Maximizing Peripheral Vascular Access Success: Clinical Application of Evidence-based Frameworks

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Disclosure of Relevant Financial Relationships

I have the following financial relationships to disclose:

• Speaker’s Bureau for: Genentech
• Employee of: AccessRN, Inc

I will not discuss off label use and/or investigational use in my presentation.
Objectives

• Describe the five elements of the framework for vascular access practice
• Describe the systems approach to vascular access
• Describe the 45/50 Rule for ultrasound guided peripheral vascular access
Why Is This Important?

Every patient deserves optimal vascular access care, regardless of: clinician, facility, or time of day!!! (Dawson, 2011)
What is Vascular Access?

Vascular access can be defined as... 
...the practice of assessment, planning, and intervention for the least risk intravascular device insertion and maintenance  (Dawson, 2014)
Defining vascular access can assist with reducing unnecessary variation to practice.

- Effective care variation (Wennberg, 2011)
- This is about not relying on clinician preference, but focusing on the patient and the evidence to provide the least risk vascular access
- Same clinical purpose is key
Knowledge Application

What is a good IV catheter?
1. Larger is better
2. Any device is good
3. Smallest device in largest vein
4. No IV is a good one
Knowledge Application

What is a good vein?
1. Larger is better
2. Any vein is good
3. Forearm is preferred
4. There is no good vein
When I fail at PIV insertion?

1. It is not my fault
2. The valves did it
3. The vein rolls too much
4. I could have done better
• Every outcome we observe is directly related to how we apply evidence within a system of care

It is more than just knowledge

Must also consider process, resources, and culture
System Layers

• Macrosystem
  – Hospital, Facility, or Healthcare Network

• Mesosystem
  – Departments, Directorships, Service Lines
  – Multiple units that may or may not depend on each other

• Microsystem
  – Clinical Unit, Clinic, Distinct Patient Population
    • DIRECT PATIENT CARE
“...A SYSTEM IS AN ORGANIZED COLLECTION OF PARTS (OR SUBSYSTEMS) THAT ARE HIGHLY INTEGRATED TO ACCOMPLISH AN OVERALL GOAL.”

- HTTP://MANAGEMENTHELP.ORG/SYSTEMS/SYSTEMS.HTM

Systems Approach to Access

- Get your ducks in a row!
Ideal Vascular Access System

Early Vascular Access Planning, within 24 - 48 hours
The System Fix

- The IOM reports:
  - To Err is Human – 1999
    - System based errors lead to 98,000 deaths per year
  - Crossing the Quality Chasm – 2001
    - Disparities in care
    - Need to be better at applying knowledge to practice
System History

• Systems Thinking
  – Florence Nightingale - Crimean War
  – Donabedian – Structure, Process, Outcomes
  – Quinn - The Intelligent Enterprise
  • Smallest Replicable Unit (SRU)
  – Batalden - Improvement Science Formula
  – Nelson - Clinical Microsystem Characteristics
Evidence into Practice

- Improvement Science Formula
  Evidence + Context = Measurable Outcomes

What do we know about this type of care?

What do we want to achieve?

How do we practice to achieve what we want?
Evaluating Practice

• Knowledge
  – What do we know
  – How should we practice
  – What are the gaps

• Process
  – How do we apply what we know
  – What is important to maximize results

• Resources
  – People, Devices, Technology
  – Support
What do we know?

• Vascular access is not just a procedure anymore, there is evidence to support how the practice is carried out
  • The biggest threat to evidence based vascular access practice is clinician preference
    – Effective Care Variation (Wennberg, 2011)
    – Preference must not replace evidence
    – Systems thinking and frameworks can help with consistent application of evidence
Key Concepts

• The evidence for vascular access device insertion can be categorized into five areas:
  – Purpose or the Need for the device
  – The type and size of Device
  – The Location for device insertion
  – The Method or Technique used for insertion
  – Consideration of Mitigators or Contraindications
Framework Tool

- Device
- Purpose
- Location
- Method

Mitigator

Process
- Assessment
- Planning
- Evaluation

(Dawson, 2012)
Framework Tool

- 1st Step: The “Why” of vascular access
  - Diagnosis
  - Treatment plan

Early Access Planning
Right Device, Right Time
Use Triggers for Assessment
Framework Tool

