

Ultrasound Guided Peripheral Intravenous Catheter Insertion Education

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Background

Peripheral intravenous catheter (PIV) insertion is a common and essential procedure performed by healthcare providers across various clinical settings. However, despite its routine nature, PIV insertion can be challenging in patients with difficult intravenous access (DIVA). Difficult PIV insertions can lead to multiple attempts, patient discomfort, delayed treatment initiation, and an increased risk of complications such as infection. The use of ultrasound guidance for PIV insertion has been shown to mitigate these challenges and improve care for patients with DIVA.

Purpose

The purpose of this evidence-based practice (EBP) project was to educate Same-Day-Surgery nurses (SDS RNs) and Registered Nurse Student Anesthetists (RNSAs) at the University of Cincinnati Medical Center (UCMC) in ultrasound guidance for PIV insertions, thus improving outcomes and decreasing complications in patients with DIVA.



Literature Review

Definition of difficult intravenous access (DIVA):

- Two or more failed attempts at PIV access using traditional techniques
- No visible or palpable veins
- Stated or documented history of DIVA

Ultrasound guidance vs traditional landmark or palpation approach:

- In patients with DIVA, ultrasound is superior
- Ultrasound decreases pain, anxiety, and the use of central venous catheters

Transverse vs longitudinal:

- The transverse approach is regarded as superior for learning

Vein selection:

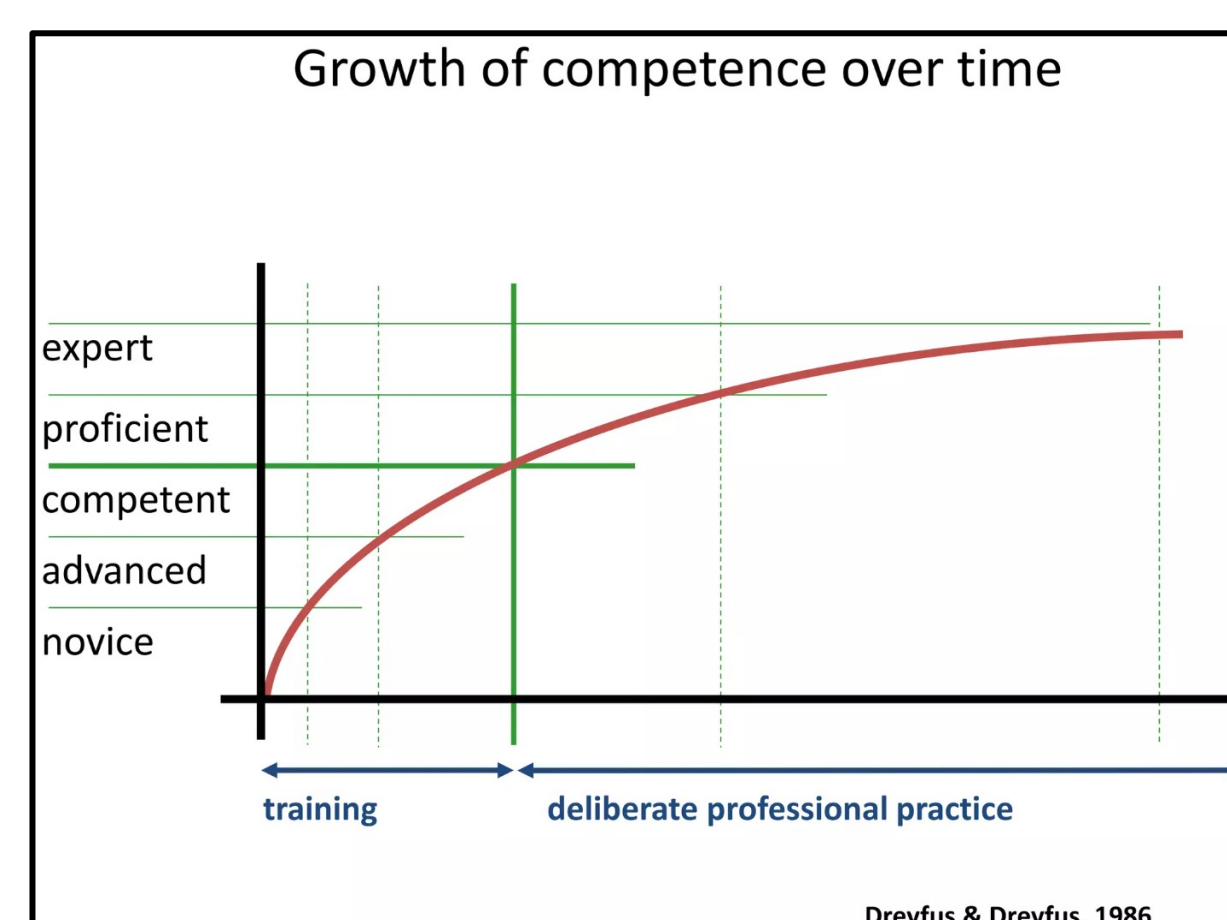
- Veins in the forearm and antecubital region have the longest survivability
- Veins in the upper arm have the worst survivability
- Veins between 0.3cm and 1.5cm in depth have a higher chance of success
- Veins with diameter > 0.4cm have a higher chance of success

