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Rethinking Vascular Access in the Emergency Department

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ABSTRACT

Many studies have concluded that implementing a vascular access program in inpatient units can reduce central line rates. However, there are limited studies on the effects of implementing these programs within the emergency department, where efforts to reduce central line rates should begin. This quality improvement project examined the effects of an ultrasound-guided peripheral access program in the emergency department has on inpatient central line rates. An ultrasound-guided peripheral IV access program was implemented at a community hospital with an annual volume of 40,000 patients. Eight Emergency Department (ED) nurse champions were trained in various ultrasound-guided peripheral IV insertions. Central line data were compared for 8 weeks pre- and post-intervention. The study site experienced a 39% reduction in the total number of inpatient central lines inserted during project implementation despite a 12% increase in the average daily hospital census. The project implementation resulted in a 46% reduction in the total number of patient days per central line. The study concluded that implementing an ultrasound-guided peripheral vascular access program in the ED was able to reduce inpatient central line use.

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Background

Non-maleficence is the foundation of all healthcare systems. However, many healthcare organizations continue to unnecessarily utilize central lines that directly place patients at risk for developing Central Line-Associated Bloodstream Infection (CLABSI). CLABSI is a potentially life-threatening complication of Central Venous Catheters (CVC) that occurs in the United States at a prevalence rate of 2.1 CLABSIs per 1,000 central line days [1]. The Joint Commission identifies the reduction of CLABSIs as a national patient safety goal, as CLABSIs are associated with an increased length of hospital stay, increased antibiotic exposure, increased healthcare costs, and increased mortality [1,2]. Ultrasound-guided Peripheral Intravenous (PIV) access programs have proven effective in reducing escalation to central lines [3,4]. Despite the proven effectiveness of these programs, they are not commonly utilized in the Emergency Department (ED) care setting. Evaluation of these programs in the ED setting is important because most patients begin their care in the ED.

The central-line rate of the study site increased by 128% during the two years prior to the implementation of this quality improvement project. The study site's increased central line usage greatly increased the likelihood of CLABSI occurrence [1,4]. This would help explain why the study site experienced more CLABSIs in the two years prior to this study being completed than the prior five years combined.

Ultrasound-guided peripheral IVs have a greater than 90% success rate in patients identified as having Difficult Vascular Access (DIVA) through multiple failed attempts at traditional vascular access insertion [5-8]. The high success rate of ultrasound uses to obtain vascular access provides a strong argument that an ultrasound-guided peripheral IV access program based in the ED can help achieve successful peripheral access at the patients' initial hospital interaction. The focus of this quality improvement project was to decrease the number of central lines inserted by creating a PIV vascular access program in the ED.

The literature search strategy addresses the identified practice problem using the Cumulative Index to Nursing and Allied Health Literature database. The library search included the Boolean phrase "ultrasound guided peripheral intravenous access program" and "vascular access decision tree" and "emergency department" and "central line rate." Limiting the search to scholarly peer-reviewed articles published within the past five years resulted eighty-three journal articles, which is a manageable number to complete the literature synthesis process. The inclusion criteria for the literature review included journal articles discussing ultrasound-guided PIV insertion, implementation of a vascular access program in the emergency department, and vascular access decision trees. The exclusion criteria for the literature review included journal articles only discussing PIV insertion with standard landmark insertion techniques, articles only discussing central lines, and articles discussing the implementation of a vascular access program outside the emergency department.

US Guided PIV: Successful Cannulation

Ultrasound-guided peripheral intravenous access programs have been proven to increase the likelihood of successful cannulation of difficult venous access patients to greater than 90%.5-9 This higher success rate for patients identified as having difficult venous access is significant when compared to less than 40% successful cannulation rate with standard landmark insertion techniques.4-6,9 This increased success rate is due to the practitioner's ability to easily visualize the needle tip and vessel on the ultrasound machine until successful cannulation of the vessel occurs.

