Peripheral Intravenous (PIV) Successful Starts & Care 2012

St. James Healthcare, SCLHS
Butte, Montana

Created By:
SJH Education Collaborative

With The Support Of:
EXEMPLA Good Samaritan Medical Center &
St. Francis Health Center Vascular Access Specialists
Medelearn Test Instructions

- This online tutorial is available on MedELearn to be completed as assigned. An 80% pass score is required.

- The St James Healthcare Education Department may assign this test for new RNs during orientation or as requested by a unit director.
Peripheral IV Starts: Adults

Learning Module Objectives: At the completion of this module the RN will be able to -

- Identify 3 layers of the blood vessel

- List the risks and benefits in starting a peripheral intravenous line (PIV)

- Identify the steps in starting a PIV

- Identify the appropriate areas of PIV insertion

- Identify 3 complications of PIV insertion
Anatomy & Physiology

Veins:
- Have thin, distensible, collapsible walls
- Are low pressured, relying on the ancillary action of skeletal muscle pumps and changes in intrathoracic pressure to return blood to the heart
- Have valves that prevent the backflow of blood, aiding in the return of blood to the heart, unlike arteries
- Are composed of three layers of tissue:
  - Tunica adventitia
  - Tunica media
  - Tunica intima
Anatomy & Physiology
Special Considerations

- With normal aging, collagen in the blood vessel wall is depleted, resulting in veins becoming thin and tortuous.

- Certain disease states affect vein wall structure, resulting in difficult PIV placement:
  - Diabetes
  - Hypertension
  - Steroid dependence
  - Autoimmune disorders
  - IV drug abuse
Veins Have Valves

- Valve are semilunar folds of endothelial cells, keeping the blood flowing towards the heart

- PIV catheters must be inserted in the same direction as venous flow to prevent permanent damage to the valves
Vasodilation / Vasoconstriction

**Vasodilation** – widening of the blood vessels from relaxation of the muscle wall:
- Exposure to warmth and relaxation will help facilitate vasodilation
- Vasodilation allows easier access, aiding in PIV insertion

**Vasoconstriction** – narrowing of the blood vessels resulting from contraction of the muscular wall of the vessels:
- Exposure to cold causes severe vasoconstriction
- Vasospasm also causes vessel constriction
- Fear, anxiety, holding one’s breath can enhance venous constriction making a PIV insertion difficult
Hand Veins

- Small digital veins line borders of the fingers
- Digital veins unite on the dorsum of the hands and metacarpals
- Cephalic vein runs along the radial aspect of the dorsal venous network
- Basilic vein originates from the union of the dorsal veins on the ulnar aspect of the arm
Solution pH

- Solutions and medications with extremes in pH (less than 5 or greater than 9) cause extensive changes in the endothelium, resulting in thrombosis and inflammation:
  - Normal blood pH is 7.35 – 7.45
  - Alkaline pH is 7.0 – 14.0
  - Acidic pH is 0.0 – 7.0

- A solution with a pH of 6 – 8 minimizes disruption of the vein endothelium

- Alkaline / Acidic solutions are phlebogenic (irritating to the vein wall)
## Movement of Fluids
(Tonicity or Osmotic Pressure)

<table>
<thead>
<tr>
<th>Hypertonic</th>
<th>Isotonic</th>
<th>Hypotonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solutions that exert more osmotic pressure than the extracellular fluid</td>
<td>Solutions used to expand the extracellular fluid</td>
<td>Solutions that exert less osmotic pressure than the extracellular fluid</td>
</tr>
<tr>
<td>Allows fluid to be pulled into the vascular system</td>
<td>Do not cause movement of fluid from or into the blood cells</td>
<td>Allows water to be drawn into the interstitial and intracellular spaces</td>
</tr>
<tr>
<td>3 % and 5 % sodium chloride 20 % and 50 % dextrose 5 % dextrose in lactated ringers</td>
<td>0.9 % sodium chloride (NS) 5 % dextrose in water (D5W) lactated Ringers (LR)</td>
<td>0.45 % sodium chloride</td>
</tr>
</tbody>
</table>

