not placing a sterile cap on the exposed tubing. The ISMP recommends to healthcare organizations that licensed healthcare professionals should cover the exposed end of IV tubing for intermittent infusions with a sterile cap between uses and disinfecting the port before connecting tubing or a syringe to the port. Additionally, unlicensed staff members should never disconnect or disconnect any type of medical tubing (Grissinger, 2011).

Problem Description

As other healthcare organizations have implemented infection control and prevention measures, a 220-bed Level II trauma center in New England has adopted various metrics (CLASBI, CAUTI, SSI, etc.) to prevent HAIs and other adverse events to patients. However, performing proper safe and effective practices related to intravenous lines remains an issue among licensed healthcare professionals. On a cardiac intensive unit at this facility, the patient population included patients with high-risk cardiac conditions, and many have undergone cardiac surgery. Therefore, preventing adverse events (i.e. infections) is essential within this unit due to the nature of these health conditions. Many of these patients had various intravenous lines including peripheral intravenous tube (PIVs), peripherally inserted central catheters (PICCs), and midlines. Without proper disinfection and sterile techniques, these patients are exposed to potential risks of infection, sepsis, or death. The longer a patient has an intravenous line, there is a greater chance of exposing patients to infectious agents. It is imperative that nurses follow consistent evidence-based practices even after insertion of an intravenous line. Maintenance of intravenous lines includes proper disinfection of hubs, use of disinfection caps, proper labelling of tubing, disposing of tubing, changing tubing per facility policies, etc.

In working with various healthcare team members on this unit, it appeared that a common theme among IV care was the lack of disinfection, capping, labelling tubing, and inadequately changing tubing per hospital guidelines. While there were current hospital guidelines in place to manage peripheral intravenous lines, nurses continued to engage in improper practices that can ultimately result in significant patient illness and deaths (morbidity and mortality). To ensure patient safety, nurses must abide by evidence-based practices regarding intravenous line

management and maintenance. More specifically, peripheral intravenous lines (PIVs) because these were most used on this unit.

While these actions may seem minor, they may have unintended consequences and affect patient's health outcomes. The unintended consequences of these actions include prolonging the duration of hospital stay and utilizing additional hospital resources that generate expenses for both the patient and hospital (Collins, 2008). Facility guidelines regarding proper intravenous line management are put in place for this reason: to ensure that adverse events or unintended consequences do not occur. Staff nurses should refer to the facility guidelines regarding proper practices and processes should be documented any time there is an intravenous line in use. If improper practices are detected, this provides an opportunity for unit leaders to conduct regular compliance rounds on all patient care to identify opportunities of improvement.

Available Knowledge

In the United States, at least 200 million peripheral intravascular (PIV) catheters are placed each year (Presley & Isenberg, 2021). Intravenous access lines are essential in-patient care for administering medications, fluids, nutrition, and blood products (Panepinto et al., 2021). With increased PIV catheter use in hospital settings, there is an additional increase in risk related to PIV-associated complications. Patients with PIV catheters have been associated with longer hospital stays, higher inpatient costs, and a greater risk of death than patients without (Lim et al., 2019). Enforcing safe management practices for peripheral intravenous lines reduces clinical complications (i.e. infections) and adverse events. Due to the increase of intravenous therapy use, the Infusion Nurses Society (INS), the Centers for Disease Control and Management (CDC), and the Joint Commission (JC) have published guidelines for safe and effective intravenous line management practices that should be followed by healthcare professionals (Panepinto et al.,

2021). Nurses must maintain evidence-based standards based on the high risk of adverse outcomes. Nurses play a significant role in reducing adverse clinical outcomes by following the current guidelines and policies regarding intravenous line management within their facility.

Although improvements have been made in healthcare settings to enhance patient outcomes, there continues to be improper and unsafe practices regarding intravenous line management. The Institute for Safe Medication Practices (ISMP) Medication Errors Reporting Program found that the two most dangerous practices include failure to place a sterile cap on the end of intravenous (IV) administration set and failure to properly disinfect the injection port when accessing needle-free valves in IV sets. These unsafe practices expose patients to potential contaminants that can lead to infection if it is reconnected to the patient (Grissinger, 2011). In this review, one pharmacist claims to have found nurses in her facility attach the exposed end of IV tubing to a port on the same tubing to maintain sterility (Grissinger, 2011). This action is known as “looping” and has not been approved or recommended by the Infusion Nurses Society (INS). The INS standard of practice states, “a compatible sterile covering should be aseptically attached after each intermittent use” (Grissinger, 2011; Infusion Nurses Society, 2006). Additional safe recommendations include both capping and disinfecting procedures to be documented in the institution’s policies and procedures as another form to uphold safe practices. This review suggests that conducting regular compliance rounds on all patient-care units can help track problem areas and opportunities for improvement.