US Guided PIV: Longevity of Devices

Ultrasound-guided peripheral intravenous catheters are durable devices that tend to experience superior dwell times compared to intravenous catheters inserted using the standard landmark technique [3-6,10-12]. Device longevity is important when considering intravenous device selection due to the negative cycle of device removal and device reinsertion progressively increasing the risk of further device failure [4,12]. More than 50% of patients receiving a standard peripheral intravenous catheter will require device replacement with more than 70% of those catheters failing within three days [11]. This is drastically higher compared to the research showing that only 10% of patients receiving an ultrasound guided peripheral intravenous device require device replacement [10]. Studies have shown that catheter longevity is directly correlated to the amount of catheter residing inside the vessel, which is more easily achieved through longer intravenous catheters designed for ultrasound guided insertion [8]. More than 87% of patients receiving midline catheters under ultrasound guidance can complete all intended therapies with the same midline catheter [10]. This is significant due to less than 10% of standard peripheral intravenous catheters being able to complete all intended therapies with the same standard peripheral intravenous catheter [11].

Methods

Ethical Statement

The study site is a rapidly growing 149-bed hospital that has nearly always been at its maximum capacity for the past two years. The 27-bed emergency department experiences an average of 40,000 annual patient visits. An Internal Review Board exemption was obtained prior to project implementation. The principal investigator did not identify any conflicts of interest throughout the project implementation.

Design, Setting, and Participants

The purpose of this quality improvement project is to implement an ultrasound-guided PIV access program in the ED to decrease the likelihood of patients requiring insertion of a central line throughout hospitalization. Being proactive with inserting the most appropriate vascular access devices in the emergency department should significantly decrease the need for improved vascular access in hospitalized patients through the insertion of central lines. The primary aim of the project is to decrease the study site's central line usage through the utilization of ultrasound-guided PIV devices, which have proven to be a safer alternative to central lines in patients with DIVA [4].

The aim of the project will be supported by the following objectives: (a) educate nursing staff about the project, (b) provide education on the venous access algorithm, (c) train a team of 8 nurse champions to cover both day and night shift coverage for the ultrasound-guided PIV access program, and (d) audit charts for patients receiving a central line during hospitalization to identify whether the ultrasound-guided PIV access program was consulted in the emergency department based on the venous access algorithm. The project manager was present in the ED daily to provide feedback, support, and additional education to staff, as needed, to assist in achieving the project objectives.

The study site has been utilizing ultrasound-guided PIV catheters for the past year, with great success in obtaining vascular access. However, there has been no standardization of this practice or decision tree created to help guide staff in deciding which form of vascular access is most appropriate for patients identified as having DIVA. The current practice at the study site merely includes a nursing supervisor calling a nurse trained on ultrasound-guided peripheral intravenous access after failing to obtain access through traditional landmark insertion techniques. Standardizing the process in the ED by creating an ultrasound-guided vascular access program and being more proactive with ensuring adequate access has been achieved at the time of admission will be a great benefit to the patients admitted to the study site [4,12]. The nurse champions in the emergency department utilized a venous access decision tree identified in Appendix A to ensure appropriate IV access has been achieved prior to the patient being admitted to the ED [3,4].

The ED staff were educated on the utilization of the venous access decision tree to assist staff in meeting the unique vascular access demands for each patient. ED staff education occurred in the form of projector presentation to ensure staff were knowledgeable in each key aspect of the venous access decision tree where nursing staff were required to decide. Competence was evaluated by nursing staff who were able to successfully complete a verbal teaching back to the project manager and correctly navigate the decision tree on three test patients.

Outcomes that will be evaluated to determine the impact of an ultrasound-guided peripheral IV access program in the emergency department include (a) organization-wide central line usage, (b) referrals to the ultrasound-guided peripheral IV access program, (c) prevalence of ultrasound to achieve vascular access, (d) number of specialty ultrasound-guided peripheral IV catheters inserted, and (e) number of midline catheters inserted [6,8,9]. Data collection occurred through reports generated by the electronic health record over an eight-week period.