[Diagram showing movement of fluids: Hypertonic, Isotonic, Hypotonic]
Blood Vessel Flow Rates

Both blood vessel diameter and blood flow increase as they get closer to the heart -

- Flow rates:
  - Digital veins of the hand is 10 – 20 ml/hr
  - Forearm cephalic vein is 40 – 90 ml / hr
  - Axillary vein is 150 – 350 ml / hr
  - Subclavian vein is 350 – 800 ml / hr
  - Superior vena cava vein is over 2000 ml / hr

- Incidence of phlebitis increases as the concentration of the infusate increases:
  - Concentration can be manipulated by adjusting the dose, diluent and volume of solution
  - pH cannot be easily adjusted, so hemodilution by blood flow should be maximized to prevent damage to the veins
Arm Veins

Median veins are created from the union of veins of the palmar aspect of the hand.

Antecubital fossa is in the fold of the elbow and contains the median cephalic and/or median basilic vein.

In adults, veins to be considered for peripheral cannulation are those found on the dorsal and ventral surfaces of the arm:

- Metacarpal
- Cephalic
- Basilic
- Median
Caution! Areas To Avoid

- Avoid the lateral surface of the wrist for approximately 2 - 3 inches because of potential risk for nerve damage.

- Avoid the median surface of the wrist due to the pain on insertion and possible damage to the radial nerve.
**Caution! Areas To Avoid**

- Avoid the anticubital fossa as a high area of flexion and risk of infiltration / extravasation.

- In an emergency or as required for a diagnostic procedure such as a Cat Scan where severe dehydration or rapid IV infusion is needed to infuse fluid, blood or radiopaque contrast into a vein, the anticubital fossa may be used for PIV placement.
Caution! Upper Arm Veins

- Cannulation of an upper arm vein eliminates use of that site for peripherally inserted central catheter (PICC) placement

- Veins in an upper extremity should be avoided on:
  - The side of breast surgery
    - With axillary node dissection
    - After radiation therapy to that side
    - With lymphedema
  - The affected extremity from a cerebrovascular accident (CVA)
  - A Dialysis Fistula / Graft extremity / site

- A collaborative discussion with the LIP needs to take place related to the benefits and risks of using a vein in an affected extremity.
Lower Extremity Veins

The pattern of vascular distribution is similar to that of the upper extremity. The greatest difference is the presence of more valves.

The dorsal metatarsal veins form a network across the top of the foot.

The medial and lateral marginal veins lie on the border of each foot.

The great saphenous vein extends from the medial marginal vein in the foot up the medial aspect of the leg to the femoral vein.

The small saphenous vein arises from the lateral marginal vein at the ankle to above the knee, where it joins the popliteal vein.

NOTE: A physician order is required to insert a PIV in a lower (foot) extremity.
Principles of PIV Insertion

- The nurse selects a short peripheral catheter based on:
  - Prescribed therapies
  - Duration of treatment
  - Availability of access sites
  - Diagnosis
  - Known complications of the device

- The catheter selected should be:
  - The smallest gauge and length
  - Fewest number of lumens
  - Least invasive device needed to accommodate and manage the prescribed therapy
Principles of PIV Insertion

- Do not place a PIV distal to existing infiltrate, phlebitis or extravasation sites
- Do not place PIV next to a failed insertion attempt
- Avoid use of lower extremities in the adult population due to the risk of tissue damage, thrombophlebitis, and ulceration
- Therapies not appropriate for short peripheral catheters include:
  - Continuous irritant therapies (i.e. chemotherapy or vasopressors)
  - Parenteral nutrition
  - Infusates with pH less than 5 or greater than 9
  - Infusates with osmolality greater than 600 mOsm/L

- The nurse collaborates with the pharmacist and LIP to assist in selection of the most appropriate vascular access device based on the projected treatment plan.
Site Assessment

- Choose the right site for the right therapy

- The IV line will only be as good as the vein cannulated. Use veins that feel round, firm, elastic, engorged and bounce when palpated.