- **2nd Step: Device**
  - Consider type
    - PIVC, Midline
    - PICC or other CVC
  - Size, gauge, length
  - Characteristics
    - Power injection for CT
    - Number of lumen
    - Length of dwell

<table>
<thead>
<tr>
<th>Least invasive</th>
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<tbody>
<tr>
<td>Lowest risk</td>
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<tr>
<td>Remove when not needed</td>
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<tr>
<td>No Device is the best Device</td>
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Framework Tool

• 3rd Step: Location
  – Avoid areas of flexion
    • Wrist, Elbow (Antecubital)
  – Avoid damaged skin
  – Consider patient preferences
  – Avoid impaired extremities
    • Trauma
    • Immobility
    • Edema
    • Mastectomy

Avoid Trauma
Avoid Flexion
Minimize Attempts
Largest Straightest Vein

AVA 2014
Framework Tool

- **4th Step: Technique or Method**
  - Ultrasound
  - Tunneling
  - Implantation
  - One hand
  - Two hands
  - Side puncture

Plan your approach
Frist pass is best chance
Don’t be blind
Know your equipment
Use technology right
Framework Tool

- **5th Step: Mitigator**
  - Something that prevents an ideal vascular access device, location or technique
    - For example: stroke, mastectomy, patient preference, clinician skill
    - For example: Chronic Kidney Disease Stage 3 or greater
      - National Kidney Foundation (NKF) recommends the dorsum of the hand, to preserve access for arterio-venous fistulas (AVF)

What prevents the ideal access?

Gives you a reason for what you did?
Clinical Application

A patient admitted with severe lower extremity cellulitis has an order for intravenous Vancomycin 1500mg every 12 hours.

“Cellulitis” fits in to which one of the five elements of the Framework Tool?

1. Location
2. Mitigators
3. Purpose
4. Device
5. Method
What do we know?

22g 1” Catheter Forearm Vein

22g 1” Catheter Forearm Vein
What do we know?

18g 1.25” in Metacarpal Vein

22g 1” in Middle Forearm Cephalic Vein
Clinical Application: Location

1. Metacarpal Vein
2. Cephalic Vein
3. Accessory Cephalic Vein
4. Antecubital Cephalic Vein
Clinical Application: Location

Which vein would you select for a PIV insertion?

1. Metacarpal
2. Cephalic middle forearm
3. Accessory cephalic upper forearm
4. Antecubital cephalic
Clinical Application: Location

Which vascular access principle did you use to answer the previous question?

1. Start distal and work proximal
2. Largest vein
3. Largest vein out of an area of flexion
4. Whatever looks good to me at the time
5. I did not use a principle
Knowledge Application: Location

Did you have enough information to answer the previous question?

1. Yes
2. No
3. I don’t know
What do we want to achieve?

- Least invasive, lowest risk access to preserve veins for future use
  - Get the most appropriate device in early
How do we practice?

- Apply what we know to achieve what we want for outcomes
  - If you are not there, just start building a foundation in one microsystem at a time
  - Get collaborators, collect baseline data
  - Be specific about what you want to do and measure
  - Start the work of improving in order to improve
How do we practice?

Nelson’s Value Compass

QUALITY AS A DETERMINANT OF VALUE IN HEALTHCARE
(“Balanced Measures,” Nelson et al., 2011)

Functional Status

Biologic/Clinical

Satisfaction & Need

Cost
Patient Assessment

- Before you walk in the room
- Framework tool- Ask Why
- Adult consideration
  - Preference
  - History
- Pediatric considerations
  - Arm dominance, parents, stage of development
Vein Assessment

- Extremity that is healthy, not compromised
- Out of an area of flexion
- Vein that is palpable, soft, elastic, straight
- Use anatomy as your guide
- Tight tourniquet

How do we practice?
A tourniquet for PIV insertion should be left in place for no longer than how many minutes?

1. 2 minutes
2. 5 minutes
3. No time limit
4. 15 minutes
Vein Assessment

Need to Palpate!