Teaching methods:

- Benner's Novice to Expert Theory as a framework
- Utilize Plan-Do-Study-Act cycles as part of the Institute of Healthcare Improvement's Model of Improvement
- Mixed pedagogic modality
- Didactic teaching followed by hands-on simulation
- Competence should be obtained on the simulation model before progressing to patients

Evaluating competence:

- 10 successful ultrasound-guided PIV insertions for competence
- 40 for proficiency



Evaluation Tools

Ultrasound IV Education Pre / Post Confidence Assessment					
ID #	Date: _____				
On the Likert scale below, please rate your level of confidence (1 being No Confidence and 5 being High Confidence) in your knowledge and ability to use ultrasound guidance for peripheral IV insertion.					
	No Confidence	Little Confidence	Some Confidence	Confident	High Confidence
1. Collecting the appropriate equipment.	1	2	3	4	5
2. Manipulating the Ultrasound machine settings.	1	2	3	4	5
3. Differentiating between an artery and a vein.	1	2	3	4	5
4. Manipulating the ultrasound probe.	1	2	3	4	5
5. Cannulating a peripheral vein.	1	2	3	4	5
6. Comfort utilizing ultrasound for PIV access.	1	2	3	4	5

Ultrasound IV Education Pre / Post-Test Questions					
ID #	Date: _____				
1. Which ultrasound mode provides real-time dynamic imaging and is often used during vascular access procedures?	a) B-mode	b) D-mode	c) M-mode	d) Color Doppler	
2. Which of the following vessels can be compressed completely when pressure is applied to the arm with the ultrasound probe?	a) Veins	b) The radial artery	c) The brachial artery	d) All of the above	e) A & B only
3. Which of the following are methods to help find your needle? (select all that apply):	a) The bounce test	b) Magnetic transducing	c) Using the Center Line function	d) Using the Needle Finder App	e) Seldinger technique
4. A regular or short IV catheter (1.16 inch) catheter may be used for superficial veins located 0.5cm and above.	a) True	b) False			
5. Match the structure with the color it will appear on the ultrasound screen:	B. Black	_____	The tip of the needle		
	G. Gray	_____	The shaft of the needle		
	W. White	_____	Arteries		
	R. Red	_____	Veins		
6. Once the needle tip is discovered under ultrasound guidance, which is advanced next proximal to the patient?	a) The ultrasound probe	b) The IV catheter / needle	c) Both at the same time		

- Knowledge tests and confidence assessments were developed from examples found in the literature review and administered to learners via paper copies
- Confidence Evaluation (Left)
 - 6-question Likert scale assessment
 - 30-point scale: 1 - No confidence; 5 - High confidence
- Knowledge Evaluation (Below)
 - A 12-question test