- Initiate the following techniques with the patient to distend / dilate veins:
  - Educate about the procedure and importance of relaxing
  - Encourage relaxation breathing techniques (not breath-holding)
  - Warm the extremity
  - Place extremity in dependent position; and, instruct to flex and relax the hand
  - Place the tourniquet high up on the arm and tightly enough to trap venous blood in the lower arm veins without interfering with arterial flow (if no pulse if felt then the tourniquet is too tight).
Equipment

Gather the necessary supplies:

- Gloves
- PIV kit
- IV catheter
- Extension tubing, if not in start kit
- Securement device / dressing
- Insulin syringe with 0.1 – 0.3 ml buffered Lidocaine, if ordered
- Normal Saline 3 – 10 ml to flush extension catheter
- IV solution with primed IV set or needleless injection port, if needed
Topical or Local Anesthetic

- Follow hospital policy for the use of a local anesthetic before venipuncture to reduce pain and anxiety.

- Document the use of topical or local anesthetic in the IV Start section of EPIC.

- 1% lidocaine (Xylocaine) intradermal is the general anesthetic of choice; and, an alternative is bacteriostatic 0.9% sodium chloride intradermal injection or a topical anesthetic cream (but must be may be applied 30 minutes to 1 hour before the procedure and may cause vasoconstriction thus difficult venous cannulation)

- To use lidocaine a health care provider’s order is required
Topical or Local Anesthetic

- First clean the skin, while the tourniquet is in place and the vein is immobilized. This technique helps to give the anesthetic at the same site a venipuncture site is selected.

- Procedure:
  - Hand wash and glove application according to facility policy for venipuncture.
  - Draw up the anesthetic solution into a tuberculin syringe.
  - The needle is positioned at a 5- to 15-degree angle to the side of the vein selected for cannulation.
  - Introduce the needle tip into the skin with the bevel up. Take care not to penetrate the vein wall. Avoid accidentally injecting the drug into the vein by injecting the solution beside or below the vein.
  - For superficial vein: insert about one-fourth to one-third of the needle’s length (for deeper veins you may have to go deeper).
  - Lift up the needle tip slightly so a wheal can be formed.
  - Observe the small intradermal wheal rise as the plunger is depressed. Superficial veins may require only 0.05 ml of solution; deep veins, may require 0.2-ml dose to produce a pea-size wheal (0.5 cm).
  - Withdraw the needle. Gently massage the wheal with an alcohol sponge to hasten absorption and prevent the wheal from obscuring the vein. Allow 5 to 10 seconds for the anesthetic to take full effect.

LYNN C. HADAWAY, RN,C, CRNI, MED, AND DORIS A. MILLAM, RN, MS (2005).
PIV Insertion

1. Tourniquet application & site selection
2. Clip excessive hair
3. Apply skin prep *
4. Stabilize vein
5. Approach vein with stylet at 10 to 30 degree angle depending on vein depth
6. Visualize backflow and lower cannula parallel to skin.
7. Push catheter off stylet completely into the lumen
8. Release tourniquet and apply finger pressure beyond insertion tip while stabilizing the hub
9. Activate safety mechanism to house needle
10. Secure and dress the catheter

Reference: On The Road To Successful IV Starts (2005). * Skin prep should be applied according to facility guidelines, i.e. chlorhexidine.
PIV Insertion

- Position self in a way this is best. Consider individual approaches to ergonomic correction, i.e. elevate bed to stand straight, lower bed to sit during PIV insertion steps

- Wash hands

- Apply gloves

- Open contents of IV start kit; do not contaminate

- Apply tourniquet to look and determine site (follow department guidelines for insertion, i.e. L & D, surgery, etc)

- Always palpate a vein before cannulation, despite how good it looks
PIV Insertion

- Remove tourniquet and apply loosely, closer to the intended insertion site.

