Peripheral Intravenous Initiation

Self-Learning Module

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The supplement "Pediatric Considerations for Peripheral IV Initiation (2012)" is also available on request.

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INTRODUCTION

Welcome to the “Initiation of Intravenous Therapy” Self Learning Module!

Infusion therapy has evolved from an extreme measure used only as a last resort with the most critically ill, to a highly scientific, specialized form of treatment used for greater than 90% of hospitalized clients. Performing venipuncture is one of the more challenging clinical skills you will need to master. The Infusion Therapy Practitioner is a Healthcare Practitioner (HCP) who, through study, supervised practice and validation of competency, gains the acquired knowledge and skills necessary for the practice of infusion therapy.

Nurses provided with specialized training in peripheral vascular access, along with supportive organizational structures and processes, results in improved client outcomes and decreased complications. Although we recognize that HCPs other than Nursing may have intravenous (IV) insertion and therapy included in their scope of practice, this Self-Learning Module has been written based primarily on the scope of practice of a Registered Nurse (RN), Registered Psychiatric Nurses (RPN), and Licensed Practical Nurse (LPN).

Completing this Self Learning Module does not imply that you are competent in IV initiation and therapy. Competency assessment is multi-faceted (see pg.61). All HCPs must practice within their own level of competence. When aspects of care or skill are beyond the HCP’s level of competence, it is the HCP’s responsibility to seek education and/or supports needed for that care setting (College of Registered Nurses of British Columbia, 2015).

This Self Learning Module does not cover or imply the ability to administer medications by the intravenous route.

INSTRUCTIONS FOR USE

1. Read the information in the module and complete the self-test provided. If, while reading the information, you feel confident in your knowledge, proceed directly to the self-test. This workbook attempts to provide information for both the beginning and experienced Intravenous Therapy Practitioner. However, if questions arise that are not answered in the manual, please feel free to contact a Clinical Nurse Educator in your area or the Vascular Access Clinical Practice Committee for further explanation.

Standards, clinical guidelines, procedures, and protocols are referred to in the manual for your learning experience. When you need to review these for clinical decision making, it is important for you to refer to the Clinical Decision Support Tools (CDSTs) on the Clinical Policy Office. Of particular importance is the IV Therapy Clinical Practice Guideline. These can be found on the Fraser Health Intranet or from your Employer.

2. Once you have completed this theory, you will have the opportunity to:
   - Attend a learning lab
   - Practice venipuncture (under supervision) on an anatomic training arm.
   - Develop competency – a Mentor (an RN or Intravenous Therapy Practitioner educated and competent in the required knowledge and skills) will supervise you in the clinical setting until proficiency is determined to be acceptable and competency has been validated (a competency assessment tool [pg.62-64 or see Clinical Skills by Elsevier: Peripheral Intravenous Therapy: Initiation and Monitoring] will be completed by the Intravenous Therapy Practitioner and the Mentor).

If you have previous IV experience, your skill competency can be validated in the clinical setting; this can be arranged through a Clinical Nurse Educator. A Mentor will observe your venipuncture practice in the clinical setting and either validate your skill competency or discuss areas for improvement.
COMPETENCY AND SCOPE OF PRACTICE

**COMPETENCY** is defined as the knowledge, skill, attitude and judgment required to provide safe, compassionate and ethical care, and includes consideration of the context in which the care is provided. Competence should initially be validated at the time of employment, after orientation to the organization, on an ongoing periodic basis, when scope of practice changes, and with the introduction of new equipment and technology. The frequency of ongoing competence validation shall be determined by the setting and associated risk. (Infusion Nurses Society, 2016) All healthcare practitioners are legally responsible to be aware of, understand, and comply with their scope of practice and understand their level of individual competence before performing skills related to IV Therapy.

A Registered Nurse (RN) and the Registered Psychiatric Nurse (RPN) may perform the assessments and skills related to insertion, care, and maintenance of PIVs. The Registered Nurse and Registered Psychiatric Nurse providing infusion therapy shall be proficient in its clinical aspects, shall have validated competency in clinical judgment and practice, and shall practice in accordance with the Health Professions Act, the Scope of Practice for Registered Nurses or Registered Psychiatric Nurses in accordance with the College of Registered Nurses of British Columbia or the College of Registered Psychiatric Nurses of British Columbia, and the Fraser Health’s Scope of Practice policy. (Canadian Nurses Association, 2008) (College of Registered Nurses of British Columbia, 2015) (College of Registered Psychiatric Nurses of British Columbia, 2016) (Fraser Health Authority, Scope of Practice, 2010) (Government of British Columbia, 2015a) (Government of British Columbia, 2015b) (Infusion Nurses Society, 2016)

LPNs may, with additional educational preparation, administer medication via the IV route to patients with stable and predictable states of health and change IV bags infusing via peripheral access (not central or midline).

**This does not include:**
- Administration of medication via the IV Direct route
- Starting transfusions of blood or blood products
- Starting or monitoring parenteral nutrition
- Administration of radiopaque dyes via parenteral instillation
- Accessing central venous catheters (CVCs)

Please contact FHA Professional Practice for further information and for help clarifying your Scope of Practice. (College of Licensed Practical Nurses of British Columbia, 2017)

Other Intravenous Therapy Practitioners, including Medical Imaging Technologists, and Nuclear Medicine Technologists may be authorized to initiate, monitor, and remove a PIV with an order from regulated members of health professions authorized by the employing agency (e.g. Physician or nurse practitioner). Clinical Competency Validation of these skills may be required prior to practicing these skills.

Student Nurses and Employed Student Nurses (ESN) who have completed education within their Nursing Program and under direct supervision of their Clinical Instructor or Preceptor may insert PIVs.

Each Intravenous Therapy Practitioner needs to check with their registering body, regulatory body (i.e. College), and their employer for their specific scope of practice standards, limits, and conditions. (See also Education and Competency Guidelines – Appendix A pg. 61)
An Infusion Therapy Practitioner’s scope of practice includes:
- Specific knowledge and understanding of the vascular system and its relationship with other body systems and intravenous treatment modalities
- Skills necessary for the administration of infusion therapies
- Knowledge of psychosocial aspects, including recognition of a sensitivity to the patient’s wholeness, uniqueness, and significant social relationships, along with knowledge of community and economic resources
- Interdisciplinary communication, collaboration and participation in the clinical decision making process.

OUTCOMES

Upon completion of this module the learner will be able to:

- Locate Clinical Decision Support Tools that contain standards, policies, and clinical practice guidelines related to IV Therapy (e.g. INS Guidelines, Clinical Policy Office, HPA regulation, etc.)
- Locate relevant learning material
- Describe and identify the anatomy and physiology of the venous system
- Describe precautions to use to prevent the spread of infection and avoid self-contamination
- Select appropriate insertion site for prescribed therapy (and understand why site selection will vary)
- Identify equipment used for venipuncture including IV cannula, IV Start Pack, needleless connector (IV cap), IV extension set, and securement dressing/device
- Select appropriate cannula for prescribed therapy
- Identify equipment used for the delivery of intravenous therapy, including IV tubing and electronic infusion pump or flow control device
- Perform venipuncture on a training arm, secure, and dress the site
- Identify approaches to take to prevent, detect, and minimize complications
- Document appropriate information in the patient’s permanent health record
- Describe the procedure for discontinuing the IV
ANATOMY AND PHYSIOLOGY

The systemic circulation consists of the arterial and the venous systems.

The venous system channels blood from the capillary bed back to the vena cava and the right atrium of the heart. The blood travels to the right ventricle of the heart where it is pumped to the lungs, via the pulmonary artery, for oxygenation. The lungs oxygenate the blood and it flows via the left atrium to the left ventricle, which pumps the blood to the aorta and all parts of the body.

Arteries are a high pressure system and when they are close to the surface of the skin a pulse can be palpated (e.g. radial or brachial pulse). The muscle layer in arteries is stronger and they will not collapse like veins. Arteries are also deeper than veins and are surrounded by nerve endings, making arterial puncture painful.