Results

Data analysis required the collection of quantitative data produced from quality reports generated by the study site's electronic health record (EHR) comparing (a) pre-intervention and post-intervention central line data throughout the entire organization and (b) pre-intervention and post-intervention ultrasound-guided peripheral IVs placed in the emergency department for a descriptive analysis of ultrasound-guided peripheral IV utilization. All data generated from the EHR reports were exported to Microsoft Excel by the project manager. A statistician from the data analysis department of the study site assisted in the data analysis of this quality improvement project.

The study site experienced 326 referrals to an ultrasound-guided peripheral IV access program. Referrals were made for vascular access evaluation because of previously failed attempts to achieve peripheral IV access through standard landmark insertion techniques. Overall, ultrasound was utilized to achieve vascular access in approximately 6% of emergency department patients throughout the project implementation. A total of 130 midline catheters, 107 guide-wire-assisted peripheral IV catheters, and 89 standard peripheral catheters were inserted with ultrasound

guidance during project implementation. Figure 1 displays eight-week project device insertion data compared to eight-week pre-implementation device insertion data. These devices inserted by the vascular access program helped achieve an impressive 39% reduction in the total number of central lines placed throughout the healthcare organization, despite the average hospital census being 12% higher during project implementation than pre-implementation.

There was one central line inserted every fifty-seven patient days during pre-project implementation data collection compared to one central line inserted every 105 patient days during project implementation. The average hospital capacity was 88% during pre-implementation data collection, compared to 99% average hospital capacity during project implementation. If project implementation had never occurred, an anticipated 90 central line would have been inserted instead of the forty-nine central lines that were inserted during project implementation. The total impact of the quality improvement project was a 46% reduction in the number of central lines inserted per patient-day. Refer to Table 1 for additional metric data that support the positive results of the quality improvement project.

Discussion

Implementing a vascular access program in the ED to ensure that each patient had the most appropriate peripheral vascular access device prior to hospital admission resulted in a significant reduction in the number of central lines inserted throughout the study site. A 39% reduction in the total number of central lines inserted during project implementation despite the hospital having a 12% increase in patient days during project implementation proves the effectiveness of an ED ultrasound-guided PIV access program for central line reduction. The total quality improvement project impact was a 46% reduction in the number of central lines inserted per patient day. This overall result is consistent with other studies that have shown an approximately 50% reduction in central-line usage after implementing an ultrasound-guided PIV access program [12].

Further reductions in the number of central lines inserted throughout the study site could be achieved through further training of nurse champions to expand the ultrasound-guided PIV access program to inpatient medical units. This recommendation comes after completing chart reviews of all central lines inserted throughout the 8 week project implementation, revealing that 26 central lines were still inserted despite the patient not being on a therapy identified as requiring a central line by the study site: (a) prolonged vasoactive medication administration, (b) total parenteral nutrition administration, (c) central venous pressure monitoring, (d) hypothermia protocol, and (e) any other therapy for which the study site required a central line. Completing chart reviews of these 26 patients confirmed that all 26 patients were admitted with appropriate vascular access based on the vascular access decision tree. These potentially avoidable central lines were inserted primarily due to the inpatient medical units' inability to regain peripheral IV access or requiring better access due to a decline in patient condition after admission to the hospital. Access to an ultrasound-guided vascular access program in the inpatient units could have reduced the vast majority of these 26 central lines [12].

The creation of ultrasound-guided peripheral IV access has several positive implications for nursing practice, in addition to improved patient outcomes. An ultrasound-guided peripheral IV access program improved the efficiency of nursing staff by eliminating the need for numerous failed attempts to achieve IV access in emergency department patients [4-9]. Feedback from the nurse champions supports the finding that patients are highly satisfied with the process of receiving an ultrasound-guided peripheral IV [3,10]. Creating an ultrasound-guided peripheral IV access program additionally helps empower bedside nurses to make decisions regarding patient care.