- Cleanse the intended site with antiseptic using sufficient friction to assure the solution reaches into the cracks and fissures of the skin.

- Allow the antiseptic to dry for 30 seconds. It should never be wiped off but rather allowed to air dry to ensure skin antisepsis. Do not re-touch the area after cleansing with antiseptic.

- If you are unable to place the IV with a no-touch technique – apply sterile gloves.

- Do not pre-tear tape – there is nowhere to place it aseptically.
PIV Insertion

- While site is drying, pre-prime needleless port and/or extension tubing
- Assemble necessary components (keeping them in the IV start kit to prevent contamination)
PIV Insertion

- Administer intradermal anesthetic agent (Lidocaine, buffered Lidocaine, bacteriostatic normal saline), if ordered by physician

- Using an insulin syringe, inject 0.1 – 0.3 ml of buffered Lidocaine or normal saline, intradermally to form a wheal slightly larger than the catheter you are going to insert on the side of the vessel to void obscuring; allow the anesthetic agent to activate for approximately 15 – 30 seconds and then continue with catheter placement

- **SJH IV Therapy** V-A 45 Policy: “0.2 cc of 1% Lidocaine may be used as a local anesthetic. Do not use a local anesthetic for venipunctures on a patient under the age of five (5) years. If a documented allergy to Lidocaine exists, normal saline with Benzyl Alcohol preservative may be used in its place.”
PIV Insertion

- PIV insertion is all about the angle

- Use a shallow angle, i.e. 30 – 45 degree angle is suggested in the literature as well as smaller angles, i.e. 10 – 30 degree depending on vein depth

- A sensation of resistance is followed by ease of penetration as the vein is entered
PIV Insertion

- Insert IV needle, bevel up, at a shallow angle approximately a half inch below the proposed site of entry.

- Lower the shaft of the needle until it is almost flush with the skin surface and enter the vein, noting a backflow of blood.

- Once the backflow occurs, advance slightly, and *slide the catheter off the needle*.

- The catheter slides off the needle, the needle should never be re-advanced inside or outside the cannula.
PIV Insertion

- Release the tourniquet and apply pressure above the end of the catheter to reduce blood spills

- Attached primed extension tubing

- Flush with normal saline, clamping the extension tubing as you are instilling the last 1 – 0.5 ml of saline

- Watch the insertion site during the flush to assess the integrity of the vein

- Apply securement device / dressing over the insertion site. Document the date, time and inserter’s initials on the dressing

- Dispose of waste in the appropriate receptacle
PIV Insertion

- Only one vascular access device will be used for each insertion attempt
- No more than two (2) attempts at vascular access placement should be made by any nurse
- Multiple attempts limit future access and cause unnecessary pain
Troubleshooting Tips

Common reasons for problems during venipuncture include:

- **tourniquet placement** - too high, too low, too tight, or too loose (causing insufficient engorgement)
- **failure to release the tourniquet promptly after venous cannulation** - causes potential bleeding into tissue
- **“stop and start” technique** - a problem with beginners injuring the vein and can cause bruising
- **inadequate vein stabilization** - allows the stylet to push the vein aside
- **failure to recognize cannula perforation through the opposite vein wall** - indicated by diminished blood return
- **stylet—not the plastic catheter—enters the lumen** - caused by stopping too soon after insertion [HINT: no blood return with stylet removal because the catheter isn’t in the lumen]
- **inserting the cannula too deep, below the vein** - improper insertion angle (too steep), causing the cannula to ride below the vein [HINT: evident with free movement of cannula because it’s imbedded in fascia / muscle; causing severe discomfort and possible nerve injury].
- **Hematoma** formation and leaking from the insertion site might require to stop venipuncture. A most common occurrence in older adults, who have fragile veins, and in infants, who have very small ones.
- **Vasospasm**, another problem that can prevent catheter insertion, is more common in patients who are anxious about the procedure. If blood backflow stops when you remove the stylet, the catheter may not be fully in the vein or it may have passed through the vein’s opposite wall.
- **occlusion of the cannula** with a fat plug or blood clot is another possible reasons for a lack of backflow include severe vasospasm; in many cases, you can’t tell exactly what’s wrong.
- **puncture of the opposite wall** indicates a sudden backflow of blood when retracting the catheter. Remove the catheter otherwise the infusing fluid could infiltrate from the additional puncture site. Never try to reinsert the stylet to avoid shearing the plastic catheter.
Troubleshooting Tips