The Venous System consists of superficial and deep veins. The superficial or cutaneous veins are those used for venipuncture. Superficial veins and deep veins unite freely in the lower extremities. For example, the small saphenous vein which drains the dorsum of the foot ascends the back of the leg and empties directly into the deep popliteal vein. Because thrombosis of the superficial veins of the lower extremities can easily extend to the deep veins, it is important to avoid the use of these veins. Superficial veins are typically bluish in colour. The pressure within veins is low and therefore a pulse will not be palpated in a vein.

Blood in the venous system is moved back to the heart by valves and the action of muscular contraction. Damage to the valves results in stasis of blood and varicosities. Initiation of an IV below a varicosity will result in reduced flow and decreased absorption of added medications and should be avoided.
Knowledge of vein wall anatomy and physiology is necessary in understanding the potential complications of IV therapy. The vein wall consists of three layers and each has very specific characteristics and considerations involved in the introduction of IV catheters and the administration of IV fluid.

**Tunica Intima** (inner layer):
This is a smooth, elastic, endothelial lining which also forms the valves (arteries have no valves). Valves may interfere with the withdrawal of blood, as they close the lumen of the vein when suction is applied. Slight readjustment of the IV needle will solve the problem.

Complications including phlebitis and/or thrombus may arise from damage to this layer. Injury to the lining can result from:
- **MECHANICAL DAMAGE** - Inserting a vascular access device causes mechanical disruption to the skin, the body’s first line of defense against infection. Movement of the cannula in the site also causes mechanical injury to the vein, as does using a catheter too large for the site.
- **CHEMICAL DAMAGE** - Chemical phlebitis can be related to the tonicity of the fluid, the number and dosage of medications, the pH of the medications, or wet skin. In particular, 5% dextrose in water is isotonic in the bag but hypotonic in the body after the dextrose is infused and metabolized. Hypertonic fluids pull fluids from the endothelium, causing the cells to shrink and making them vulnerable to infiltrations and phlebitis. Chemical irritation also happens when the skin is not allowed to dry after cleaning and before insertion of the catheter.
- **BACTERIAL INTRODUCTION** - When the skin is breached, patients are at risk for bacterial infection. Hand hygiene and cleansing the insertion site thoroughly before insertion and applying a dressing after are the major steps to prevent bacterial infection. The number of PIV restarts increases the risk of contamination and may also influence bacterial phlebitis.


**Tunica Media** (middle layer):
The middle layer of the vein wall consists of muscle and elastic tissue. This layer is thick and comprises the bulk of the vein. This layer is stronger in arteries than veins, to prevent collapse of the artery. Stimulation or irritation of the tissue may produce spasms in the vein or artery, which impedes blood flow and causes pain. The application of heat promotes vasodilation and reduces pain. If venospasm occurs, apply heat above the IV site to help reduce spasm.

**Tunica Adventitia** (outer layer):
This consists of areolar connective tissue, which supports the vessel. It is thicker in arteries than in veins because of the greater blood pressure exerted on arteries.
Valves:
Valves are structures within the lumen of veins that are formed by the lining of the Tunica Intima. They are a system of semi-circular flaps that are arranged in pairs and function to help keep blood flowing towards the heart by opening and closing like a “trapdoor”. Valves present as bumps along the course of primarily large veins and also occur at areas where two veins join (bifurcations). Assess veins for the presence of valves prior to venipuncture and avoid inserting a catheter near a valve. (BD Medical, 2015)

Digital Veins:
The dorsal digital veins flow along the lateral portions of the fingers. If large enough they may accommodate a small gauge needle, however they are used as a last resort.

Metacarpal Veins:
The metacarpal veins are formed by the union of the digital veins. They are usually visible, lie flat on the hand, are easy to feel, and are easily accessible. The hand provides a flat surface for stabilization and as this vein is in the extremity it allows successive venipunctures to be performed above the site. These veins may therefore be the first choice for venipuncture and can often accommodate 20 to 24 gauge catheters. When using, however, the distance from the insertion site to the prospective catheter tip must be considered to avoid tip positioning in the wrist area. It is preferred that the wrist not be immobilized. One must consider the impact that limited ability to use the hand will present to patients requiring hands to support position changes, use crutches, walkers, and home infusion therapies. Don’t use this site for vesicants, irritants, or medications known to cause phlebitis.

Cephalic Vein:
The cephalic vein flows upward along the radial aspect of the forearm. Its size readily accommodates a large needle (often up to 16 gauge), while its position provides easy access and natural splinting. This vein can be accessed from the wrist to the upper arm (using the most distal region of the vein first). These veins tend to “roll” so “anchoring” the vein during venipuncture essential. The large size is an excellent choice for infusing irritants. However, because the radial nerve is close to this vein, perform venipuncture 10 to 13 cm above the wrist.

Accessory Cephalic Vein:
The accessory cephalic vein ascends the arm and joins the cephalic vein below the elbow. Its large size accommodates a large needle (usually up to an 18 gauge). Be cautious not to place the IV catheter tip in the bend of the arm.

Basilic Vein:
The basilic vein originates in the dorsal venous network of the hand, ascending the ulnar aspect of the forearm. It is large and usually prominent that may be visualized by flexing the elbow and bending the arm upward. The vein will accommodate a large needle (usually up to a 16 gauge). It is often ignored as it tends to “roll” during insertion, therefore needs to be stabilized well during venipuncture. Try placing the patient’s arm across their chest and standing on the opposite side of the bed when performing venipuncture at this site.

Median Veins:
The median (antibrachial) vein may be difficult to palpate and the location and size of this vein varies. It is usually spotted on the ulnar side of the inner forearm. It is easily accommodates 20 to 24 gauge IV catheters, just be sure to stay well clear of the inner wrist area as it may be more painful and there is a risk of nerve damage.

The Median Cubital Vein:
This vein lies in the antecubital fossa and is used mostly for emergency, short term access or blood withdrawal. It should be used only as a last resort for routine IV therapy due to the high rate of complications, such as infiltration, associated nerve injuries, and phlebitis. Accidental arterial puncture is a concern in this area. A catheter in this site also limits mobility.
**Basilic Vein**

**Advantages**
- Largest, straight pathway in the upper arm
- Enhanced by positioning the arm at 90-degree angle from body

**Disadvantages**
- May be located too far medially or posteriorly, making insertion and care difficult
- Close proximity to brachial artery and some branches of the internal cutaneous nerve

**Brachial Vein** (Only used with ultrasound-assisted insertion)

**Advantages**
- Large vessel
- Usually undamaged, even in patients with history of many IVs

**Disadvantages**
- Deep location. Insertion requires ultrasound guidance
- Proximity to median nerve poses risk of nerve injury

**Cephalic Vein**

**Advantages**
- Easy access for insertion and care
- Easy to palpate and locate visually

**Disadvantages**
- Vessel may be small with a tortuous pathway
- Joins axillary vein at an angle that may make advancement difficult
- Vessel narrows as it ascends the upper arm

**Median Cubital Vein**

**Advantages**
- Easy access for insertion and care
- May be most prominent vessel in the antecubital fossa

**Disadvantages**
- Anatomy may vary from person to person
- May be difficult to insert due to valve locations
Figure 4 - Superficial veins of the upper limb

From Dorland’s Illustrated Medical Dictionary, 30th ed., Plate 53, p. 2015, © 2003, used with permission from Elsevier. (Infusion Nurses Society, 2016)
FLUID AND ELECTROLYTE BALANCE

The concepts discussed in this section will alert the IV nurse to the potential dangers of electrolyte therapy and changes in the patient’s condition which might alter the therapy. Knowledge of fluid and electrolytes in the body will contribute to safe and successful therapy.