7. Which vein is considered the primary target for ultrasound-guided PIV insertion?	a) brachiocephalic vein	b) radial vein	c) brachial vein	d) cephalic vein	e) basilic vein	
8. Rank the expected length of IV catheter longevity with the corresponding depth of the vein being cannulated (1 being the longest surviving and 3 being the shortest surviving).	_____	Shallow veins (less than 0.4cm)	_____	Intermediate veins (0.41cm to 1.2cm)	_____	Deep veins (greater than 1.2cm)
9. Which of the following IV insertion sites is correlated with catheter longevity?	a) Forearm	b) Antecubital	c) Upper arm	d) A & B only	e) A & C only	
10. Which type of ultrasound probe provides higher frequency and is ideal for superficial vein visualization during peripheral IV insertion?	a) Phased array probe	b) Longitudinal probe	c) Linear probe	d) Convex probe	e) Curvilinear probe	
11. The transverse approach for IV insertion using ultrasound guidance utilizes (select all that apply):	a) an in-plane view	b) an out-of-plane view	c) a short-axis view	d) a long-axis view	e) a longitudinal view	
12. What is the purpose of applying ultrasound gel to the patient's skin during an intravenous IV insertion? (select all that apply):	a) Protect the ultrasound probe during insertion.	b) Create a medium that minimizes acoustic impedance.	c) Allow the ultrasound probe to glide along the patient's skin.	d) Minimize the risk of infection from the ultrasound machine.		



Methods & Implementation



Target Populations (IRB approval obtained):

- Same-Day-Surgery RNs
- Second-year Registered Nurse Student Anesthetists
- Third-year Registered Nurse Student Anesthetists

Pretest:

- Baseline knowledge and confidence scores were obtained before the education and simulation intervention

Education:

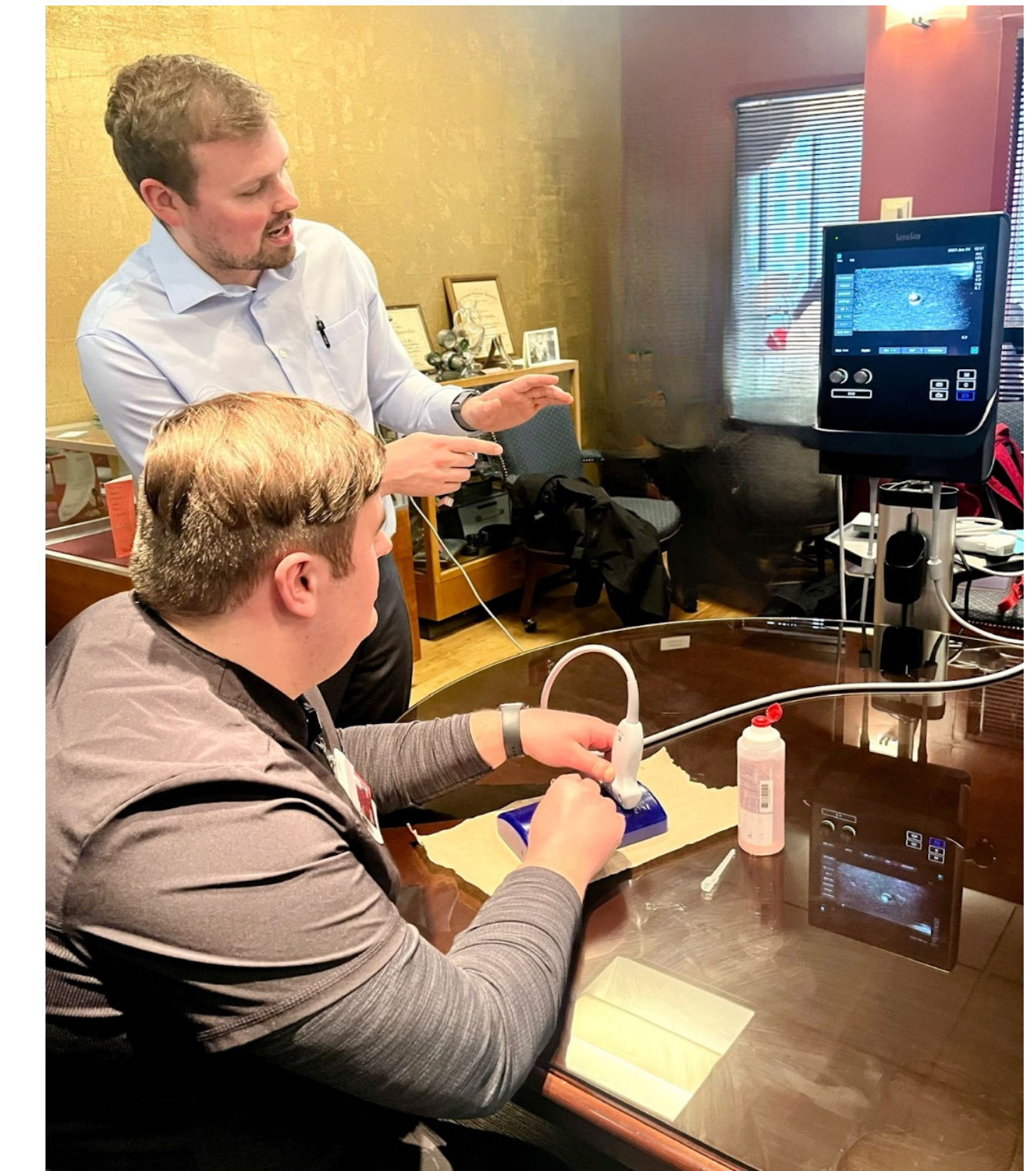
- 20-minute PowerPoint presentation
 - Instructional videos