As you work to correct problems, don’t forget to check the patient and be reassuring. Inexperience can tend to make a nurse become overly focused on a difficult IV start so that the patient is forgotten. Check the patient’s level of anxiety and reactions to having a venipuncture performed. Collaborate with a peer for support if needed or who can be present for the patient if they are predisposed to fainting or vasovagal responses.
Joint Stabilization

PIV’s placed in areas of flexion (i.e., wrist, elbow) are at increased risk of:

- Phlebitis (due to movement of the IV catheter)
- Malfunctioning (catheter kinking, preventing or slowing infusion rate)
- Catheter fracture (constant movement can damage catheter materials)

Protection devices such as an arm board, limb or finger splint may be implemented to facilitate infusion delivery when the catheter is located in or adjacent to an area of flexion:

- Protective devices are not restraints
PIV Documentation

- If you are not successful with the first attempt, repeat one time

- Document in the medical record your failed attempt and the outcome:
  - Hematoma developed
  - Patient had pain
  - Unable to cannulate the vein
  - Unable to thread the cannula
Complications of IV Therapy

- **Phlebitis:** inflammation of the vein

- **Infiltration:** the inadvertent administration of non-irritant medication or solution into the surrounding tissue

- **Extravasation:** the inadvertent administration of an irritant medication or solution into the surrounding tissue

- **Infection:** the presence and growth of a pathogenic microorganism at the IV site
Phlebitis

Nurse documents:
- Signs and symptoms of phlebitis (using standardized scale below)
- Intervention implemented
- Patient response to treatment

<table>
<thead>
<tr>
<th>Grade</th>
<th>Clinical Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No symptoms</td>
</tr>
<tr>
<td>1</td>
<td>Erythema at access site with or without pain</td>
</tr>
<tr>
<td>2</td>
<td>Pain at access site with erythema and/or edema</td>
</tr>
</tbody>
</table>
| 3     | Pain at access site with erythema and/or edema  
      | Streak formation  
      | Palpable venous cord |
| 4     | Pain at access site with erythema and/or edema  
      | Streak formation  
      | Palpable venous cord greater than one inch in length  
      | Purulent drainage |
Infiltration and Extravasation

Nurse documents:
- Signs and symptoms of infiltration (using standardized scale below)
- Intervention implemented
- Patient response to treatment

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No symptoms</td>
</tr>
</tbody>
</table>
| 1     | Skin blanched, cool to touch  
       | Edema less than 1 inch in any direction  
       | With or without pain |
| 2     | Skin blanched, cool to touch  
       | Edema 1 – 6 inches in any direction  
       | With or without pain |
| 3     | Skin blanched, translucent, cool to touch  
       | Gross edema greater than 6 inches in any direction  
       | Mild to moderate pain |
| 4     | Skin blanched, translucent; skin tight, leaking  
       | Skin discolored, bruised, swollen  
       | Gross edema greater than six inches in any direction  
       | Deep pitting tissue edema  
       | Circulatory impairment; moderate to severe pain  
       | Infiltration of any amount of blood product, irritant |
Infiltration Management

- Nurse immediately stops all infusions when a patient complains of any type of pain, burning, stinging at or around the insertion site, catheter tip, or entire venous pathway.