<table>
<thead>
<tr>
<th>INTRACELLULAR FLUID</th>
<th>EXTRACELLULAR FLUID (ECF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40% of Body Weight</td>
<td>20% of Body Weight</td>
</tr>
<tr>
<td>Interstitial Fluid</td>
<td>Plasma</td>
</tr>
<tr>
<td>80% of ECF</td>
<td>20% of ECF</td>
</tr>
<tr>
<td>Plasma</td>
<td></td>
</tr>
<tr>
<td>20% of ECF</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 5 – Total Body Water**

Total body fluid is about 60% of the body weight. The body fluid content in infancy is 70-80% of the total body weight. Aging reduces the total body fluid to about 52% after age 60 years. The proportion in newborn infants is approximately three-fifths intracellular and two-fifths extracellular, but changes to the adult ratio by the time the child is 30 months old.

**Body Fluid Balance**

When the volume or composition of body fluid is in the compartments deviates even a small amount, the cells and vital organs of the body suffer.

The intravascular compartment is the most accessible. Fluid is filtered from it to the kidney, lungs, skin; fluid can enter it from the GI tract and directly from IV fluids.

The interstitial space is next in accessibility, acting as a sort of storage area. The body can store extra fluid here (over time) or fluid can be borrowed from this space.

The intracellular space is the least accessible space and is protected by the cell membranes. Gains or losses of hypertonic or hypotonic solutions (to be discussed later) will affect this compartment, causing the cell to gain or lose fluid. Cells function best in a constant environment.

**Composition of Body Fluids**

Body fluid contains two types of solutes (dissolved particles): *non-electrolytes* such as glucose, creatinine and urea, and *electrolytes* (see Figure 6 and Table 1).

![Figure 6 - The Concentrations of Different Elements in Key Bodily Fluids](http://cnx.org/content/m46411/1.3/)
### Table 1: Electrolytes

<table>
<thead>
<tr>
<th>ELECTROLYTE</th>
<th>LOCATION</th>
<th>FUNCTION/SIGNS OF IMBALANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium (K+)</td>
<td>Intracellular</td>
<td>• essential for normal function of muscle tissue, especially heart muscle tissue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• a low K+ will cause generalized decrease in muscular activity, apathy, postural hypotension</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• excess K+ causes heart irregularities, ECG changes and tingling or numbness in extremities</td>
</tr>
<tr>
<td>Magnesium (Mg++)</td>
<td>Intracellular</td>
<td>• enzyme action important for the metabolism of proteins and carbohydrates</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• necessary to maintain osmotic pressure and neuromuscular stability (like calcium)</td>
</tr>
<tr>
<td>Sodium (Na+)</td>
<td>Extracellular</td>
<td>• essential for regulating water distribution in the body (water follows sodium)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• deficiency will cause weakness, dehydration and weight loss</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• excess sodium can cause oliguria, dry mucous membranes and convulsions</td>
</tr>
<tr>
<td>Chloride (Cl-)</td>
<td>Extracellular</td>
<td>• tends to follow sodium</td>
</tr>
<tr>
<td>Bicarbonate (HCO₃⁻)</td>
<td>Extracellular</td>
<td>• is the most important buffer in the body and helps to maintain acid base balance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• excess bicarbonate causes alkalosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• deficiencies result in acidosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Normal range 7.35 - 7.45</td>
</tr>
<tr>
<td>Calcium (Ca+)</td>
<td>Extracellular</td>
<td>• essential for blood clotting and required for muscular contraction (e.g. heart muscle)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• important for bone development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• deficit causes muscular irritability, cramps and convulsions</td>
</tr>
</tbody>
</table>

All of these electrolytes are available to be given intravenously to provide, maintain, or correct fluid and electrolyte balances or to treat other associated co-morbidities. Their use must be approached with caution, particularly when administered as a dedicated treatment or therapy, and follow the standards set out in the Parenteral Drug Therapy Manual (PDTM). It is not within the Scope of Practice of many Intravenous Therapy Practitioners to administer IV medications. Please contact FHA Professional Practice for further information and for help clarifying your Scope of Practice.

**Movement of Body Fluids and Electrolytes**

Body fluid compartments are separated by a semi-permeable membrane that allows both body fluids and solutes to move back and forth. Movement of water and electrolytes between compartments occurs in four ways:

- **Diffusion** is the random movement of molecules and ions from an area of higher concentration to an area of lower concentration.

- **Osmosis** is the movement of water across a semi-permeable membrane in response to osmotic pressure. **Osmotic pressure** is regulated by electrolytes and non-electrolyte particles in the fluid. If the extracellular fluid contained a large number of particles and the intracellular fluid contained a smaller number of particles, the water would pass from the cell into the extracellular space, until the particle ratio was equal. In this case the cell might be deprived of needed water.

- **Active transport** is a mechanism used to move molecules across a semi-permeable membrane against a concentration gradient. This process requires cellular energy. An example is the
sodium pump, which uses energy to keep the sodium in the extracellular space and the potassium in the intracellular space. Otherwise they would equalize over time.

**Filtration** is the movement of solute and water through semi-permeable membranes from an area of higher pressure to an area of lower pressure. This pressure called *hydrostatic pressure* and is the force exerted by a fluid against a wall, and causes movement of fluid between compartments. The hydrostatic pressure of blood is the pressure exerted by blood against the walls of the blood vessels by the pumping action of the heart. In capillaries, hydrostatic pressure (also known as *capillary blood pressure*) is higher than the opposing “*colloid osmotic pressure*” in the blood—a “constant” pressure primarily produced by circulating albumin—at the arteriolar end of the capillary (Figure 7). This pressure forces plasma and nutrients out of the capillaries and into surrounding tissues. Fluid and the cellular wastes in the tissues enter the capillaries at the venule end, where the hydrostatic pressure is less than the osmotic pressure in the vessel. Filtration pressure squeezes fluid from the plasma in the blood to the interstitial fluid surrounding the tissue cells. The surplus fluid in the interstitial space that is not returned directly back to the capillaries is drained from tissues by the lymphatic system, and then re-enters the vascular system at the subclavian veins.

Net filtration occurs near the arterial end of the capillary since capillary hydrostatic pressure (CHP) is greater than blood colloidal osmotic pressure (BCOP). There is no net movement of fluid near the midpoint of the capillary since CHP = BCOP. Net reabsorption occurs near the venous end of the capillary since BCOP is greater than CHP. The balance of these two pressures keeps the fluids within the capillaries. (OpenStax College, 2013) [http://cnx.org/content/m46411/1.3/](http://cnx.org/content/m46411/1.3/)

![Figure 7- Capillary Exchange](http://cnx.org/content/m46411/1.3/)

Hydrostatic pressure is especially important in governing the movement of water in the nephrons of the kidneys to ensure proper filtering of the blood to form urine. As hydrostatic pressure in the kidneys increases, the amount of water leaving the capillaries also increases, and more urine filtrate is formed. If hydrostatic pressure in the kidneys drops too low, as can happen in dehydration, the functions of the kidneys will be impaired, and less nitrogenous wastes will be removed from the bloodstream. Extreme dehydration can result in kidney failure.

Fluid also moves between compartments along an osmotic gradient. Recall that an osmotic gradient is produced by the difference in concentration of all solutes on either side of a semi-permeable membrane. The magnitude of the osmotic gradient is proportional to the difference in the concentration of solutes on one side of the cell membrane to that on the other side. Water will move by osmosis from the side where its concentration is high (and the concentration of solute is low) to the side of the membrane where its concentration is low (and the concentration of solute is high). In the body, water moves by osmosis from plasma to the interstitial fluid (and the reverse) and from
the interstitial fluid to the intracellular fluid (and the reverse). In the body, water moves constantly into and out of fluid compartments as conditions change in different parts of the body.

For example, if you are sweating, you will lose water through your skin. Sweating depletes your tissues of water and increases the solute concentration in those tissues. As this happens, water diffuses from your blood into sweat glands and surrounding skin tissues that have become dehydrated because of the osmotic gradient. Additionally, as water leaves the blood, it is replaced by the water in other tissues throughout your body that are not dehydrated. If this continues, dehydration spreads throughout the body. When a dehydrated person drinks water and rehydrates, the water is redistributed by the same gradient, but in the opposite direction, replenishing water in all of the tissues.