Positive feedback from each nurse champion, patients referred to the ultrasound-guided peripheral IV access program, and key stakeholders will aid in enhancing the sustainability of the program in the emergency department. Plans for sustainability include additional training of nurse champions, incorporating ultrasound-guided peripheral IV insertion into the study site's nursing residency program, and continuing to work with the study site's information system and billing department to fine-tune the requirements for full reimbursement from all CPT codes billable by the ultrasound-guided peripheral IV access programs (a) 36410, (b) 76937.

Limitations

This study has a notable limitation. This study was conducted at an acute care hospital in Illinois, which utilizes only peripheral vascular access devices and midline catheters manufactured by BD. Therefore, the results of this study may not be generalizable to other healthcare organizations that use different models or brands of vascular access devices and midline catheters.

Conclusion

Creating an ultrasound-guided peripheral IV access program in the emergency department has proven safe and feasible.8 Successfully development of an ultrasound-guided peripheral IV access program at the study site was an effective solution to reduce the number of central lines inserted throughout the entire organization. There was a 39% reduction in the total number of central lines inserted at the practicum site during project implementation, despite the practicum site experiencing a 112% increase in the daily hospital census during project implementation. Overall, the study site experienced a 46% reduction in the number of central lines inserted per patient-day during project implementation, which is consistent with the results of other projects [12].

This project supports the development of ultrasound-guided peripheral IV access programs at other healthcare organizations to decrease unnecessary central-line usage. The Joint Commission continues to identify the reduction of CLABSIs as a national patient safety goal because CLABSIs are associated with decreased quality of care, as evidenced by increased length of stay, antibiotic exposure, healthcare costs, and mortality.1,2 Decreasing unnecessary central line usage is an important task for nursing leadership because CLABSI prevalence is directly related to central line days [1,4].

Disclosures

The author has no conflicts of interest to declare throughout this study. Neither the author nor any member of the study site was affiliated with BD. No honorarium or financial exchange occurred

Table 1: Measurable Hospital Data Supporting Project Results

Reported Data	Pre-Implementation	Post-Implementation
Average Daily ED Visits	101	111
Average Daily ED Admissions	27	27
Average Daily Hospital Capacity	88%	99%
Total ED Visits	5,636	6,222
Total ED Admissions	1,520	1,509
Total Patient Days for all Admitted Patients	4,570	5,162
Total Patient Days Per Central Line Insertion	57	105

Note. This table was compiled by data collected through EMR generated reports through D2 Analytic