According to a published survey of nurses, nurses were conducting varied practices on changing IV tubing sets and disinfection of ports. This survey highlights the continued need for further nursing education regarding PIV line management and care (Hadaway, 2007). Furthermore, a systematic review found that 33-45% of needless connector hubs were

contaminated and that compliance with disinfection is as low as 10% (Moureau & Flynn, 2015). These practices put patients at risk for potential contaminants that can ultimately lead to infection. In a quasi-experimental study conducted by Duncan et al. (2017), researchers investigated and monitored compliance with a PIV maintenance bundled approach to reduce the number of infections in trauma I medical center. The bundle approach included using disinfecting caps and tips to encourage safe practices within PIV care and management. Weekly audits pre-intervention and post-intervention were conducted to measure nursing compliance with this bundled approach. While conducting audits, more unsafe and unacceptable practices were found, including looping of tubing, using the cap of a saline syringe, leaving the end uncovered, or using the cap from another tubing. Upon discovering these unsafe practices, this study prioritized the need to educate nurses on current guidelines from the Infusion Nurses Society on all components related to safe PIV line management. The disconnection method of “looping” went from 51% to 2% at the time of the intervention. Overall, results from this study revealed a 90% rate for the new intervention and the use of disinfecting caps on peripheral lines could reduce the rate of infections. The bundle approach in this study is one step toward preventing complications in PIVs and encouraging safe and effective standards of care in nursing. Organizations need to identify gaps in nursing compliance and educate their staff on current standards of care, to enhance patient safety and quality of care.

Panepinto et al. (2021) review examines best practices related to intravenous line management for nurses and common bundle strategies to reduce infection. The CDC recommends utilizing bundle strategies, including assessing PIV sites, ensuring dressing is dry and intact and labelled, using 2% chlorhexidine gluconate, using alcohol disinfection caps on all needleless connectors, and minimizing intravenous use tubing disconnections. In a 2018 study

conducted by Duncan et al., there was an 81% reduction in peripheral line-associated bloodstream infections when incorporating a bundle approach to decrease the rate of infections at a trauma care center (Duncan et al., 2018). To further promote patient safety, PIV catheters should be assessed every 4 hours or more frequently according to hospital guidelines. Assessment should include visual inspection and palpation of the insertion site for redness, swelling, draining, or tenderness. When using a needleless system, all components, including the administration sets, should be changed every 72 hours (Panepinto et al., 2021). Using these bundle strategies within hospital systems can help nurses uphold safe and effective standards for peripheral line management practices.

Nurses' non-compliance to guidelines regarding PIV care can incur complications included extended length of hospital stay, increased treatment expenses for the hospital and patient, increase risk of infection, and reduction in quality of care. To achieve continuous compliance with best practices for intravenous line management, nurses need to be knowledgeable and skillful in current evidence-based practices and remain informed on current guidelines per facility. A study by Hadaway (2012) claims that "nurses' lack of standardization in practice and knowledge of PIV catheter care directly affects patient' safety risks and outcomes". Another study found that 25% of unused peripheral intravenous catheters were used or left in for long periods, showing inadequate knowledge on proper care and removal of PIVs (Do Rego Furtado, 2011). Se et al. (2016) study gauges nurses' knowledge of peripheral line management, post-insertion care, and possible complications. This study showed that nurses in specialty units were more knowledgeable on this subject than in medical-surgical units. Additionally, nurses in leadership roles, such as charge nurses, were more equipped with PIV care and management. Similar to another study by Glover (2000), this study emphasizes the

importance of nurses being informed of the latest nursing practices regarding line management care. Proper training and knowledge on current evidence-based practices can encourage nursing compliance with hospital guidelines about IV-line management.

Based on the current literature, there is a gap in nurses' knowledge of PIV line management care including disinfection of ports, changing tubing, proper disconnection methods, and other related safe practices. Common themes found regarding PIV line management and care in nursing include IV tubing not capped, lack of disinfection cap use, ports not cleaned, and lack of changing IV tubing per facility guidelines and leaving peripheral lines in longer than clinically indicated. In a setting where nurses are engaging in improper practices, it is imperative to identify potential barriers or challenges that lead to these behaviors. As Grissinger (2011) found in their study, conducting routine audits or compliance rounds can serve as a method to measure PIV line management and to identify areas of improvement or opportunities for nursing education. Proper management of PIV catheters should be documented in policies and procedures within a hospital facility to ensure that nurses are complying with safe practices (Infusion Nursing Society, 2021).

Rationale

The framework behind this quality improvement project was based on the DMAIC framework. The framework is as follows,

- 1. Define:** Nurses in this microsystem were not demonstrating proper peripheral intravenous line management and maintenance practices. In doing this, they were also not adhering to the facility guidelines regarding proper PIV line management practices. Based on baseline data, nurses demonstrated <10% of proper and safe