(Open Stax College, 2013)

Because cells of the vital organs require precise and constant source of fluids and electrolytes and correct pH, IV therapy is important to replace losses caused by GI suction, burns, NPO, diuresis or diaphoresis.

Acid-Base Balance

The topic of Acid-Base balance is complex and cannot be covered in this module in its entirety. Therefore we will only touch upon it briefly as it applies to IV infusions.

The acidity or alkalinity of body fluid depends upon the hydrogen ion concentration expressed as the pH. The extracellular fluid pH is 7.35 - 7.45, which is the optimum for cells to function.

- Acidosis is a decrease in pH
- Alkalosis is an increase in pH

Both extracellular and intracellular fluids contain systems to buffer or maintain the proper acid-base balance. The carbonic acid-sodium bicarbonate system is the most important buffer system in the extracellular compartment. Other organs in the body also help to maintain fluid, electrolytes and acid-base balance. Healthy kidneys, skin and lungs are the main regulating organs, by selectively retaining or secreting electrolytes and fluid according to the body’s needs.

The buffer systems functioning in blood plasma include plasma proteins (e.g. hemoglobin), phosphate, and bicarbonate and carbonic acid buffers. The kidneys help control acid-base balance by excreting hydrogen ions and generating bicarbonate that helps maintain blood plasma pH within a normal range. Protein buffer systems work predominantly inside cells.

(OpenStax College, 2013)

The pH of a medication or fluid may play a part in contributing to chemical phlebitis. Medications/fluids with an osmolarity of greater than 900, a pH of less than 5 or greater than 9, vesicants, and known irritants need to be given via a CVC. (Infusion Nurses Society, 2016)
INFECTION CONTROL

Infection Control Principles

Phlebitis and Catheter Related Bloodstream Infections (CR-BSI) are a preventable nosocomial infections and adverse events. (Stevens & Schulman, 2012) These infections increase hospital length of stay and facility costs.

Infective organisms may access the vascular access device surface by either:

1. Invasion of the percutaneous tract
2. Contamination of the catheter hub
3. Seeding from a remote source of localized infection

(Association for Professionals in Infection Control and Epidemiology, 2009)

Increased CR-BSI rates are associated with a PIV inserted in the antecubital fossa, a PIV placed in the Emergency Department, or a PIV placed outside of hospital (e.g. EHS). (Trinh, et al., 2011)

Airborne bacteria increase in number when the activity in the area increases. They interfere with aseptic technique and may also find their way into unprotected IV solutions, which hang during intermittent infusion.

The skin is the main source of bacteria responsible for IV infections. Resident bacteria adhering to the skin include: *Staphylococcus albus, Staphylococcus epidermidus*

In hospitalized patients the following may also be present: *Staphylococcus aureus, Klebsiella, Enterobacter, Serratia*. (Most hospital-acquired infections are now of the gram negative type)

Blood may also harbour microorganisms such as:

- Hepatitis B and HIV; dangerous to the health care worker. Adhering to the Standard Precautions (Universal Precautions), including the use of recommended gloves for blood and body fluids, is essential. Needles or stylets should not be recapped, but should be disposed of in rigid, tamper-proof containers
- Other bacteria from a distant site of infection may seed the cannulated area. Assessment is necessary to determine early signs of a low grade infection

Cannula contamination can occur (see Figure 8):

- From skin during insertion. Carefully follow site preparation
- At the hub by health care worker, breaking system during tubing changes. Perform Hand Hygiene and maintain strict aseptic technique during tubing and needleless connector changes.
- At the tip if a thrombus occurs and is seeded by a distant local infection
- During manufacturing

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![Image of cannula contamination](Image courtesy of 3M©)
Solution contamination can occur:
- During admixture of drugs; use of a filtered needle is recommended
- When accessing needleless connectors; should be cleansed for 30 sec with 70% alcohol and allowed to dry completely as per IV Therapy Clinical Practice Guideline.
- By improper protection of tubing of intermittent infusions; use single-use intermittent IV tubing
- By allowing IV bag to hang for prolonged periods (> 24 hrs)
- On the shelf or during handling if small punctures occur to the bag.
- If using expired solutions
- More frequently in nutrient-rich solutions such as TPN and blood. Use laminar hood to prepare TPN solutions and follow protocol re: tubing changes. Follow Clinical Practice Guidelines for Parenteral Nutrition and/or Blood and Blood Product Administration.

General Measures to Reduce IV-Related Infections
- Use of strict aseptic technique
- Tourniquets and all insertion equipment are to be single patient use (i.e. IV Start Pack)
- Careful skin preparation
- Careful site management
- Examine equipment for integrity and expiry date
- Use of filter needle for IV medications
- Correct storage and handling of blood products
- Schedule for change of IV tubing and solutions (see Table 2)
- Ongoing assessment to find signs of infection early
- Use of safety engineered IV catheters

Infection Control Guidelines/ Policies
- All staff will follow the latest Infection Control Guidelines for Principles of Infection Prevention and control, Routine Practices (including hand hygiene, application of personal protective equipment, and sharps handling and disposal) and Additional Precautions, and blood and body fluid spills clean-up.
- All IV insertion sites will be cleansed with a vigorous fraction scrub using 2% Chlorhexidine with 70% alcohol solution, prior to insertion. Cleanse an area larger than the intended dressing and allow solution to air-dry completely prior to applying dressing.
- The site must dry completely prior to the catheter insertion to allow CHG to have maximum antimicrobial effect.
- All needleless connectors will be cleansed with 70% alcohol for 30 seconds and allowed to dry completely before accessing.
- It is strongly recommended that all IV insertion sites will be covered with a transparent semi-permeable membrane dressing.
- A securement dressing/device must be used to stabilize the IV catheter. Some transparent IV dressings (Tegaderm IV Advanced®) are rated as a securement device. If a “stand-alone” securement device is used, (e.g. Statlock®) placed under a sterile dressing it must be changed at least every 7 days.
- The use of “IV baskets/trays” is strongly discouraged as the potential for cross-contamination between patients is greatly increased. Single patient use IV start packs should be used whenever possible. A minimum of IV supplies should be taken to the patient’s bedside. Unused supplies that have been in contact with the patient or their bedding can be wiped down with a disinfectant wipe provided there is no blood or body fluid contamination. If they are contaminated they should be discarded before leaving the patient bedside/room.
Table 2: IV Tubing Line Setup, Configurations, and Change Frequency

**PRIMARY IV ADMINISTRATION SETUP ONLY** (e.g. 2/3 1/3 @ 125 mL/hr):
- **Acute Care & Residential**: Date and change primary administration tubing every 96 hours, when contaminated, or whenever indicated by the solution/medication that is being administered (e.g. proPOFol, lipids), and/or after each use.
- **Community Care**: Change tubing every 24 hours in clinic setting, Change tubing every 72 hours and prn in home setting

**PRIMARY ADMINISTRATION SETUP WITH SECONDARY ADMINISTRATION SET**
(“piggyback”) (e.g. QID antibiotic, etc.)
- **Acute Care & Residential**: Date and change primary administration tubing every 96 hours, when contaminated, or whenever indicated by the solution/medication that is being administered (e.g. proPOFol, lipids), and/or after each use.
- **Community Care**: Change tubing every 24 hours in clinic setting, Change tubing every 72 hours and prn in home setting
- **Secondary**: change Q24H

**PRIMARY ADMINISTRATION SETUP WITH CONTINUOUS INFUSION SET** (e.g. continuous infusion of heparin, nitroglycerin, etc.)
- **Acute Care & Residential**: Date and change primary administration tubing every 96 hours, when contaminated, or whenever indicated by the solution/medication that is being administered (e.g. proPOFol, lipids), and/or after each use.
- **Community Care**: Change tubing every 24 hours in clinic setting, Change tubing every 72 hours and prn in home setting

**INTERMITTENT INFUSION** (with no Primary Administration Setup) (e.g. BID antibiotic, etc.)
- **Intermittent infusion**: change tubing after each dose

**ADD-ON DEVICES** (Needleless Connectors, Extension tubing, dead end caps)
- **PIVs**
  - **Acute Care & Residential**: Change needleless connectors and/or extension tubing every 7 days
  - **Community Care**: Change needleless connectors and/or extension tubing every 6-7 days
- **CVCs**
  - **Acute Care**: Change needleless connectors and/or extension tubing every 96 hours
  - **Residential & Community Care**: Change needleless connectors and/or extension tubing every 6-7 days

**SPECIALTY PRODUCTS**
- **Blood Products**: Change blood tubing after 4 hours or after 4 units of blood, whichever comes first. (Refer to Blood Administration Clinical Practice Guidelines for further details)
- **Parenteral Nutrition**: For infusions containing amino acids/dextrose, change the tubing every 96 hours.
- **Infusions containing lipid emulsion (proPOFol)**: change the tubing with each dose or a minimum of every 6 to 12 hours.

