Abstract

Variation impacts control over performance and patient outcomes. Systematic application of best known generalizable knowledge at the bedside can reduce unnecessary variation.

This poster case study seeks to demonstrate that improved device utilization outcomes are achievable with application of an evidence based framework for vascular access practice.

Application of a framework for vascular access practice includes five key concepts: Purpose, Device, Location, Technique, and Mitigator. Consideration of these 5 elements of practice will lead to the most ideal procedure to reduce risk related to vascular access. A clinical case is described that illustrates the application of this framework.

A pre and post intervention methodology will demonstrate the value of systematic application of this evidence based framework. The pre and post metrics feature a novel value metric called: Device Optimization Ratio (DOR). DOR reflects decisions in vascular access by measuring device utilization for context specific patient populations. It is a way to show the value of knowledge driven vascular access decision making.

Pre-intervention metrics: 3 Devices in 2 days = DOR of 1.5, 9 attempts at access, 2 missed IV Antibiotic doses by >3hours. The Post-intervention metrics: 1 Device in 4 days = DOR of 0.25, 1 attempt at access, 0 missed doses, 0 phlebotomy attempts.

Consistent application of evidence reduces variation in care and can be measured in terms of clinical performance outcomes, specifically device utilization. In addition, there can be satisfaction and cost implications to this approach. An evidence based conceptual framework for practice is a useful tool to drive performance and value in vascular access. The metric of Device Optimization Ratio may be a simple, convenient way to measure the efficiency and effectiveness of vascular access practice for patients staying more than 3 days in the inpatient setting and or context specific sup-populations.

References
Abstract

Variation impacts control over performance and patient outcomes. Systematic application of best known generalizable knowledge at the bedside can reduce unnecessary variation.

This poster case study seeks to demonstrate that improved device utilization outcomes (DOR) are achievable with application of an evidence based framework for vascular access practice.

Application of a framework for vascular access practice developed by the author includes five key concepts: Purpose, Device, Location, Technique, and Mitigator. Consideration of these 5 elements of practice will lead to the most ideal procedure to reduce risk related to vascular access. A clinical case is described that illustrates the application of this framework.

Case Study and Images

A morbidly obese 52 year old female admitted to the hospital for abdominal cellulitis. She entered the system through the ED and was started on Aztreonam IV, 2grams q8 hours. Initial IV access from the ED (Day 1), but placed by an IV nurse, was a 22g in the left AC vein, this took two attempts. On Day 2 but only 8 hours later the PIV failed, it could not be restarted at 0300, an IV nurse took 3 attempts to restart at about 0600. The ABX were delayed by over 3 hours, the device failed again on Day 2 leading to 4 more attempts at failed access...

The Framework of Evidence

Application of evidence in vascular access should start with understanding the **Purpose (treatment plan and diagnosis)** for device need. Once Purpose is determined this directs the choice for the best type of **Device** for the prescribed treatment plan. The device naturally drives **Location** selection and **Technique** for insertion. A patient assessment of history, comorbidities, and preferences helps to determine any **Mitigating** factors that may prevent a device, location or technique from being utilized, e.g. a CKD patient may prevent a PICC or Midline from being used in the arm, in contrast to a patient without CKD. A mitigator could also be device or technology available to use, or even clinical license, skill, and staffing levels.

Click headings to further view content

Framework Figure Explained

**Method**

**Purpose**

**Device**

**Location**

**Mitigator**

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Case Study

A morbidly obese 52 year old female admitted to the hospital for abdominal cellulitis. She entered the system through the ED and was started on Aztreonam IV, 2grams q8 hours. Initial IV access from the ED (Day 1), but placed by an IV nurse, was a 22g in the left AC vein, this took two attempts. On Day 2, but only 8 hours later the PIV failed at 0300, but could not be restarted at 0300 due to routine staffing patterns of the IV specialists. The IV nurse staffing at night drops to one RN, who leaves the facility by 0130, no expert help is available again until 0530 during the week and 0700 on weekends. An IV nurse took 3 attempts to restart just after 0600. The antibiotics were delayed by over 3 hours, the device failed again on Day 2 leading to 4 more attempts at failed access that day buy two more IV nurses. By the evening of Day 2, the patient had 3 devices and at least 9 attempts at IV access (in just over 24 hours), but also lab attempts for phlebotomy and two doses of missed IV antibiotics by more than 3 hours.