- practices. The estimated goal was to reach 50% nursing compliance regarding proper line management practices by July 1st.
- 2. Measure:** Baseline data on current nursing practices regarding PIV management has been measured through weekly audits. The expected start date to implement the change idea was May 23rd. Data was collected through weekly audits post-intervention to identify if there was an improvement in nursing practices. The results of the audits pre and post-intervention were analyzed to assess if there was an upward trend. Achieving >10% of nursing compliance on proper PIV management practices will demonstrate a positive result. If there were no data changes post-intervention, this would indicate a negative outcome.
 - 3. Analyze:** To attain baseline information, current nursing practices have been analyzed through weekly audits. The following criteria was included in the audits: number of IV fluids, use of disinfection caps, labelling of lines, and proper disposal of tubing sets. Additionally, current facility guidelines regarding PIV line management practices were analyzed to identify specific information to include in the reminder cards or infographics. For example, how often tubing sets should be changed and disposed of based on the type of fluid. Post-intervention data were collected from May 23rd-July 1st.
 - 4. Improve:** To improve current nursing practiced related to PIV management and to improve compliance of hospital guidelines regarding these practices within a cardiac step down unit.. By engaging in proper and safe practices, nurses would be adhering to the facility guidelines. Enhancing nursing practices on PIV lines will create

positive outcomes for patients by reducing their risk of infection or other adverse consequences.

- 5. Control:** Measuring nursing practices related to PIV management through pre-intervention and post-intervention weekly audits.

Global Aim

The global aim of this quality improvement project was to improve best practices regarding peripheral line management among the staff nurses in the microsystem.

Specific Aim

The specific aim of this quality improvement project was to enhance PIV maintenance practices from <10% to 50% by July 8th, 2022.

Methods

Context

With this microsystem, nurses are caring for critically ill patients that require peripheral IV lines to administer medications, fluids, blood products, nutrition, etc. The nurses are expected to abide by hospital guidelines that ensure proper and safe practices for PIV catheter care and management. Upon review, nurses were found to be engaging in practices that are not evidence-based nor approved by the facilities policies/guidelines. Similar to studies found in the literature review, nurses are engaging in improper disconnection methods, lack of hygienic practices, lack of labelling tubing, etc. The implications of these unsafe practices can lead to increased hospital length of stay, increased infection rates, and mortality as identified by Lim et al. (2019) and Infusion Nurses Society (2021).

Prolonged hospital length of stay can generate additional expenses for both the hospital and the patient. Increased length of stay can expose patients to other health conditions including hospital acquired infections such as CLASBI, MRSA, CAUTI, etc. Fortunately, this hospital has sustained low incidence rates of CLASBI, however, that does not mean peripheral IV infections are still not cause for concern. Conducting a quality initiative project that enhances proper PIV line maintenance practices among nurses can reduce long-term economic burden on this hospital by preventing adverse events (i.e. hospital acquired infection). Proper PIV line management practices among nurses in a hospital setting can improve quality of patient care and overall patient outcomes (i.e. reducing length of stay, mortality risk, infection risk).

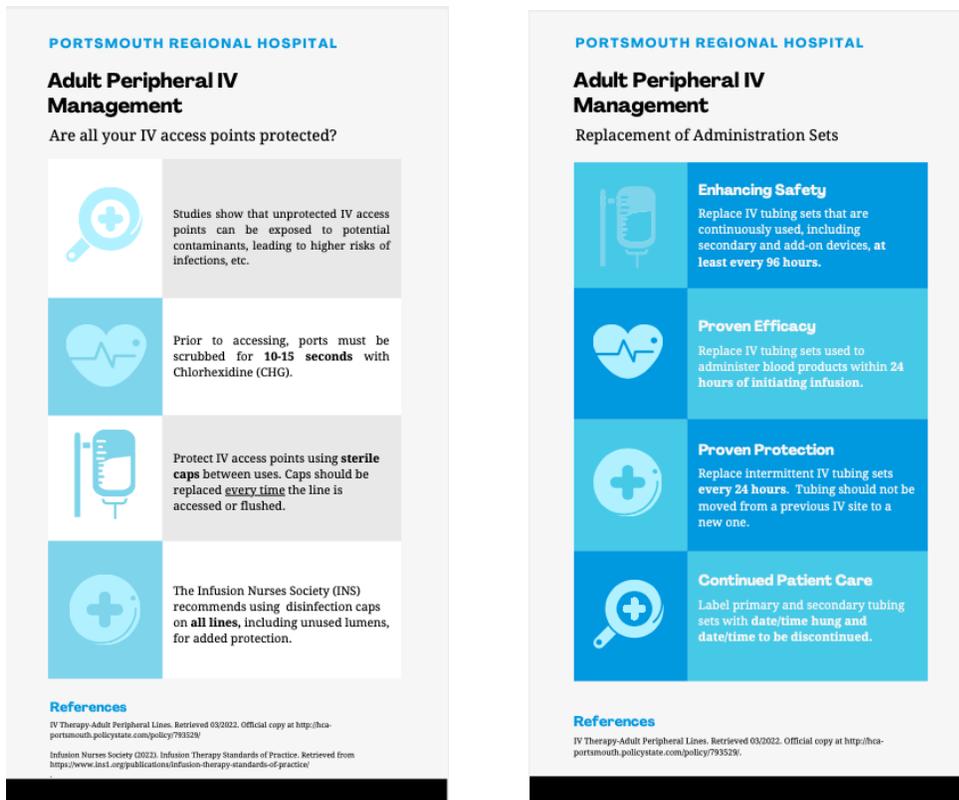
Interventions

The following interventions for this quality initiative (QI) project was to enhance current nursing practices related to peripheral IV-line management and maintenance backed by evidence-based research. By improving these practices, nurses will be adhering to the hospital guidelines surrounding proper PIV line management. Since the current hospital guidelines are not considered user-friendly, creating reminder cards with specific and relevant information on PIV line management (i.e. timeframe for changing tubing based on type of fluid or medication) based on the facility's guidelines. Reminder cards that are easily accessible, visually appealing, and concise will be easier for nurses to digest information instead of using standard hospital paper guidelines. These reminder cards will be hung on the IV poles so that staff nurses can see it and keep themselves accountable of adhering to proper practices. These reminder cards will have a more profound effect than having signs posted at the nurse's station because it is more likely to get lost or overlooked.