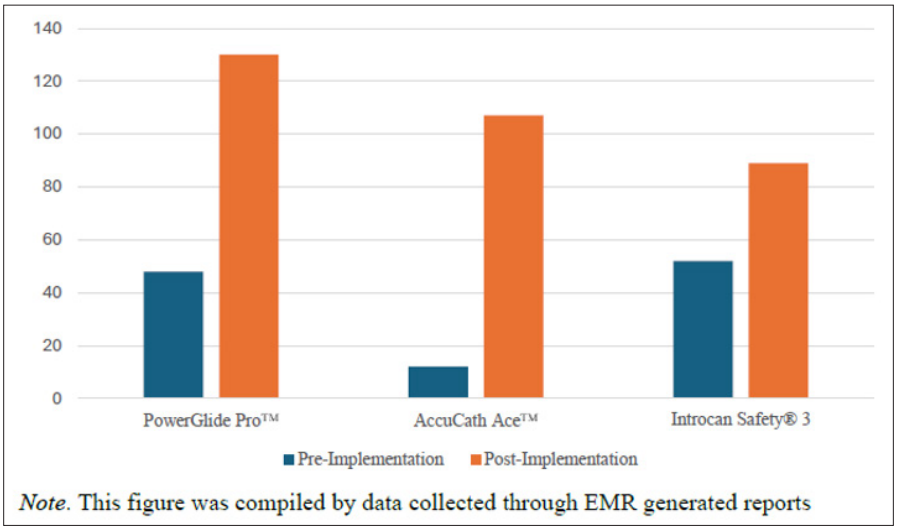


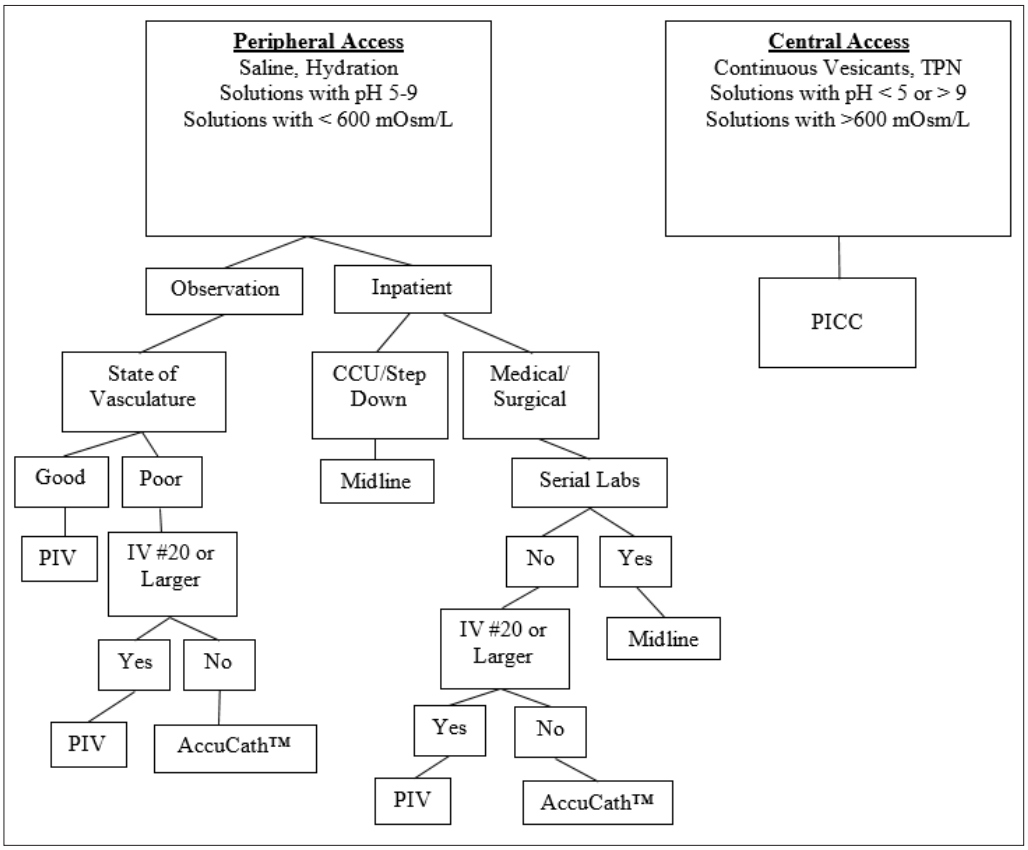
Figure 1: Device selection by Vascular Access Program. PowerGlide ProTM, AccuCath AceTM, and Introcan Safety® 3 insertion data compared during eight-week project implementation and eight-week pre-implementation.

Appendix A
Plan for Educational Offering

Objectives	Content (Topics)	Teaching Methods	Timeframe	Evaluation Method
Nurse will correctly identify medication pH and mOsm/L in EMR.	How to identify medications with pH and mOsm/L requiring central access in the EMR.	Projector presentation to review test patient charts to educate staff about new icon in EMR alerting medication may require central venous access.	15 minutes	Verbal teach back method.
Nurse will correctly identify admission status and admission unit.	How to identify admission status and admission unit from admitting provider's orders.	Projector presentation to review test patient charts to educate staff how to identify admitting information.	15 minutes	Verbal teach back method.
Nurse will correctly assess state of vasculature.	Nurse will understand the ED criteria for good/poor vasculature	Discussion regarding the differences between good/poor vasculature.	5 minutes	Verbal teach back method.
Nurse will correctly identify frequency of laboratory orders.	How to understand admitting provider's laboratory orders.	Projector presentation to review test patient charts to educate staff how to find admitting lab orders.	10 minutes	Verbal teach back method.

Appendix B

Emergency Department Vascular Access Decision Tree



between BD and the author.

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