The patient needed IV antibiotics for a severe cellulitis, but had also received two doses of calcium gluconate and intermittent IV morphine for pain. She was known to have difficult IV access. The Framework Tool intervention took place the night of Day 2. It was realized after a review of Purpose and initial assessment that the Device could be peripheral but ultrasound Technique was needed. The veins of the forearm were too deep for ultrasound guided PIV catheters less than 2 inches (5cm) in length. The unique anatomy of the upper arm lead to an upper forearm Location for the procedure. A midline was chosen given available resources and patient need. The Infusion Nurses Society standards state the Midline tip should be in the proximal upper arm veins near the axilla (2011). Given proximal tip location desirability, a 20cm 3fr silicone Midline was placed below the AC space. Ultrasound was used with a Modified Seldinger Technique (MST). The line was placed with one attempt in a near 2cm deep median cubital vein. The midline was placed at an angle corresponding with the vein path to avoid kinking and concerns with dressing integrity. The patient was very satisfied with the procedure, and the 3fr, 20cm silicone midline was the last device used for the next 4 days for all infusions and for blood sampling. It was removed upon discharge without complication.
Framework Tool

Purpose.
The driving element of the framework is the purpose for vascular access. Studies by Barton et al. (1998), Santolucito (2001), Anderson (2004) focus on diagnosis and treatment plan to determine the purpose of access. Purpose of access should lead a clinician to consider the other components of the framework (Barton et al., 1998; Moureau et al., 2012). Purpose leads to type of device, i.e. central or peripheral (INS, 2011; Moureau et al., 2012).

Device and Method.
Device type influences both location and method of insertion. Peripheral devices are often inserted in superficial vessels of upper extremities, whereas central device can be inserted from deep or superficial veins of the upper arm, neck, chest or groin. Ultrasound is the best method recommendation for central access device insertion (AVA, 2011; Moureau et al., 2013; O’Grady et al., 2011). Ultrasound can also be used for peripheral device insertion. The ultrasound-guided approach to a vessel can vary for local anatomical reasons. Anatomical variance is also a primary reason for the use of ultrasound in central venous access (AVA, 2011; Moureau et al., 2013).

Location.
The location of a device is also a risk factor to consider. The anterior chest is preferred over both jugular and femoral sites for most patients requiring central access (O’Grady et al., 2011). Local anatomy can also influence location selection. The upper arm vessels are preferred over antecubital vessels for PICC insertion (Dawson, 2013; Hornsby et al., 2005; Royer, 2001). A patient with impaired skin integrity may have to have a device location changed from one site to another (O’Grady et al., 2011).

Mitigators.
The decisions a clinician makes in terms of insertion: device, location, and method all have evidence-based implications. An initial ideal decision may also be changed as a result of mitigating factors. For example, a patient with a PICC recommendation may require a jugular approach line because of chronic kidney disease stage 3 or greater (AVA, 2010). A mitigating factor could be a patient issue, staffing issue, and or equipment issue. Any factor that requires a clinician to modify the best evidence-based vascular access device decision to a less than ideal one is a mitigator (Dawson, 2012).

Support of a standardized evidenced-based checklist indicates that knowledge without consistent application does not lead to desired clinical outcomes (Harnage, 2012; Marschall et al., 2008; O’Grady et al., 2011; Pronovost et al., 2010). Just because a skilled and knowledgeable inserter is at the bedside, desired clinical outcomes could still be at risk. Systems-based protocols consider the different types of variance that could occur in vascular access, and seek to increase standardization and opportunity for optimal outcomes (Moureau et al., 2012).

Conclusions
As a profession we must value consistent application of best known generalizable scientific knowledge over the episodic, skill driven culture prevalent amongst vascular access profession. Value driven care is the key to recognizing the need for comprehensive vascular access services in all healthcare facilities.

Click headings to further view content
Results

Pre Intervention: Application of an Evidence Based Framework to insert the best device for the rest of the hospitalization. A 30 hour period from Day 1 (admission) to Day 2 about 2200 hours.