Since the initiation phase of this project, the interventions have evolved to fit the unit's needs and priorities. The proposed idea had been to create signs or checklists that would be posted at the patient's bedside for the nurses to see. In collaboration with the unit leaders, it was found that creating small, laminated "reminder cards" would be more effective and appropriate. Additionally, the unit leaders recommended that these reminder cards would be hung on the IV poles to grasp nurses' attention when hanging their IV medications or fluids. The alternative would have been to place a sign at the patient's bedside; however, this could cause confusion for the patients as this specific information is necessary for nurses, not patients. Additionally, it would be best to avoid overwhelming patients with only pertinent information related to their care. To refrain from visual overload, the only signs posted in the patient's bedside is specific to what they need to know for their stay. In Figure 1, the image displayed provides an example of the reminder cards that are currently placed in the cardiac step down unit.

Figure 1.

Illustration of Reminder Cards



Note. Both images displayed above have been printed to be double-sided and is approximately 5x7.

The second intervention proposed is to ensure that disinfection caps are readily available and accessible in patients’ rooms for nurses. For example, in the ICU where IVs are constantly used, disinfection caps are readily available at the patient’s bedside. In this microsystem, disinfection caps are typically held in the supply room, which is farther away from the patients’ rooms. If disinfection caps are not already in the patient rooms, nurses are less likely to search for them because they are extremely occupied and may not be their top priority now. Therefore, ensuring that readily available disinfection caps can serve as an appropriate intervention to reduce this barrier/challenge. All pertinent supplies needed for patient care, including IV caps,

will be placed in a patient's room to make it easier for the nurses to find them without leaving the room to search for them. Placing disinfectant caps in preparation for a new admission will be one less task that a nurse must do, and it will make it easier for them to comply with capping IV lines.

The second part of this intervention has also been modified to fit the unit's current demands. In cooperation with Infection Control and Prevention guidelines, a handful of disinfection caps have been placed in small clear bags available at the nurse's computer station in the patient's room. The idea behind placing the disinfection caps in the nurse's computer station in the patient's room is so that they are easily accessible and in plain sight. According to Infection Control and Prevention, the safest and appropriate action would be to place them out of patient's sight. Additionally, the unit leaders notified the licensed nursing assistants (LNAs) to stock disinfection caps when preparing for a new admission. The goal is that this action will further encourage nurses to use disinfection caps, when possible, especially when it is readily available to them.

Contextual elements

Upon beginning the implementation phase of this project, there were delays that interfered with the interventions. For example, the interventions were supposed to be implemented starting May 23rd. Due to delayed responses from stakeholders and restricted time constraints, the interventions were not implemented until June 6, 2022. This quality improvement project is also being implemented during a period where many employees are away for summer vacation. Therefore, it was more challenging for these interventions to attain final approval by the unit leaders because of changes in their schedules. Due to the delayed start of the

implementation phase, data collection is still being collected to thoroughly analyze the results. The expected goal is to finish data collection by July 8th, 2022, which a week later than the original date.

Some barriers that have also interfered with these interventions is the lack of compliance among the staff nurses on the unit. This QI project has been discussed throughout weekly and monthly staff meetings to encourage participation and compliance. The unit leaders have also provided opportunities through zoom meetings to endorse the project by discussing appropriate PIV line management practices on the unit. Additionally, the unit leaders have helped to finalize the reminder cards and hang them on the IV poles. It appears that the lack of nursing compliance may be due to the fact that nurses are short staffed, extremely busy, and their workload is already cumbersome. More specifically, the day shift nurses already have many tasks to balance and may be more attentive to other dire responsibilities.

Study of the Interventions

The project baseline data was collected using excel spreadsheet that included the following criteria: the number of IV fluids on the unit, how many are labelled, and capped correctly. After conducting weekly audits, the results were analyzed using a tally system. The total number of each category were tallied. After implementing these interventions in the microsystem, another round of audits has been conducted to identify if there have been any improvements related to PIV line management and care. In collaboration with the unit leaders, they have concluded that conducting an audit before and post- intervention will help assess the impact of these interventions. Therefore, comparing the before and after-implementation data to

identify if there is an increased number of “correct” practices performed. An increased number of “correct” practices being done will indicate a positive result.