Do Not Make Assumptions
Vein Selection

- Largest, straightest vein out of flexion
  - Forearm
    - Cephalic
  - Forearm
    - basilic, radial, ulnar, median basilic
  - Hand
    - metacarpal, dorsal network
  - Antecubital
    - cephalic, median cubital
Site Selection Tips

- **Hand** – dorsal surface, used for surgery, renal disease, common in pediatrics
- **Forearm** – middle anterior, lateral, and posterior surfaces, ideal choice for most adults
- **Upper arm** - is an option if forearm and hand are not acceptable
- **Legs and feet** - avoid in adults, useful in pediatrics when not walking yet
Key Concepts

- Patient assessment start before you walk in the room
- Know the reason for access, ask “why”
- Establish a rapport with the patient, ask what his or her concerns are, do they have any preferences or history with vascular access
- Select the healthiest, largest, straightest vein possible, out of an area of flexion (Best Vein)
- Use the smallest, shortest device in the best vein
The Procedure

• Device insertion
  – Patient positioning
  – Mark the path
  – Procedure steps
  – Local anesthesia
What if you miss?

- Do not panic! Stay calm, evaluate your needle position, and patient comfort
- Keep skin traction, until catheter has been advanced into the vein
- If you have more than half of the needle in the skin without flash, stop and pull back
- Only one needle per attempt, do no reuse the needle
- Only two attempts per clinician
Post Procedure

- Securement
- Dressing
- Labeling
- Documentation

J – LOOP – is a “J” shaped curve applied to the extension tubing.
Documentation

- Education, patient and family involvement
- Site preparation solution, use of standardized checklists
- Device type, length, size
- Date and time of insertion, device function, insertion method, use of assistive technology
- Site location, number of attempts, laterality
- Patient response to procedure

(INS, 2011)
• Provider order for PIVC. Patient requires a PIVC for Normal Saline infusion. Site prep with a 2%CHG solution per facility policy, air dried. Right lateral middle forearm Cephalic vein accessed with a 22g 1” Introcan catheter, positive blood return noted. Advanced catheter without difficulty. Patient commented, “I did not feel anything, good job”, catheter secured with Statlock, transparent Tegaderm applied. 3ml NS flush. Line ready for use.
Clinical Application

• Ms. Smith requires a PIVC for once a day cephtriaxone 2gm IV push. She prefers you do not use her hands so she can wash easily. She has cellulitis from a cat bite in her right wrist.
Clinical Application

Which device type and vein would be most appropriate?

1. Left wrist dorsal vein, 20g 1.25 inch
2. Right posterior forearm basilic vein, 22g 1 inch
3. Left middle forearm cephalic vein, 22g 1 inch
4. Right anterior forearm median cubital vein, 18g 1 inch
Clinical Application

You palpate a dilated, spongy, large vein in the left middle lateral forearm. Ms. Smith reports she is a “difficult stick”, and you realize that although you feel the vein, you have trouble visualizing the vein path. You remember that you could use a skin marker, or oral thermometer probe cover to mark the vein. What is one reason for marking the vein?
Clinical Application

1. To make the patient more comfortable prior to puncture
2. To visualize the vein path without touching prior to puncture
3. To dilate the vein prior to puncture
4. To take their mind off of the needle stick
5. I don’t need to mark the vein path
Key Concepts

- Answering the “Why” of insertion gives the purpose, to then match with the most appropriate device type and size.
- Be calm and project confidence, put the patient at ease, position the arm and yourself for success.
- Documentation completes the procedure and should include: preprocedure education and assessment, device and anatomy specifics, as well as device function and patient response.
Patterns of Practice

What stops you from doing the ideal procedure most of the time?
1. Colleague
2. Patient
3. Administration
4. Self
5. I don’t know
Ultrasound PIV Insertion

Make an improvement in care!
Guidelines for Ultrasound Guided PIV Insertion

Use the Framework Tool

- Evaluate Purpose
- Then choose Device
- Next select best Location
- Apply most appropriate Method
- Finally, ask about Mitigators
Approach to Access