(Fraser Health Authority, 2016)
SKIN CARE

All interventions related to IV Therapy, have the potential to affect skin integrity; from the cleansing solution, to the friction scrub, to the securement device, to the application of the dressing. Catheter insertion also creates an unavoidable full-thickness wound at the entry site. Cleansing solutions and a friction scrub disrupt the skin and create shearing forces on the skin. Antimicrobial preparation of the skin is necessary, but disrupts the natural flora of the skin by design.

Despite their accepted safety, alcohol, chlorhexidine gluconate (CHG), and povidone-iodine have all been shown to cause contact reactions in otherwise healthy individuals.

Securement devices and dressings can contribute to shearing forces on the skin. Unfortunately, despite the prevalence of IV Therapy, little research has been done on the effects on the skin.

When erythema is present after application of cleansing solutions, it is generally presumed to be an allergic reaction. However, two forms of contact dermatitis have been reported in the literature. Allowing the cleansing solution to dry completely before dressing application and the use of new dressing products made for sensitive skin will help to alleviate this is a large sector of the population.

Adhesive trauma is also present, particularly skin stripping and tension blisters. Correct application and removal techniques for adhesive products are vital to avoid injury to the skin. Ensure you follow all of the manufacturer’s directions for use.

(Thayer, 2012)

To prevent damage to the skin, a sterile barrier product (see Figure 9) shall be applied to the skin after the cleansing solution has dried completely.

Use of a sterile clear acrylic absorbent dressing product (see Figure 10) underneath the TSM dressing has been shown to be effective in managing skin tears without compromising the efficacy of a TSM dressing with securement properties. See also Clinical Skills by Elsevier for application procedure. In cases of more severe or complex skin damage, complete a Wound Assessment and consult with your Wound Care Clinician as required.
PIV INSERTION KEY POINTS

Approach to the Patient

The approach of the nurse is important in the patient’s ability to accept the therapy. Safety both physical and psychological is important to the patient. Although routine to the nurse, many procedures in hospital are frightening to the patient. Exaggerated fear triggers the "stress response" with a cascade of undesirable physiological events, including fluid retention and increased work of the heart. Avoid using words that might add to the patient's apprehension, such as “needle” or “stick”. You might say “I’m going to put this soft plastic catheter in your arm to deliver your medication” (Hadaway, 2005).

- Check patient's chart for IV order and pertinent history and allergies (e.g. to tape or cleansing solution)
- Identify the patient by identiband and by asking his/her name and birthdate (at least 2 identifiers)
- Address the patient by name
- The patient’s level of comfort should be assessed and pain controlled if possible, and positioning should be adjusted as needed for access to the desired insertion site.
- By calm explanation of the therapy and it’s expected benefits, the patient’s misinterpretations and fears may be alleviated
- Involve the patient in site selection (if possible)
- Draw bedside curtain and ensure privacy (as needed)

Key points to Site Selection

Many factors should be considered when choosing a vein for venipuncture:

- Patient’s age, body size, condition and level of physical activity
- Patient’s condition and medical history
- Vein condition, size and location
- Type and duration of prescribed therapy. If prolonged therapy is anticipated, preservation of veins is essential. Select most distal and appropriate vein first. If medication/solution has high potential for vein irritation, select the largest and most appropriate vessel to accommodate the infusion. Perform venipuncture proximal to a previously cannulated site, injured vein, bruised area or site of a recent complication (infiltration, phlebitis, infection) or where impaired circulation is suspected.
- Patient activity
- Your skill at venipuncture
- Surgery to be done, position of limb during surgery, or if orthopedic surgery, avoid hands (needed for crutch walking)
Points to Ponder on Insertion

- Do not routinely re-site PIVs. The decision to replace the PIV should be based on whether the PIV is still clinically indicated, functioning, the integrity of the insertion site, and whether it is a source of sepsis. (Infusion Nurses Society, 2012) (Infusion Nurses Society, 2016)
- No more than 2 attempts at insertion should be made by any one IV practitioner whenever feasible. Efforts should be made to have subsequent insertion attempts made by a more experienced IV Therapy practitioner. If attempts by 2 IV practitioners are unsuccessful, consult with Physician re: early referral for Extended-Dwell PIV or CVC. Patients with difficult vascular access require a careful assessment of their vascular access device needs and collaboration with the healthcare team to discuss appropriate options. Multiple unsuccessful attempts limit future vascular access, cause the patient unnecessary pain, and increase their risk of developing phlebitis. (Infusion Nurses Society, 2016) (Washington & Barrett, 2012)
- Use strategies to "Save the Vein" when selecting a PIV site with Renal patients, including using the dorsum of the hand of the non-access limb for PIVs. See details in BC Renal Agency Chronic Kidney Disease: Vein Preservation Vascular Access Guideline. (BC Renal Agency, 2012)
- Avoid using areas of flexion, areas of pain on palpation, compromised veins, areas near valves, areas where there are planned surgical procedures, or the extremity on the side of breast surgery with axillary node dissection, after radiation therapy to that side, with the presence of lymphedema, or the affected side after a stroke. (Infusion Nurses Society, 2016)
- Use of the veins in the antecubital fossa should be used for emergent access only due to associated high rates of phlebitis and nerve injuries. Consider the use of alternate veins in the lower arm and hand before using the antecubital fossa or the inner aspect of the wrist. (Infusion Nurses Society, 2016)(Masoorli, 2007)
- Use of the veins in the inner aspect of the wrist should be avoided due to high rates of phlebitis and nerve injuries. Venipuncture should be initiated at least 2 in and/or 5 cm above the crease of the wrist in an adult patient and 1 in above the crease of the wrist of a baby. (Masoorli, 2007)
- The use of veins in the lower extremities does not require an Order. These veins should not be used routinely in the adult population and should be limited to emergent access. Any patient who requires an IV in a lower limb due to access problem with an upper limb should be considered for the insertion of a central venous catheter (CVC). This route should be considered with caution in patients with peripheral vascular disease (e.g. diabetes).
- Consider application of transdermal topical anesthetic cream, spray, or patch to intended insertion site as needed and when available. Remove anesthetic cream/patch after manufacturer recommended application time. Remove any residual cream with a gauze pad. The use of transdermal topical anesthetic cream, spray, or patch to intended insertion site by an RN does not require an Order.
- Obese patients are considered difficult vascular-access patients. IV site assessment should be conducted during the initial patient assessment or preoperative examination. Traditional methods of vascular access placement have low success rates in the obese population. Consider referral to a PICC RN or MRP for insertion using real-time ultrasonography in conjunction with longer peripheral IV cannulas to improve outcomes for obese patients. (Houston, 2013)
- External Jugular Peripheral Intravenous Catheters (EJ PIVs) (Infusion Nurses Society, 2008)
  - Are used for emergent access or for individual situations when other veins cannot be accessed.
  - May only be inserted by a Physician in FHA.
  - Contraindicated for use with power injectors or contrast media.
  - Dwell times must be limited to prevent formation of fibrin sheaths. Plan immediately to place an alternative vascular access device.
  - Patients with an EJPIV must have alternate access established before transfer to a non-Critical Care unit or staff on the receiving unit must have training and be assessed as competent in their use.
Evaluating the Selected Vein

Carefully examine both extremities using observation and palpation before selecting the most appropriate vein. By using the same fingers (not thumbs) consistently, palpation skills will become more sensitive. To palpate a vein, place one or two fingertips (not thumbs) over it and press lightly. Release pressure to assess the vein’s elasticity and rebound filling. To acquire a highly developed sense of touch, palpate before every cannulation – even if the vein looks easy to cannulate (Hadaway, 2005).