Measures

Prior to the implementation phase, there was a less than 10% of compliance in capping tubing correctly, labelling tubing correctly, and changing of tubing sets. The goal was to increase this number to 50% to improve PIV line management practices per hospital guidelines and decrease the risk of infections or harm to the patient. The expected goal was to attain close to or at 50% compliance is a reasonable number considering the baseline data. To measure data, the results from pre-intervention audits were compared to the post-intervention audit results to identify if there had been an increase or decrease in compliance with these behaviors. For example, comparing the percentage of correctly labelled tubing found before the intervention and post-intervention. An increased number of “correct” practices in these categories will indicate a positive result. A positive result indicates that nurses are performing safe and proper practices regarding PIV line management and maintenance. A negative result will indicate that there are no changes or improvements made to PIV line management nursing practices.

The desired outcome of these interventions was that the staff nurses improved their practices by demonstrating proper and safe PIV line management that includes disinfection, use of disinfection caps, labelling, and changing tubing sets per hospital guidelines. Having reminder cards placed on the IV poles will remind the nurses and be accountable for these practices.

Analysis

Data was collected from baseline and post-implementation. Post-implementation data was collected from June 6th to July 8th, 2022. Methods used for collecting and analyzing data include observations through audits and excel to track trends in nursing practices. The variables observed

in this project are the number of IV fluids being used, number of tubing capped properly, and number of tubing labelled properly. The quantitative data was displayed through a column chart on excel. A positive result of this QI result was an increased number of “correct” practices compared to the baseline data. Reaching at or close to 50% of compliance indicated that the staff nurses are practicing safe and proper PIV line management and adhered to the posted signs or checklist found at the patient bedside. Any rate higher than 10% showed there have been improvements in use of disinfection caps, labelling of tubing, and tubing changing per guidelines.

Ethical Considerations

All ethical factors, including voluntary participation, informed consent, anonymity, confidentiality, potential for harm, and communication of results have been considered for the validity of this quality improvement project. While this project revolves around improving patient care, the primary participants are the staff nurses and the unit leaders who will be upholding new and improved practices relating to PIV line management. Patient health information (names, phone numbers, IP addresses, email addresses, etc.) will not be collected nor interviewing patients for this project. Data collection will be kept anonymous and confidential to ensure that it is not identifiable or linked to other persons. Any files with pertinent data will be password-protected and will be deleted upon completion of the QI project. All participants can choose whether they want to participate or withdraw from the study without any consequences.

The potential for physical, social, psychological and other types of harm is very low. This project does not include direct contact or communication with patients as they will also not be surveyed in this project. Data collection involves observation of nursing practices and gathering information on hospital guidelines obtained through the PRH health system. These interventions

have been discussed and approved by the unit leaders and managers. The UNH nursing department and unit leaders will oversee this QI project. All results and interventions from this project will be communicated to the appropriate personnel. Data and results will be shared only in an academic setting to learn and gain knowledge on nursing practices. This proposal will be reviewed by the UNH academic system to ensure that this project is quality improvement based and IRB exempt.

Results

Upon assessment of the microsystem, it was found that there was a gap in peripheral intravenous (PIV) line maintenance practices among nurses within a cardiac-intensive unit. Barriers to proper PIV line maintenance practices included lack of flexibility and time to read through the current hospital guidelines. The current hospital guidelines contain lengthy documents with a plethora of information, that may not be considered user-friendly or easy to digest. To combat this barrier, a change idea was implemented to facilitate proper PIV maintenance practices among nurses. In addition, disinfection caps have been stocked in all patient rooms to make it easier for nurses to cap their tubing, a maintenance practiced found in the hospital guidelines.

Data was collected through weekly audits pre-intervention and post-intervention for a total of eight weeks. There was a total of four audits conducted pre-intervention and four audits conducted post-intervention. Weekly audits were conducted to identify two main criteria's: 1) the use of disinfection caps and 2) proper labelling of tubing based on product or medication (time/date). Descriptive statistics were used to analyze the data (Figures 1 and 2) for trends on PIV line management practices pre-intervention and post-intervention. Based on the sample, there is an upward trend of increased use of disinfection caps among nurses within the cardiac

step-down unit. When reviewing proper labelling of tubing among PIV lines, there is not increased, or downward trend identified. This category demonstrates that the intervention implemented has not created a significant change from the original data.

Figure 1.

