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Intravenous Catheterization – More Than a Poke in the Arm

Summary:

Reviewing training equipment and population served:

1. Current equipment presentations: what is the range of variable presentations, and does it relate to the population your students will face in clinical settings?
2. Can you scale the complexity and make the case of the variance based on common medical diagnosis and patient history profiles?
3. How do you train failure and can your force the student or practitioner to react to it?

Most Intravenous Catheterization (IC) or venous access training starts an instructor turns to an IV training arm as the go-to build around. The question is the underlying design philosophy, does it address the clinical challenges that a practitioner is facing beyond just basic mechanical skills like the orientation of the needle's bevel prior to insertion?

When we start looking at the research in IC insertion there are things that come up frequently that impact insertion failure.:

> *"Peripheral intravenous catheter (PIVC) insertion is the most common invasive clinical procedure for adult hospital patients. More than 50% of all hospitalized patients receive a PIVC to administer fluids and parenteral medications.*
>
> *Despite their ubiquity, PIVC insertion can be challenging, even for experienced practitioners. Across all hospital settings, between 35% and 40% of first-attempt PIVC insertions fail, resulting in repeated painful insertion attempts and significant treatment delays …….Approximately, 30% of adults who receive a PIVC experience difficult intravenous access (DIVA), typically defined as two or more failed insertion attempts."* [1]

What influences impact the failure rate?

First Time Insertion Success (FTIS) is influenced by patient and clinician factors. Patient characteristics reported in the literature which compromise FTIS include:

> *"Few visible and or palpable veins; diabetes or cancer diagnoses and emaciated and obese weight. Specific to the ED, Sebbane et al proposed extremes of body mass index (BMI) and absence of vein visibility and palpability to be independently associated with insertion difficulty. In contrast, Fields et al reported medical conditions such as diabetes, intravenous drug abuse and sickle cell disease to be significantly associated with repeat attempts."* [2]
>
> *"This rate (Insertion failure) is likely to increase in coming years with growing chronic disease and morbidity burden in the community…….generally includes few or limited visible and/or palpable suitable veins, since these are the main criteria traditionally used to guide insertion using the "landmark" technique.*
>
> *Landmark PIVC insertion technique is typically used for PIVC insertion. However, the technique has limitations. It does not allow for the comprehensive assessment of vein caliber, depth, valve location, or tortuosity before device insertion, further tip position within vessel is unable to be confirmed (rather than the tissue) post-procedure."* [3]

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Taking a step back and looking at the training arms, we can start seeing the need to ask about some key functions that need to be addressed:

Patient driven dynamics, such as male, female, age and how they impact visual cues, the feel of the vein and skin. Do we know the population we are going to serve and the diagnosis and histories that will impact how we are able to do insertions? Can we replicate the variability in our training?

Providing an overly simplified presentation to the student to build confidence but it will not prepare them for the patients they have to work with.

In modeling the training, looking at presenting several variations of presentations that include different levels of visual cues, depth of veins and movement to provide a progressive level of challenge to the student to develop not only a skill but critical thinking on evaluating the patient prior to the insertion, determine a strategy and know the limits of insertion capability.

In clinical settings we set limits on the number of sticks, are we engaging that during the training to train best practices and patient safety. As outlined in the research failure is common, what is the handoff for managing the failed insertion? How do we train for it?

Are we setting up the student to have to practice on patients or preparing them to think critically.

Example:

A model of this training strategy is the Training Bridge Adult IV family arms. They provide three core presentations to present different levels of clinical presentations along a common family design. Available in three skin tones, the mechanical attributes differ in three models: Male, Female and Geriatric.

Adult Male

- Visual cues in hand and arm are aligned with veins.
- Veins sit higher to reflect a thinner body fat layer
- Skill level easy to moderate

Adult Female

- Few visual cues than male arm
- Width of hand smaller than male
- Veins sit deeper to reflect deeper body fat layer
- Skill level moderate to hard

Geriatric

- Visual cues on hand aligned with veins
- Vein channels allow some float in the veins to reflect roll.
- Skill Level Moderate to Hard

The varied levels of complexity reflect not reflect common category difference but can be selected to reflect challenges for specific diagnosis in a population being worked with. The use of different levels of complexity will also foster the development of planning to approach not just focusing on procedure.

References:

1. Review article: Peripheral intravenous catheter insertion in adult patients with difficult intravenous access: A systematic review of assessment instruments, clinical practice guidelines and escalation pathways, Rebecca S PATERSON et al, Emergency Medicine Australasia (2022) 34, 862–870

2. Factors associated with peripheral intravenous cannula on first-time insertion success in the emergency department. A multicentre prospective cohort analysis of patient, clinician and product characteristic, Carr PJ, et al. BMJ Open 2019;9:e022278. doi:10.1136/bmjopen-2018-022278

3. Improving difficult peripheral intravenous access requires thought, training and technology (DART[3]): a stepped-wedge, cluster randomised controlled trial protocol, Schults et al. BMC Health Services Research (2023) 23:587