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Project #45: Unit-based Training Program for Ultrasound-Guided Peripheral Intravenous Catheter Insertion

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Abstract

Introduction: Peripheral intravenous catheters (PIVs) are routinely utilized for infusions of medications and/or fluids in the healthcare setting. PIVs vary in length, gauge (catheter diameter), and other properties such as radiopaque guidewires, flexible guidewires, etc. The placement site, catheter length, and diameter is selected by the healthcare personnel inserting the PIV. The healthcare personnel inserting PIVs varies across institutions, but registered nurses insert most PIVs in the hospital setting. Ultrasound machines and vein illuminators are devices that can assist with PIV placement in patients that are identified as having difficult vascular access. The use of the ultrasound machine requires special training and competence for successful PIV placement.

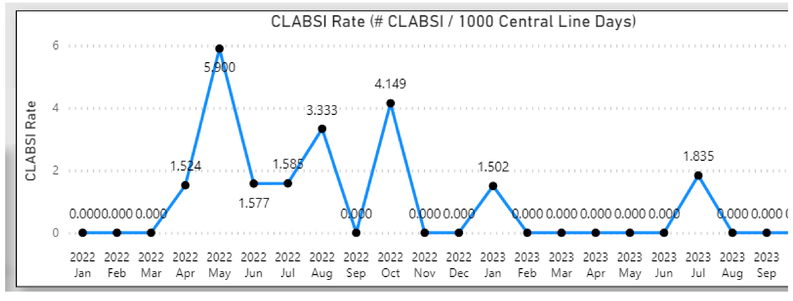
In the Cardiovascular Intensive Care Unit (CVICU) at Henry Ford Hospital (HFH) in Detroit, many nurses utilized an ultrasound machine to insert PIVs for patients with difficult vascular access. The nurses inserted 1-inch and 1.88-inch standard PIV catheters. All, but one of the nurses, had no previous ultrasound training. Since there is currently no Henry Ford policy requiring a nurse to have ultrasound training to insert PIVs, this had been the standard practice. This practice placed patients at risk for complications, decreased PIV dwell time, increased PIV cannulation attempts, and increased number of PIVs. Complications include PIV infiltrations, extravasation, and infection. In addition to lack of training, lack of appropriate supplies was identified. The PIVs available for insertion were 1-inch and 1.88-inch catheters. These PIVs were utilized to access deep brachial veins, however in most patients, a longer catheter is required to access deep brachial veins to achieve appropriate vessel purchase. To achieve appropriate vessel purchase and reduce risk of dislodgement, at least half of the catheter must be situated within the actual vessel.

Methods: Nine nurses were selected to participate in the ultrasound-training program in the CVICU. Training included an online module and hands-on training with a BD clinical specialist. The nurses were trained to place the BD Accucath, a 2.25 inch, 20-gauge PIV, with a coiled tip guidewire. Training was completed within two weeks.
In addition to training a group of nurses, education was provided to the unit staff and medical teams. Education included rationale for training, new type of PIV, and appropriate patient selection for ultrasound PIV placement. Approximately one month after program initiation, a difficult access algorithm was introduced to assist in decisions for vascular access in patients identified as difficult peripheral access.

Results: Implementing the ultrasound training program increased the ultrasound-guided PIV dwell time from 3.47 days to 7.19 days, representing a 107.2% increase in dwell time. Additionally, there were no documented extravasations from ultrasound-guided PIVs in the 3 months following initiation of the training program.

Conclusions: Appropriate catheter selection and ultrasound training to ensure competence, increases patient safety and dwell time of PIV catheters. Additional data is needed to determine secondary outcomes, such as decreased PIV cannulation attempts, decreased number of PIVs per patient, decreased costs, and decreased midline, PICC, and central line utilization rate. A decreased central line utilization rate will potentially decrease central-line associated bloodstream infections (CLABSIs).

CLABSI Rate



	2022	2023
CLABSI count	12	2
CLABSI rate	1.561	0.371

P5 CLABSI rate decreased from 1.561 in 2022 to 0.371 from January 2023 to September 2023, representing a 76.2%.