Audit on PIV Line Management Practices Pre-Intervention

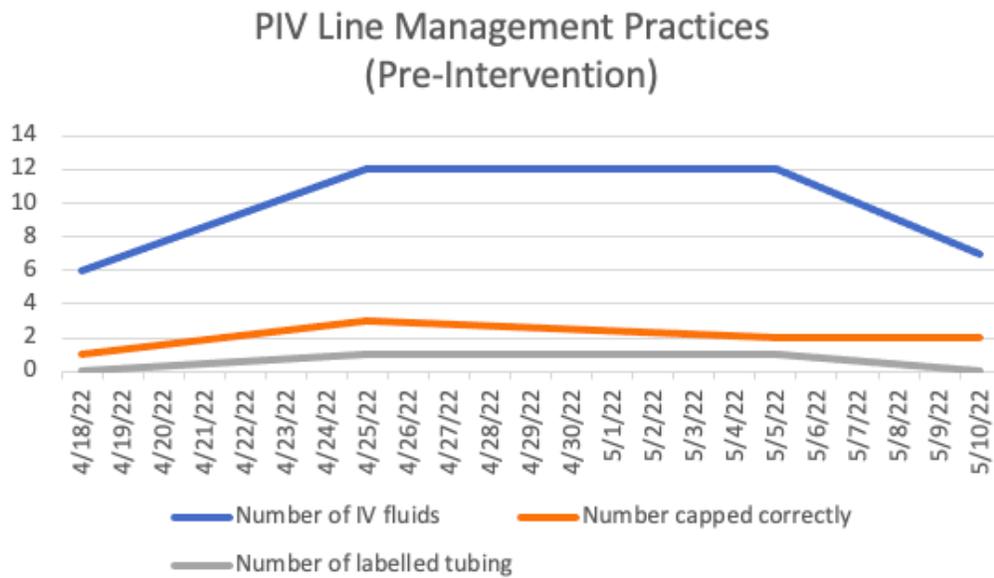
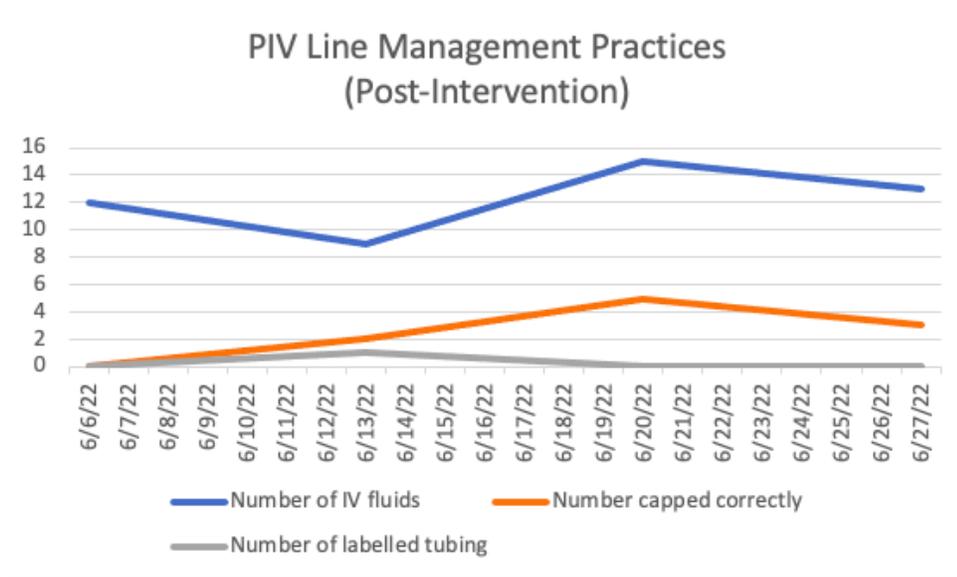


Figure 2.

Audit on PIV Line Management Practices Post-Intervention



Key Findings

A total of 86 peripheral intravenous lines were assessed within an eight-week period to identify trends in proper maintenance practices among nurses. After the introduction of the reminder cards, the use of disinfections caps on the unit did not significantly increase during the four week period where audits were conducted. In addition, there was no significant changes in proper labelling of tubing (i.e. time started/date to be disposed). This rate did not significantly differ from the baseline data, which demonstrates that the intervention did not initiate changes among PIV maintenance practices. Long-term use of these reminder cards would be needed to identify if these attributed to nurses engaging in proper PIV practices.

Despite the implementation of the reminder cards that highlighted proper PIV maintenance practices for nurses, this QI project identified a gap in nursing practices that serves

as an opportunity to educate nurses on this subject matter. Adherence to these practices requires substantial nursing time and effort. Therefore, it is vital for clinical unit leader to continue reinforcing these practices to ensure safe and efficient patient outcomes. Adhering to proper PIV line maintenance practices can enhance patient outcomes by reducing the risk of infection or other adverse events.

This QI project highlighted the significance of incorporating audits into unit standards to identify improper practices or behaviors and finding opportunities to modify these behaviors. The Infection Control and Prevention department within this facility conducts audits on the use of disinfection caps on the intensive care unit (ICU), however, there had been no history of audits on this specific microsystem where intravenous lines are heavily used. Due to the increased risk of infections in adult intravenous therapy, it is essential to regularly monitor and measure PIV nursing practices to promote quality care and patient safety. Additionally, it can be used to assess the microsystem and detect problems or issues. Monthly audits or compliance rounds on PIV maintenance practices can help unit leaders identify current practices and opportunities to reinforce evidence-based practices for staff nurses. For example, unit leaders can conduct audits to ensure that disinfection caps be used on all lines, including unused lumens for added protection as recommended by the Infusion Nurses Society (INS, 2022). The use of audits serves a tool to identify common themes found in current PIV maintenance practices as backed by current literature review.