Simulation:

- Hands-on practice using Blue Phantom gel models
- Real-time feedback from instructors

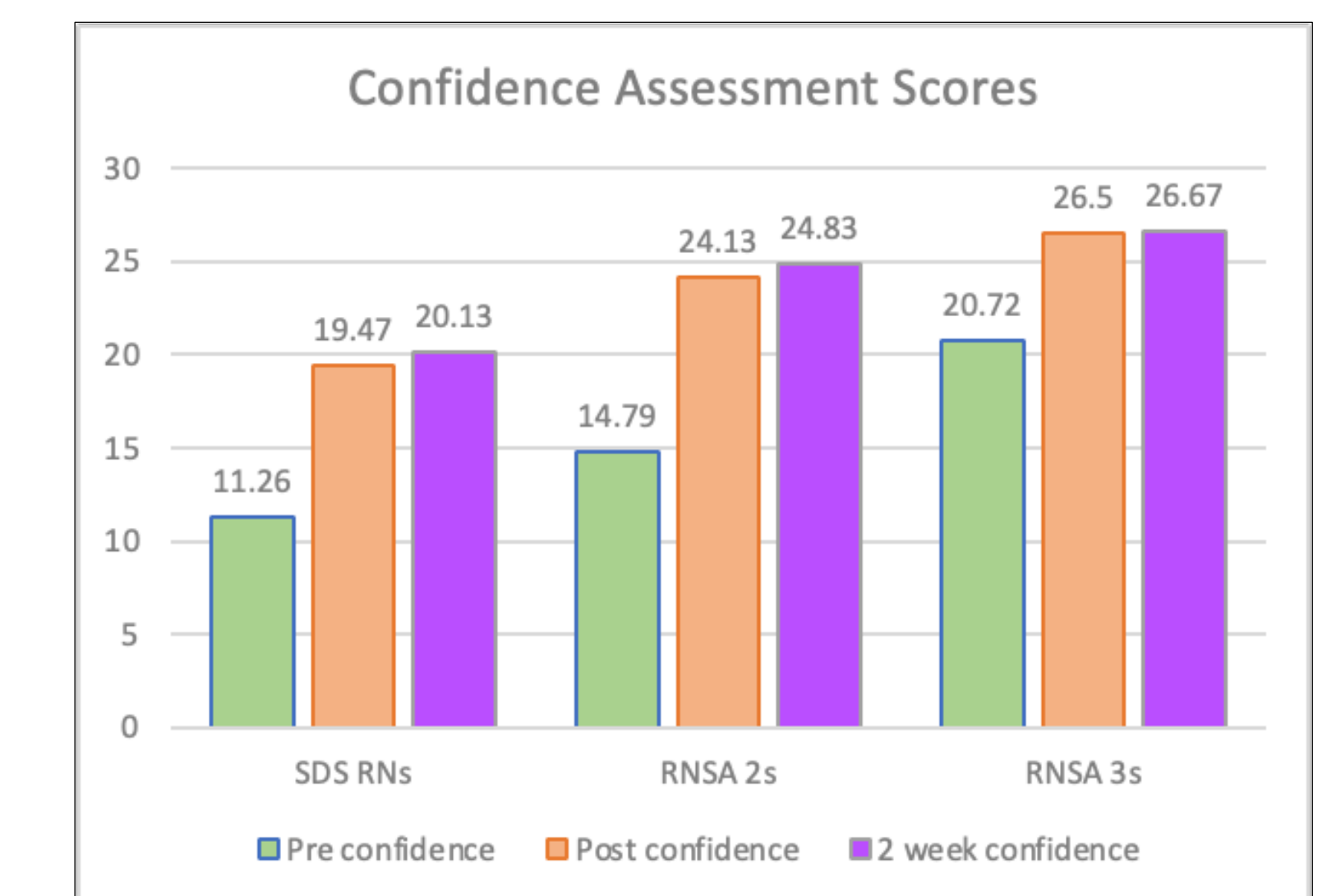
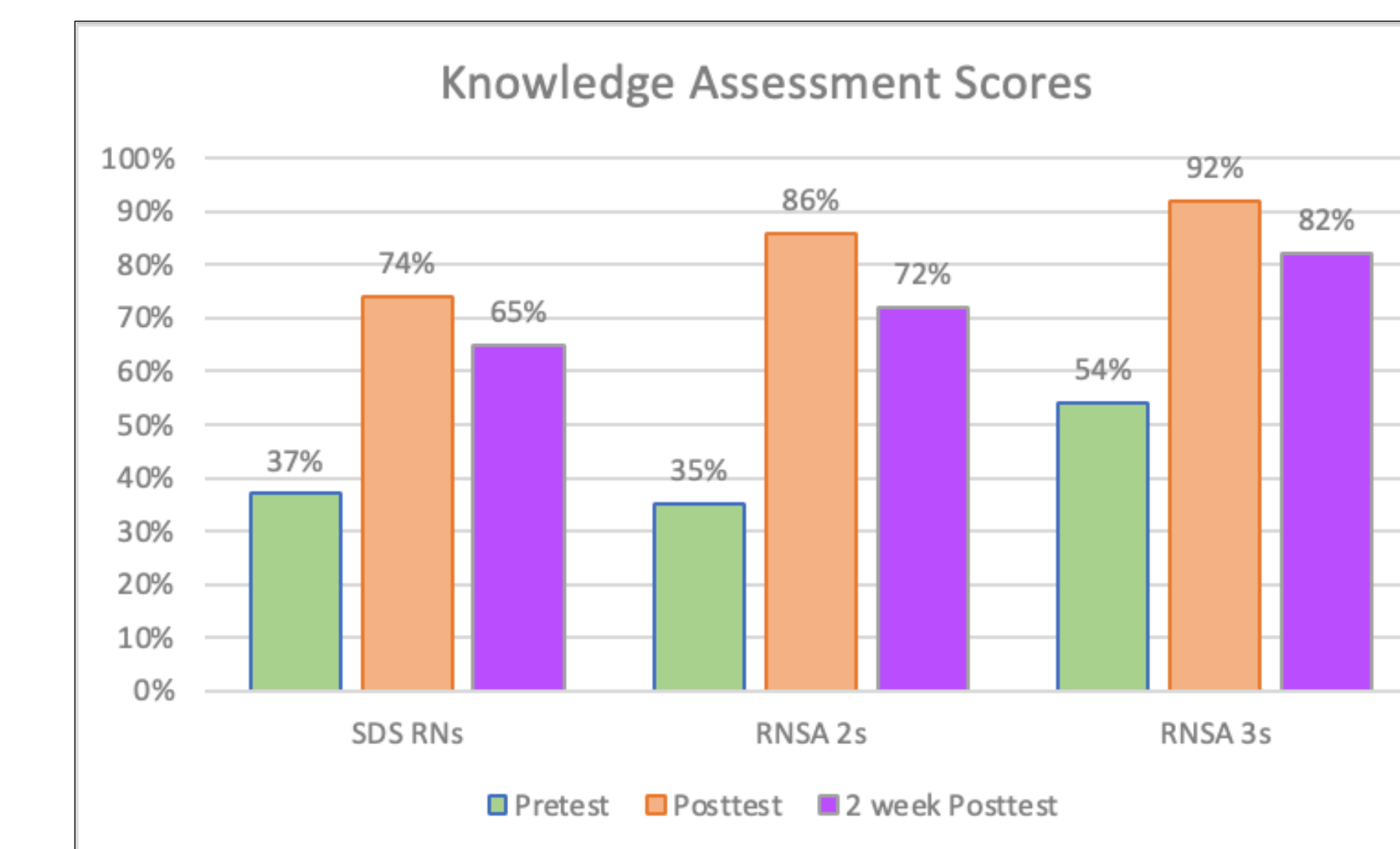
Posttest:

- Knowledge and confidence scores were evaluated immediately after the intervention
- Repeated 2 weeks later



Results & Discussion

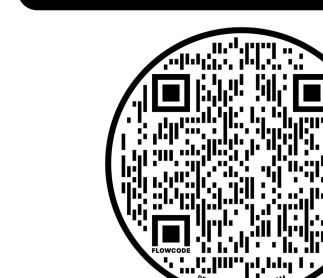
- 66 total participants: 19 SDS RNs, 29 RNSA 2s, 18 RNSA 3s
- Paired t-tests were used to evaluate the scores before and after the education and simulation intervention
- Across all 3 cohorts, there was a statistically significant ($p < 0.01$) increase in knowledge and confidence following the education and simulation
 - Knowledge scores decreased slightly in the 2-week posttest; while confidence scores continued to increase
 - Statistical significance was observed from both the pretest to the immediate posttest and the pretest to the 2-week posttest



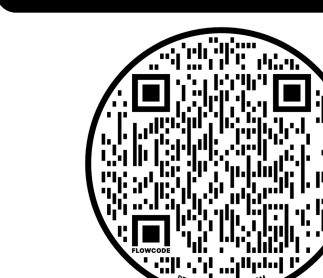
The results from our EBP project demonstrate that education and simulation can increase learners' knowledge and confidence in performing ultrasound-guided PIV insertions. Although learners' knowledge decreased from the immediate posttest to the 2-week posttest, the overall increase in knowledge retained was statistically significant ($p < 0.01$). Furthermore, across all the cohorts, confidence continued to increase in the immediate and 2-week posttests. In conclusion, having more SDS RNs and RNSAs at UCMC with the ability to utilize ultrasound for PIV insertions will improve care for patients with DIVA. However, further study is needed to analyze the direct impact of ultrasound-guided PIV insertion education to patients with DIVA at UCMC.

References, Contacts, & Video

References



Contacts



Video