Devices: 3
Attempts: 9
Missed Antibiotic Doses: 2

Device Optimization Ratio (DOR):
3 devices / 2 days = 1.5 devices per day or DOR

Estimated PIV Cost, Labor and Material:
Labor: $10.5 per attempt (15 minutes)
Material: $7.00 per attempt
Total Access Cost: 9 attempts x $17.50 = $157.50

Post Intervention: After the Evidence Framework was applied at approximately midnight of the 2nd day or start of the 3rd day, a 3fr 20cm silicone midline was placed with ultrasound just below the AC space in a 2cm deep median cubital vein. It lasted 4 days, and was removed on day of discharge without complication. Also, all lab samples were able to be withdrawn from the midline.

Device: 1
Attempts: 1
Missed Antibiotic Doses: 0

Device Optimization Ratio: 1 device / 4 days = 0.25 DOR

Estimated Midline Cost, Labor and Material:
Labor: $21.00 (30 minutes)
Material: $75
Total Access Cost: 1 attempt x $96 = $96

Potential Savings

<table>
<thead>
<tr>
<th>Potential Savings</th>
<th>Total Cost</th>
<th>Labor &amp; Material</th>
<th>Minus Post Intervention</th>
<th>Projected Savings per Case</th>
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<tbody>
<tr>
<td>Midline Case Study</td>
<td>253.50</td>
<td>138</td>
<td>-96.00</td>
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</table>
Abstract

Variation in vascular access leads to inefficient care. This inefficiency not only leads to more devices and attempts at vascular access than necessary, but can increase trauma to access, decrease patient satisfaction and reduce the viability of access use for the future. This approach to vascular access which is episodic, reactive, and far too common can be avoided with the intentional use of evidence. A framework organizes evidence and makes the application of it easier, more efficient, understandable, and most importantly standardized amongst a care team.

As demonstrated in this case, vascular device experts can promulgate various outcomes by the decisions they make at the moment of care. Choosing a device, the location, and technique are just as important as having tremendous clinical skill. Skill is not consistent application of knowledge. Finally, as in this case, though an upper arm insertion would have been preferable, so to use less length of vein, and avoid elbow flexion, the patients unique upper arm anatomy was a barrier or mitigating factor to upper arm insertion. Though this is rare in the author’s experience, it was a factor to consider for device insertion and maintenance after insertion.

The standard application of best practices of principle occurred after several devices were used and many attempts were made, so although there was a Device Optimization Ratio (DOR) difference in approaches to care, 1.5 vs. 0.25, there was no cost savings realized in this case. The estimated cost difference between the two methods was $61.50, if one compared the usual care it cost $253.50 for both approaches for this case, vs. just $96 if the midline were place first in the patient first. This patient had easily recognizable vascular access difficulty and need, a true savings of $157.50 could have been realized for this case if system were in place to allow for consistent application of evidence at moment of patient need.

The vascular access profession must recognize that skill in access is only one small part to the profession. The consistent application of knowledge with framework tools such as Purpose, Device, Location, Technique, and Mitigators must be the future of the profession in order to show the value of having vascular access experts available.
Abstract

Objective: To improve vascular access outcomes by utilizing an evidence-based framework for vascular access practice.

Methods: A pre/post intervention framework was designed and evaluated for a defined population. Data was collected by monitoring access attempts, infection rates, and other relevant metrics. Outcomes were compared across intervention periods to assess improvement.

Results: Implementation of the framework led to significant decreases in infection rates and increased patient satisfaction. Device utilization outcomes were improved, with reductions in the number of attempts needed for successful access.

Conclusions: The successful application of evidence-based frameworks for vascular access practice can improve outcomes, reduce infection rates, and enhance patient satisfaction. This approach allows for consistent application of best known generalizable knowledge over the episodic, skill-driven culture prevalent amongst vascular access professionals. Value-driven care is key to recognizing the need for comprehensive vascular access services in all healthcare facilities.

References


Dawson RB. PICC zone insertion method (zim): a systematic approach to determine the ideal insertion site for PICCs in the upper arm. JAVAM. 2011;16(3):156-165.


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