The strengths of this QI project include the reminder cards created to reiterate basic PIV maintenance practices for nurses. These reminder cards included information on the importance of using disinfection caps to prevent adverse clinical outcomes and timelines for changing tubing based on product or medication. These informational cards can be used as a reference guide for

future QI projects to refer to or use within the nursing practice. Management and nursing leadership can use these cards to edit or replicate for other units within the hospital. This QI project highlighted the need for reinforcement of PIV maintenance nursing practices and tackled the barriers leading to lack of proper PIV nursing practices.

Interpretations

Association between interventions and outcomes

As peripheral intravenous catheters have evolved to needleless systems in healthcare settings, these catheters have raised an increased concern for the potential of contamination and infection. Risk factors for infection can include poor adherence to aseptic technique, lack of disinfection cap use on needleless connectors, or inconsistent health care staff education and training (Moureau & Flynn, 2014). Studies have shown that there is approximately a 48-86% reduction in infection when alcohol disinfection caps are used (Moureau & Flynn, 2014). It is critical for healthcare personnel, specifically nurses who work closely with intravenous therapy, to comply with the standards of IV therapy care.

To encourage compliance of proper PIV maintenance practices among nurses, infographics or “reminder cards” were created to reinforce safe nursing practices in peripheral intravenous therapy. The aim of these infographics was to remind staff nurses of the current facility guidelines regarding essential adult PIV therapy maintenance practices. By incorporating user-friendly and visually appealing infographics, the expected goal was for the staff nurses to refer to these daily without having to search through several pages of the original hospital guidelines. Additionally, these infographics would include reminders to use disinfection caps on all lines to reduce potential contaminants from entering those ports of entry.

Along with the reminder cards, the second intervention implemented was the stocking of disinfection caps in each patient rooms. Prior assessment of the microsystem demonstrated that disinfection caps were not easily accessible in-patient rooms and nurses would have to leave in search for them, which is not time efficient. Bags of disinfection caps were placed in each patient rooms to make it easier for staff nurses to comply and cap the ends of their ports. The anticipated goal from this intervention was to observe an increased use of disinfection caps on peripheral lines. An overall increased use of disinfection caps would demonstrate a positive outcome to enhancing patient safety and quality care.

Comparison of results with findings from other publications

The results of this quality improvement project varied from the expected outcome that was found in the literature review. In a Duncan et al. (2017) study, researchers implemented a bundled approach within a trauma I medical center to encourage safe PIV maintenance practices. The bundled approach includes assessing PIV sites, use of disinfection caps, and minimizing intravenous tubing disconnections. Similarly, this study conducted weekly audits to identify common trends including disinfection of ports and use of disinfection caps. This study demonstrated that the use of disinfection caps on peripheral lines can drastically reduce the rate of infections and complications. Grissinger (2011) also found that conducting routine audits or compliance rounds can be a useful tool to assess patterns within a microsystem. Further, nurses should have various opportunities for education and training regarding the latest evidence-based nursing practices. While infographics or reminder cards can be used as an educational tool, it should also be paired with in-person training and staff education.

Impact on people and systems

While other studies correlated the use of disinfection caps to reducing infections (i.e. CLASBIs), this quality improvement project aimed to enhance patient safety and patient outcomes through a broader scope of lenses. The overarching approach was to eliminate potential contaminants or pathogens from entering intravenous lines through adherence to safe maintenance practices. Lack of adherence to standards of care regarding IV therapy can place patients in danger of an infection, resulting in increased length of stay, cost, and patient morbidity and mortality. The impact of disinfection cap use can be associated with a reduction in infections. Improper practices among healthcare workers can vastly impact not only the patients, but the macrosystem itself (i.e. the overutilization of healthcare services).

According to Merrill et al. (2014), the use of disinfection caps within a healthcare system decreased the rate of patient infections by >40%. Increased compliance of disinfection caps among nurses have been shown to reduce infections rates in patient populations. When assessing the macrosystem level, disinfection cap use can save almost \$300,000 per year for hospitals (Merrill et al., 2014). While this quality improvement project did not focus on CLASBIs specifically, it is essential to note the potential impact these infections have on patients and healthcare systems. It was estimated that each patient case associated with CLASBIs can incur \$25,000-\$55,000 per incident. These are the potential opportunity costs that hospital systems would incur if safe practices were not enforced. Infections associated with IV therapy is preventable in all healthcare systems. Healthcare systems and those who work within the systems have the responsibility to uphold safe practices to continuously improve patient outcomes.

Differences between observed and anticipated outcomes

The observed outcomes post-intervention was a minimal increase in use of disinfection caps among peripheral intravenous lines. However, there are several reasons posed that could have interfered with the outcomes of this quality improvement study. Given the time constraints, a longer timeframe was needed to observe if the intervention had created a positive change. Had the post-intervention audits been conducted for longer periods of time, it is possible that there could have been increasing trends developed. A quality improvement study would need to be conducted for a longer period of time (i.e. >6 months or longer) to fully grasp the success of implementation of the infographics.