EQUIPMENT

The Cannula

The selected cannulation device should be the smallest gauge and shortest length to accommodate the prescribed therapy. This allows better blood flow around the catheter, reducing the risk of phlebitis and promoting proper hemodilution of the fluid (Hadaway, 2005).

IV catheters are available in a range of sizes:

<table>
<thead>
<tr>
<th>Catheter Gauge Size</th>
<th>Use this size gauge for:</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 – 18</td>
<td>Trauma patients/Rapid Infusions</td>
</tr>
<tr>
<td></td>
<td>High Viscosity Fluids</td>
</tr>
<tr>
<td>20</td>
<td>Pre-Operative Patients</td>
</tr>
<tr>
<td></td>
<td>Blood Transfusions</td>
</tr>
<tr>
<td>22</td>
<td>General Infusions</td>
</tr>
<tr>
<td></td>
<td>Blood Transfusions</td>
</tr>
<tr>
<td></td>
<td>Children and Elderly</td>
</tr>
<tr>
<td></td>
<td>(Not suitable for rapid infusions)</td>
</tr>
<tr>
<td>24</td>
<td>Fragile-Veined Patients</td>
</tr>
<tr>
<td></td>
<td>Children</td>
</tr>
</tbody>
</table>

The IV Solution

- The Physician’s Order should be checked for type, amount and rate of solution
- The colour, clarity and expiry date of the solution
- The integrity of the container and the administration set should be inspected
- The IV administration set should be primed
- The fluid should be suspended approximately 3 feet above the pump on an IV pole.
Electronic Infusion Devices

- To prevent or closely control fluid volumes an electronic or flow control infusion device should be used.
- Examples may include a Large Volume IV pump, CADD pump (often used for epidural and subcutaneous infusions), Patient Controlled Analgesia (PCA) pump, or syringe pump.
- Ensure you have completed the Infusion Pump Learning Program at least every 2 years to maintain your competency and meet Accreditation Canada standards. (Accreditation Canada, 2016).
- IV Infusion pumps shall be used for administration of all IV fluids and medications, including blood and blood products. Appropriate tubing type and/or filter size should be considered when selecting the correct tubing for the intended purpose. See medication specific information in the PDTM and transfusion specific recommendations from FH Transfusion Medicine and FH Blood Administration Guidelines.
- Use of gravity flow-based IV fluid administration is limited to circumstances where an IV Pump cannot be used or with specified uses in specific care areas. These may include IV rates greater than 999 mL/hr when a Rapid Infuser is not used, during Medical Imaging procedures that do not allow for the use of a pump or where other infusion devices are used (e.g. Magnetic Resonance Imaging, CT Scans using pressure injection of contrast media, Nuclear Medicine injection of radioactive isotopes), in Community home-based settings with intermittent infusions, and in areas where the primary route is IV Direct only making the use of a pump unworkable (e.g. Procedural/Conscious sedation, endoscopy procedures). In general, gravity flow-based medication administration is not recommended and should be avoided due to the risks of medication error and patient safety. **Exception:** In certain circumstances administration of chemotherapeutic agents may be required to be infused via gravity. For further information, refer to the BC Cancer Agency Guidelines at www.bccancer.bc.ca. (BC Cancer Agency, 2014)
- Unique or different infusion devices should be used for administration of fluids and/or medications via different routes (e.g. IV, epidural, subcutaneous, gastrointestinal). Using physically separate infusion devices for different routes prevents medication errors by making the routes and associated infusion devices separate and easily distinguishable. When using multiple infusion devices with the same patient, ensure you trace the line from the pump to the patient. Label each line at the connection nearest the patient with the fluid and/or medication and the route it is being administered.  
TECHNIQUES IN VENIPUNCTURE

GATHER EQUIPMENT

- Non-sterile Gloves
- IV Catheter
- Start Pack Kit/ Insertion supplies:
  - Chlorhexidine 2% with Alcohol 70% swab
  - Single use tourniquet
  - Transparent securement dressing
  - Tape
  - Sterile 2x2 gauze
- IV Catheter Extension set with needleless connector
- Pre-filled 5 mL NS syringe
- Stand-alone securement device (optional and primarily only used for some Pediatric and NICU patients)
- IV solution as required (prepared with appropriate primed tubing suspended on a pole)
- Electronic Infusion Device or Flow Rate Control Device as required

VENOUS DISTENTION

Perform hand hygiene and put on non-sterile gloves. Apply a single-use disposable tourniquet tightly enough to distend the vein, while still allowing an arterial pulse. Latex-free tourniquets are preferred as they can be a source of exposure to those with a latex allergy. The tourniquet is applied to the mid-forearm for use of hand veins, and to the upper arm for veins in the forearm. Apply the tourniquet flat, to avoid pulling hair or pinching skin. Venous distension may take longer in elderly or dehydrated patients.
If the vein fills poorly, try the following:

- Position the arm below heart level or hang arm down (before securing tourniquet) to encourage capillary filling
- Have the patient open and close their hand several times (the hand should be relaxed during venipuncture)
- Light tap of your finger over the vein (Do not slap; hitting it too hard will cause vasoconstriction)
- If necessary, cover the entire arm with warm compresses for 10 – 15 minutes to trigger vasodilation

![Figure 15](Image courtesy of J. Switzer©)

**SITE PREPARATION**

- **Shaving is not recommended** because there is a potential for causing micro-abrasions which increase potential introduction of microorganisms into the vascular system. If excess hair must be removed, clipping with scissors is recommended.
- Using friction, apply the facility approved antimicrobial solution in a back and forth using friction, 2 to 3 inches in diameter (Center for Disease Control and Prevention, 2011). The solution should be allowed to completely air dry prior to venipuncture. This may take up to 3 minutes.

![Figure 16](Images courtesy of 3M®)
STABILIZING THE VEIN

Stabilizing or “anchoring” the vein prevents movement of the vein during insertion and minimizes the pain associated with venipuncture. Superficial veins have a tendency to roll because they lie in loose, superficial connective tissue. To prevent rolling, maintain vein in a taut, distended, stable position.

Hand Vein - Grasp the patient’s hand with your non-dominant hand. Place your fingers under his palm and fingers, with your thumb on top of his fingers below the knuckles. Pull his hand downward to flex his wrist, creating an arch (Hadaway, 2005). Use your thumb to stretch the skin down over the knuckles to stabilize the vein.

Forearm Vein - Encircle the patient’s arm with your non-dominant hand and use your thumb to pull downward on the skin below the venipuncture site. If the skin is particularly loose, the vein may need to be held taut downward below the vein and to the side of the intended site.

Maintain a firm grip of the vein throughout venipuncture.

METHODS OF VENIPUNCTURE

Direct Method - performed by holding the skin taut and entering the skin directly over the vein at a 5 – 15 degree angle. This technique is useful for large veins. If inserted too far it may penetrate the back wall of the vein.

Indirect Method - the skin is entered beside the vein, and the catheter is redirected to enter the side of the vein. This motion reduces the risk of piercing the back wall.
INSERTING THE CANNULA

Before performing venipuncture, remove the cover from the IV catheter and examine the tip for smoothness. If any barbs are evident, discard the catheter. Rotate the catheter 360 degrees to release the catheter from the stylet as they are heat sealed during the manufacturing process. Once you have anchored the vein, press the vein lightly to check for rebound elasticity and to get a sense of its depth and resilience. Palpate the portion where the cannula tip will rest, not the point where you intend to insert the cannula. **Note: If you touch the insertion site after cleansing, you will need to re-clean the site and let it dry completely before proceeding. DO NOT remove fingertip from gloves for PIV insertion.**

While holding the skin taut (and keeping the vein immobilized) with your non-dominant hand, grasp the cannula (bevel facing up to reduce the risk of piercing the vein’s back wall). Your fingers should be placed so that you can see blood backflow in the flash chamber or extension tubing. Some catheters are designed to provide early flashback of blood between the needle and the catheter.