- Treatment of infiltration depends on the severity.

- Treatment may include:
  - Elevation of extremity
  - Thermal manipulation
  - Use of antidotes
  - Surgical interventions
Extravasation Management

- Inadvertent administration of Vesicant solution or medication into the surrounding tissue

- Estimate the volume of fluid that has escaped into the tissue based on the rate of infusion and the length of time since the last assessment

- Nurse provides ongoing observation and assessment of the extravasated site, including:
  - Circulation
  - Motion
  - Sensation

- Document this in the patient’s medical record
Infection

Nurse documents:

- Signs and symptoms of infusion and vascular access device (VAD) related to infection
- Interventions implemented
- Patient response to treatment
Educate healthcare personnel regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection control measures to prevent intravascular catheter-related infections [7–15]. Category IA

Periodically assess knowledge of and adherence to guidelines for all personnel involved in the insertion and maintenance of intravascular catheters [7–15]. Category IA

- Designate only trained personnel who demonstrate competence for the insertion and maintenance of peripheral and central intravascular catheters. [14–28]. Category IA

- Ensure appropriate nursing staff levels in ICUs. Observational studies suggest that a higher proportion of "pool nurses" or an elevated patient–to-nurse ratio is associated with CRBSI in ICUs where nurses are managing patients with CVCs [29–31]. Category IB
Center of Disease Control (CDC)


- In adults, use an upper-extremity site for catheter insertion. Replace a catheter inserted in a lower extremity site to an upper extremity site as soon as possible. Category II

- In pediatric patients, the upper or lower extremities or the scalp (in neonates or young infants) can be used as the catheter insertion site [32, 33]. Category II
Select catheters on the basis of the intended purpose and duration of use, known infectious and non-infectious complications (e.g., phlebitis and infiltration), and experience of individual catheter operators [33–35]. Category IB

Avoid the use of steel needles for the administration of fluids and medication that might cause tissue necrosis if extravasation occurs [33, 34]. Category IA

Use a midline catheter or peripherally inserted central catheter (PICC), instead of a short peripheral catheter, when the duration of IV therapy will likely exceed six days. Category II
Evaluate the catheter insertion site daily by palpation through the dressing to discern tenderness and by inspection if a transparent dressing is in use. Gauze and opaque dressings should not be removed if the patient has no clinical signs of infection. If the patient has local tenderness or other signs of possible CRBSI, an opaque dressing should be removed and the site inspected visually. Category II

Remove peripheral venous catheters if the patients develops signs of phlebitis (warmth, tenderness, erythema or palpable venous cord), infection, or a malfunctioning catheter [36]. Category IB
Peripheral IV Catheters and Blood Exposure: Is It an Issue?  
Recorded on May 1, 2012

In the US, healthcare workers insert over 300 million short peripheral intravenous (PIV) catheters every year. The insertion of a PIV catheter predisposes the nurse to certain occupational hazards, such as needlestick injury and blood exposure.

Mucocutaneous Blood Exposure and Peripheral Catheters: Acknowledging the Risk, Documenting Occurrences  
Recorded on April 30, 2012

Discussions among nurses and two recent published surveys reveal anecdotal reports of blood exposure to mucous membranes during peripheral IV catheter insertion; however, an integrative literature review found no documented reports of these events. Reports of all percutaneous injuries are about four times greater than those from all mucocutaneous blood exposures, indicating the continued need for improvements in and correct use of engineered safety devices.

INS Knowledge Center (2012). Retrieved online @ http://knowledge.ins1.org/
Helpful Online Resources

- Infusion Nurses Society (INS)
- Infectious Disease Society of America (IDSA) - Home Infusion
- National Home Infusion Association
References


• SJH IV Therapy V-A 45 Policy