 Warning signs for your practice
   multiple unsuccessful peripheral sticks
   numerous peripheral IV restarts

 Patient assessment signs
   history of difficulty obtaining IV access
   limited vascular options
   large gauge access needed
   central line contraindicated or unsuccessful
Approach to Access

• **Antisepsis does not mean to accept contamination**

• A standard does not necessarily represent current evidence

• Take initiative to apply evidence and match purpose of access with new technology and approaches
How to Insert

• INS Standard 35
  – “…non-sterile gloves in conjunction with a no-touch technique for peripheral IV insertion.” p.S44

  …
  – “With no touch technique, the planned IV insertion site is not palpated after skin cleansing unless sterile gloves are worn.” p. S44
How to Insert

INS Standard 33

- “The nurse should consider using visualization technologies that aid in vein identification and selection.” p. S41
What to Avoid

cephalic vein

median antebrachial vein

cubital vein

basilic vein

basilic vein
How to Insert: 45/50 Rule

In Plane, Long Axis

Angle of Insertion? 30 degrees

How much catheter in before blood flash? Approx. 70% = 3cm

www.youtube.com
Right Triangle Method
Right Triangle Method

Image by Rob Dawson
## Right Triangle Method

### 1cm Vein Depth, 4.5cm Catheter

<table>
<thead>
<tr>
<th></th>
<th>15 degree Angle</th>
<th>30 degree Angle</th>
<th>45 degree angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needle Distance from US Probe (b)</td>
<td>37.3mm</td>
<td>17.3mm</td>
<td>10mm</td>
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<tr>
<td>Needle Length to Reach Vein (c)</td>
<td>38.6mm</td>
<td>20mm</td>
<td>14mm</td>
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<tr>
<td>% Catheter in Vein</td>
<td>12%</td>
<td>55%</td>
<td>68%</td>
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### 2cm Vein Depth, 4.5cm Catheter

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<th>30 degree Angle</th>
<th>45 degree angle</th>
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</thead>
<tbody>
<tr>
<td>Needle Distance from US Probe (b)</td>
<td>74.6mm</td>
<td>34.6mm</td>
<td>20mm</td>
</tr>
<tr>
<td>Needle Length to Reach Vein (c)</td>
<td>77.3mm</td>
<td>40mm</td>
<td>28.3mm</td>
</tr>
<tr>
<td>% Catheter in Vein</td>
<td>0% Does Not Reach</td>
<td>9%</td>
<td>36%</td>
</tr>
</tbody>
</table>
• Mr. Jones complains of pain at his PIV insertion site. He has a 22g 1” catheter in his right lateral forearm accessory cephalic vein. He is on IV Nafcillin every 4 hours, and IV fluids with 20 meq of Potassium Chloride at 125ml/hr. You suspect phlebitis related to irritating infusions.
Clinical Application

• After removing Mr. Jones’ PIVC for suspected phlebitis what is your next best course of action?
  1. Restart his PIV catheter in the other arm
  2. Place a midline catheter in an upper arm vein
  3. Ask why he is getting IV Abx and how long he will need them
  4. Get an order for a PICC
Clinical Application

- The provider for Mr. Jones agrees that a PICC would be the best device and will discuss it with ID staff, but for now the patient still needs IV access. You find a 4mm Cephalic vein, 5mm deep. Your method of approach to vein is the Right Triangle Method with ultrasound guidance. What length catheter and angle should you use to reach this vein?

1. 1” 22g, 30 degree angle
2. 1.75” 22g, 45 degree angle
3. 1.25” 20g, 15 degree angle
4. 1.88” 18g, 45 degree angle
Clinical Application

- You decide that a 22g 1.75” catheter will be inserted using ultrasound and the Right Triangle Method. At a near 45 degree angle of insertion for a 5mm deep vein how far should the needle be inserted from the ultrasound beam?
  1. 2-3mm
  2. 1cm
  3. 0.5cm
  4. As close to the probe as possible
In conclusion...

• What is the best way to start improving PIV results?
  1. Start distal and move proximal
  2. Find the largest vein
  3. Ask why the patient needs access
  4. Mark the vein path for a no touch technique
• Thank you
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References