![Figure 18](Image courtesy of BD®)

![Figure 19](Image courtesy of BD®)

![Figure 20](Image courtesy of BD®)
- Encourage the patient to relax (breathe slowly in and out as you insert the cannula). Talk to the patient through the procedure to educate them and decrease their anxiety.
- Insert catheter at a 5 to 15 degree angle (depending on depth of the vein), about 1 cm below the point where the vein is visible.
- Don’t always expect to feel a “popping” or “giving-way” sensation (not usual on thin walled, low volume vessels). Look for blood backflow to tell you that you have entered the vein lumen.
- When you see continuous backflow (and you are confident the stylet tip is in the vein), lower your angle (almost to skin level) and advance slightly (approximately 1/8 inch) to ensure the cannula tip is also in the lumen of the vein. Continue to hold the stylet hub with your dominant hand.
- While immobilizing the vein, advance the catheter into the vein lumen. There are three methods of advancing the catheter:

**ONE-HAND TECHNIQUE** - While non-dominant hand maintains skin traction, advance the catheter using the push-off tab with one hand.

![Figure 21](Image courtesy of BD®)

**TWO-HANDED TECHNIQUE** - Release skin traction held by your non-dominant hand. Move dominant hand to the plastic catheter hub and hold the stylet hub with your non-dominant hand. Separate the plastic catheter from the stylet by pushing the catheter into the vein slightly. Continue to hold the plastic catheter with your dominant hand. Reestablish skin traction with your non-dominant hand. Advance the plastic catheter with your dominant hand until it is inserted completely. Avoid moving the stylet back into the catheter lumen (this can shear the catheter).
“FLOATING” THE CANNULA INTO THE VEIN – Connect the primed administration set to the catheter hub (when the catheter is only partly inserted into the vein). Flush catheter with IV solution while advancing the catheter.

- Once the cannula is totally advanced into the vein, apply digital pressure beyond the cannula tip and release the tourniquet.

- If using a cathalon with Blood Control® technology, the tourniquet may be released and the safety mechanism activated without applying digital pressure, due to the valve in the cathalon hub. The blood control valve will only function when initially connected to the IV tubing and will not function as a blood control mechanism afterwards.

- Stabilize the hub and activate the safety mechanism. Dispose of the shielded needle in a sharps container.

- Connect the pre-primed extension set with needleless connector with/without continuous IV tubing. Flush extension tubing with needleless connector with 2-3mL of NS using a pre-filled 3-5 mL NS syringe. Clamp extension set for safety in case of accidental removal of needleless connector. The frequency the PIV is flushed is every 12 – 24 hrs, depending on setting (e.g. acute vs community).

- Apply dressing (see next page)

- If the IV is continuous, loop the administration set tight (without kinking tubing) and secure with tape. Set appropriate IV rate.
3 Hold dressing with adhesive side facing the skin, grasping the non-adhesive portion of the dressing frame. Bend slightly with thumb. Position clear portion of dressing over insertion site with notch ends of the dressing pointing distally toward fingers.

5 Apply firm pressure over film to establish adhesion to hub and skin. Wrap notched ends of dressing beneath catheter hub, one at a time. Apply firm pressure to entire dressing and frame.

6 Slowly peel back frame while simultaneously pressing down dressing edges.

7 Remove precut sterile tape strips from paper frame. Fold edge over itself making a small tab for easier removal. Apply large tape strip over the tubing by pinching tape around luer hub and applying firm but gentle pressure to maximize adhesion. Apply documentation tape strip to secure the J loop with the extension tubing.

**It is acceptable to place this tape strip over the connection if desired as it is designed to be removed and re-applied without damaging the dressing. However, any other kind of tape over a connection should be avoided.

8 Apply firm pressure to entire dressing to ensure optimal adhesion. Apply documentation label.

Figure 28
Images courtesy of 3M® (3M Health Care, 2014)
TROUBLESHOOTING IV INSERTION

If the initial insertion attempt is unsuccessful, consider the following options:

<table>
<thead>
<tr>
<th>COMMON PROBLEMS WITH IV INSERTION</th>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approaching a palpable vein that is only visible for a short segment</td>
<td>Patient anatomy</td>
<td>- Insert the cannula 1 – 2 cm distal to the visible segment and tunnel the cannula through the tissue to enter the vein</td>
<td></td>
</tr>
<tr>
<td>Missed Vein</td>
<td>Vein rolled or moved with inadequate “anchoring” allowing stylet to push the vein aside</td>
<td>- Anchor vein, maintain traction and reposition catheter slightly - DO NOT excessively probe the area and NEVER RESINSERT STYLET BACK INTO CATHETER (can shear off a piece of the plastic)</td>
<td></td>
</tr>
<tr>
<td>Hematoma develops with insertion</td>
<td>- Failure to lower the angle after entering the vein (trauma to the posterior vein wall) - Angle too great - Used too much force during insertion - Failure to release the tourniquet promptly when the vein is sufficiently cannulated (increased intravascular pressure) - Wrong angle</td>
<td>- Lower angle after entering skin - Decrease angle with insertion - Use a smoother approach (to avoid piercing posterior wall) - Release tourniquet once catheter has been “threaded” - Ensure angle is reduced once stylet is in the vein and advance slightly to ensure catheter is in the vein</td>
<td></td>
</tr>
<tr>
<td>Cannot advance the catheter off the stylet</td>
<td>- Stopping too soon after insertion (so only the stylet, not the plastic catheter, enters the lumen, blood return disappears when you remove the stylet because the catheter is not in the lumen). - Heat seal on catheter not released prior to use</td>
<td>- Pull catheter back slightly - Rotate catheter 360 degrees on needle and re-seat before insertion</td>
<td></td>
</tr>
</tbody>
</table>

- If still unsuccessful, remove the catheter, apply pressure to the site, and try again with a new catheter and a new site (preferably on the opposite arm). If you are unsuccessful after two attempts, have another RN or Intravenous Therapy Practitioner attempt insertion. If attempts by 2 IV practitioners are unsuccessful, consult with Physician re: early referral for Extended-Dwell PIV or CVC.
IV FLOW RATE MAINTENANCE

Although IV infusions should be run by an IV pump, understanding the basics of how to calculate rate manually is a foundation skill for IV therapy. Maintaining the IV involves planning and delivering nursing care to prevent problems, plus frequent assessment of the patient to identify problems or to treat them early.

1. **Calculating Flow Rate:**
   - Formula for calculating the flow rate using Macrodrif Tubing

   \[
   \text{gtt/min} = \frac{\text{gtt/mL of administration set} \times \text{total hourly volume (mL)}}{60 \text{ min.}}
   \]

   - Calculating flow rate using Microdrip Tubing

   For microdrip tubing the **number of gtts per minute equals the number of mL/hr**

2. **To Monitor flow rate:**

   Connect administration set to an IV infusion pump or other flow-control device. If a pump is not available, prepare a “time tape” with the volume of fluid to be infused over one hour. Attach the tape next to the solution container.

   If the IV is not running properly, you need to check the entire system to determine the cause. Sometimes the problem can be corrected easily; other times you will need to discontinue the IV and manage complications.