While these reminder cards can serve as informative materials for the nurses, it is imperative to continue education and training surrounding proper and safe PIV practices. This unit specifically, accounts for various new graduate registered nurses who may not be up to date with the current hospital guidelines regarding PIV therapy maintenance practices. This can be applied to the senior nurses who do not have the flexibility or the time to educate fellow nurses regarding this subject. For this same reason, unit leaders or managers can use the quality improvement project as an opportunity to close the gap in improper PIV nursing practices. It is equally important for nursing leaders to foster an environment where staff nurses can practice and learn the most recent evidence-based research to incorporate within their practice. Another study exploring in depth barriers as to the knowledge surrounding current peripheral intravenous therapy practices would be needed to address the problem.

Given the status of overwhelmed healthcare systems across the United States, nurses are facing staff shortages, stress and burnout crises. This sole factor can play a role in lack of compliance in proper nursing practices or facility guidelines due to tiresome and overworked

individuals. Through observations of this unit, these staff nurses take on multiple roles and responsibilities that leave them with time constraints and inflexibility. Considering the various tasks nurses are asked to complete on a day-to-day basis, they may not have the time to look at reminder cards or secure their peripheral lines in a timely manner. While these are not excusable actions, it is important to address potential barriers that may hinder the overall outcomes of this study.

Costs and Strategic trade-offs

This quality improvement project did not incur any additional costs at the researcher's expense. Resources and materials used for the interventions were provided by the facility. The materials needed for the creation of the reminder cards including paper and lamination services were provided by the unit leaders. Disinfection caps were already available in the supply room on the unit and only a certain number of caps (4) were placed in patient rooms to refrain from unnecessary waste. This project was successful in part that the hospital and management understood the value of this quality improvement project to enhance patient safety and cost savings.

In studies similar to this quality improvement project, researchers have considered the impact of the use of disinfection caps in terms of cost avoidance. Treating patients with infections related to poor intravenous practices can be linked to increased length of stay, higher costs of hospitalization, greater risk of mortality than those patients without peripheral intravenous therapy. One study compares patients with versus without peripheral intravenous complications: inpatient length of stay was 5.9 versus 3.9, mean hospitalization cost was \$10,895 versus \$7,009, and most likely to have died from complications 3.6% versus 0.6-0.9%. (Lim et

al., 2019). The burden of complications associated with peripheral intravenous therapy can be significant when doing a cost-analysis.

Limitations

There were multiple limitations to this quality improvement project that could have affected the results. One of the limitations was the lack of time given to implement the intervention, collect data, and analyze the results post-intervention. Similar studies have included interventions that have been put in place for at least > 6 months to identify if the intervention is the cause of the expected result. With a shortened time period, it is challenging to analyze if the intervention implemented is creating a positive or negative change. In this quality improvement project, weekly audits would need to be conducted for at least a couple months to detect if the reminder cards/infographics have been useful to the nurses. The limited number of audits post-intervention may not be representative of the usefulness in the reminder cards. For future studies, audits along with post-implementation surveys can be incorporated to grasp nurses' viewpoints on the usefulness of the reminder cards and stock of the disinfection caps. Short surveys can gather insight on nurses' insight on what interventions may or may not work within the unit and serves as an opportunity to collaborate as a healthcare team.

The second limitation is that there were conflicting priorities that delayed the implementation phase among the nursing leadership and staff nurses. At the time of the initiation of the QI project, the nursing leadership on this unit were also managing other quality improvement initiatives. To collaborate with the unit leaders, interventions were held until approval was given. It is highly possible that the delay in approval could have been due to these conflicting priorities or the time period in which this project was conducted. These interventions

were implemented during the summer months, where various staff nurses are away including nursing leadership for vacation, time-off, etc. Communication can also pose as a barrier if staff members are away or unable to get in contact promptly. Future projects should include an ample amount of notice prior to the start of any QI project to give enough time for nursing leadership or management to verify or approve. Proper and strategic planning is necessary in organizing a quality improvement to ensure that there are no barriers in collecting and analyzing data.

Implications for practice

This quality improvement project identified gaps in peripheral intravenous line maintenance practices among nurses in a cardiac step-down unit. It is essential for nurses, especially those in critical care settings, to recognize the high risks associated with poor peripheral line maintenance practices from a clinical and financial standpoint. Engaging in proper PIV maintenance practices promote safe, effective, and quality care for all patients. The use of compliance rounds or monthly audits can serve as a helpful tool to analyze current nursing practices within a microsystem and how to best improve these practices. Nursing leadership can also explore other ways to simplify the hospital guidelines in a way that is easier to digest information for staff nurses, especially new graduate nurses. Suggested next steps would be to execute a QI project that implemented these interventions for a longer period of time (i.e. >6 months) to evaluate whether they were effective. Future projects would benefit from exploring nurses' perspectives on proposed interventions in order to encourage compliance. In addition, more projects could be done to explore nurses' knowledge on the latest evidence-based practices on PIV maintenance practices.

Conclusion

While there are various benefits to enhancing peripheral intravenous line maintenance practices in critical care settings, it can be challenging to implement due to the various factors at the microsystem and macrosystem level. Healthcare teams must continue to address these barriers in order to foster an environment that leads with safety and improving quality of care. Hospital management and nursing leadership can play a role in enhancing in educating nurses about the latest evidence-based practices in adult intravenous therapy.

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