PIV Dwell Time in Days

ALL PATIENTS		
Mean	3.77	days
ULTRASOUND-GUIDED PIVs		
Mean	3.47	Days
PIVs		
Mean	5.64	Days

Table 1. Mean dwell time for August 2022 to January 2023

ALL PATIENTS		
Mean	5.10	Days
ULTRASOUND-GUIDED PIVs		
Mean	7.19	Days
PIVs		
Mean	4.28	Days

Table 2. Mean dwell time for June 2023 to August 2023

Ultrasound-guided dwell time increased from 3.47 to 7.19 days, representing an 107.2% increase in dwell time in the three months after program implementation.

Difficult Peripheral Access Algorithm

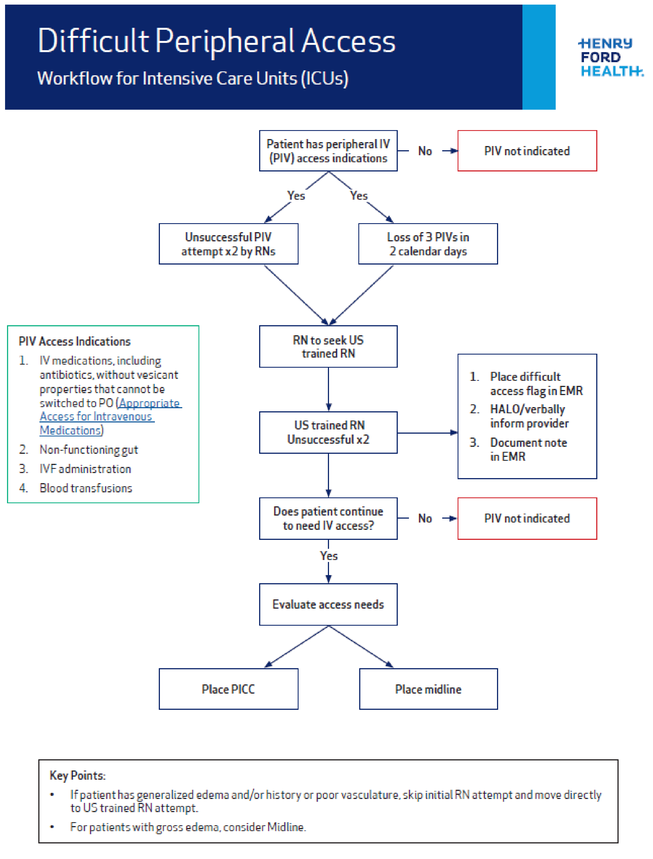


Figure 1. Difficult Peripheral Access Algorithm.

Accucath Peripheral Intravenous Catheter

Figure 2. Accucath. Coiled tip guidewire designed to navigate tortuous vessel anatomy and minimize the need for needle advancement

The Accucath is 2.25 inches in length and can access veins that are deep to the skin surface while ensuring enough of the catheter is in the vessel to reduce the risk of dislodgement. Ideally, at least half of the catheter will be within the vessel itself, while the remainder is within the subcutaneous layer

Future Implications

This program demonstrates that ultrasound training, with the use of the appropriate catheter, can increase PIV dwell time and decrease CLABSIs secondary to decreased central line utilization. These findings establish the need for PIV catheter selection and competent skills for ultrasound-guided PIV placement.

Additional data is required to determine PIV cannulation attempts, number of PIVs per patient, potential cost reduction, and decreased midline and PICC utilization rates.

It is estimated that each PIV attempt costs $32. Decreased cannulation attempts, number of PIVs per patient, and decreased midline and PICC utilization rates can result in significant cost savings. Further data analysis required for an estimated cost savings of this program.

References

1. Hoskins, M.J., Nolan, B.C., Evans, K.L., & Phillips, B. (2023). Educating health professionals in ultrasound guided peripheral intravenous cannulation: A systematic review of teaching methods, competence assessment, and patient outcomes. *Medicine*, 102(16), doi: 10.1097/MD.0000000000033624.
2. Idemoto, B.K., Rowbottom, J.R., Reynolds, J D., & Hickman, R.L. (2014). The AccuCath intravenous catheter system with retractable coiled tip guidewire and conventional peripheral intravenous catheters: A prospective, randomized, controlled comparison. *JAVA*, 19(2), 94-102.