   When evaluating patency, start at the venipuncture site and work up towards the IV bag. The chart on the following page outlines common problems that affect flow rate and corrective actions that can be taken.
### TROUBLESHOOTING IV INFUSION

Table 5

<table>
<thead>
<tr>
<th>CAUSES</th>
<th>PREVENTION</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinked tubing</td>
<td>- Tape tubing without kinks</td>
<td>- Check IV tubing for kinks and re-tape if necessary</td>
</tr>
<tr>
<td>IV catheter kinked</td>
<td>- Securely tape after insertion</td>
<td>- Remove dressing and re-tape if necessary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Remove catheter if permanently kinked</td>
</tr>
<tr>
<td>Air trapped in tubing or injection</td>
<td>- Remove air from administration set when</td>
<td>- Tap the tubing until the bubbles rise into the drip chamber, disconnect tubing</td>
</tr>
<tr>
<td>sites</td>
<td>priming line</td>
<td></td>
</tr>
<tr>
<td>Improper height of container</td>
<td>- Suspend container a minimum of 1 meter above</td>
<td>- Increase height of container</td>
</tr>
<tr>
<td></td>
<td>IV pump/site</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drip chamber less than ½ full</td>
<td>- Fill drip chamber ½ full when priming</td>
<td>- Fill drip chamber appropriately, removing air in line if necessary</td>
</tr>
<tr>
<td></td>
<td>administration set</td>
<td></td>
</tr>
<tr>
<td>IV positional</td>
<td>- Avoid areas of flexion when inserting IV</td>
<td>- Remove tape, pull catheter back slightly &amp;/or adjust the angle of the</td>
</tr>
<tr>
<td>(catheter tip lying against vein</td>
<td></td>
<td>catheter by placing a 2 x 2 under the catheter hub.</td>
</tr>
<tr>
<td>wall)</td>
<td></td>
<td>- Watch for the IV to run @ acceptable rate) and re-tape.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note: Never reinsert a catheter that has been pulled back, as it is now</td>
</tr>
<tr>
<td></td>
<td></td>
<td>contaminated</td>
</tr>
<tr>
<td>IV blocked (clotted) due to:</td>
<td>- Maintain continuous solution in container</td>
<td>- Remove IV catheter and replace</td>
</tr>
<tr>
<td>- No remaining solution container</td>
<td>- Instruct patient to maintain at least 1 meter</td>
<td>- Increase height of pole during ambulation if necessary</td>
</tr>
<tr>
<td>- Blood backed up during</td>
<td>between container and IV site when ambulating</td>
<td>- Inspect and replace filters as needed</td>
</tr>
<tr>
<td>ambulation</td>
<td>- Prime IV filter and change as needed or</td>
<td></td>
</tr>
<tr>
<td>- Blocked in-line filter or air</td>
<td>change blood filter as per Blood Administration</td>
<td></td>
</tr>
<tr>
<td>lock in filter</td>
<td>Guidelines</td>
<td></td>
</tr>
<tr>
<td>- Phlebitis or Infiltration</td>
<td>- REFER to pg. 35 - Complications of IV Therapy</td>
<td></td>
</tr>
<tr>
<td>- Administration of medication</td>
<td>- REFER to Parenteral Drug Therapy Manual</td>
<td>- REFER to PDTM. Consider obtaining physician referral for insertion of a</td>
</tr>
<tr>
<td>with very high or low pH or</td>
<td>(PDTM) and only infuse compatible and appropriate</td>
<td>central venous catheter (CVC) if appropriate.</td>
</tr>
<tr>
<td>precipitates</td>
<td>solutions and medications through a Peripheral</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td></td>
</tr>
</tbody>
</table>

If the problem of altered flow rate has not been resolved using these actions, IV cannula removal may be necessary. Consider consulting a more experienced IV Nurse/ Practitioner prior to discontinuing IV.
PERIPHERAL IV DAILY ASSESSMENT

PIV sites should be routinely assessed for redness, tenderness, swelling, drainage, and/or the presence of paresthesias, numbness, or tingling at the specified frequency listed below. Assessment should minimally include visual assessment, palpation, and subjective information from the patient. Use the Phlebitis Scale and Infiltration Scales as warranted by the assessment and whenever the PIV is discontinued. If there is tenderness at the site, the dressing may be removed to more carefully visualize the site:

1) **At least every 4 hours:**
   a. Patients who are receiving non-irritant/ non-vesicant infusions *and* who are alert and oriented *and* who are able to notify the nurse of any signs of problems such as pain, swelling, or redness at the site.

2) **At least every 1 to 2 hours:**
   a. Critically ill patients
   b. Adult patients who have cognitive/ sensory deficits or who are receiving sedative-type medications and are unable to notify the nurse of any symptoms
   c. PIVs placed in a high-risk location (e.g. external jugular, area of flexion)

3) **At least every hour:**
   a. Neonatal patients
   b. Pediatric patients

4) **More frequently: every 5 to 10 minutes:**
   a. Patients receiving intermittent infusions of vesicants
      *(NOTE: The nurse should advocate for central vascular access administration of vesicant medications whenever possible. The peripheral infusion of vesicant agents should be limited to less than 30 to 60 minutes. In addition to visual assessment of the site, a blood return should be verified every 5 to 10 minutes during the infusion.)*
   b. Patients receiving infusions of vasoconstrictor agents.
      *(NOTE: The nurse should advocate for central vascular access administration of vasoconstrictor agents whenever possible as these agents can cause severe tissue necrosis with extravasation.)*

5) **With every Home/ Outpatient visit** - For patients receiving peripheral infusions at home as overseen by Community or Outpatient nurses, patient and family education should include:
   • What to look for: redness, tenderness, swelling, or site drainage
   • To check the site at least every 4 hours during waking hours
   • Ways to protect the site during sleep and activities
   • How to stop the infusion if signs/symptoms occur
   • To promptly report to the nurse
   • The organization’s 24-hour contact telephone numbers

6) For all patients who have a locked PIV for intermittent infusions, the site should be assessed with every catheter access/infusion or at a minimum of twice per day.

7) Temperature should be checked at a frequency according to Physician’s Orders, unit standards, and more often based on nursing clinical judgment. The possibility of Catheter-Related Bloodstream Infection should be considered when there is fever in any patient with a PIV even in the absence of site redness, tenderness, swelling, or drainage.

*(Infusion Nurses Society, 2012)*
An order from a regulated member of a health professions authorized by the employing agency is required to discontinue IV therapy (e.g. continuing order of IV fluids or parenteral medication). However, upon discharge of the patient from the healthcare facility, and when they will not be returning for outpatient IV therapy, the IV may be discontinued without an order.

IV catheters do not need to be re-sited at a pre-determined interval. They should be discontinued and re-sited upon suspected contamination or complications (e.g. interstitial, phlebitis, etc - see Complications of IV Therapy starting on pg. 38).

### Table 6 - Discontinuing a Peripheral IV

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Verify physician’s or authorized prescriber’s written order</td>
</tr>
<tr>
<td>2.</td>
<td>Verify patient’s identification, using at least 2 independent identifiers, not including the patient’s room number</td>
</tr>
<tr>
<td>3.</td>
<td>Explain procedure to patient</td>
</tr>
<tr>
<td>4.</td>
<td>Position patient as condition allows. Recumbent or Semi-Fowler’s position is preferred.</td>
</tr>
<tr>
<td>5.</td>
<td>Perform hand hygiene and don gloves</td>
</tr>
<tr>
<td>6.</td>
<td>Select and assemble equipment</td>
</tr>
<tr>
<td>7.</td>
<td>Discontinue administration of all infusates in the IV line to be discontinued.</td>
</tr>
<tr>
<td>8.</td>
<td>Gently remove all adhesive materials, including dressing. Lifts tapes toward the catheter-skin junction by stabilizing skin surrounding venipuncture site. (see Figure 30–Dressing Removal)</td>
</tr>
<tr>
<td>9.</td>
<td>Assess site for any complication, such as infiltration or phlebitis. Send swab for Culture if infection suspected.</td>
</tr>
<tr>
<td>10.</td>
<td>Place sterile gauze above site and withdraw catheter, using a slow, steady motion. Keep the hub parallel to the skin.</td>
</tr>
<tr>
<td>11.</td>
<td>Apply pressure with sterile gauze to the insertion site for 1-2 minutes or until hemostasis is achieved.</td>
</tr>
<tr>
<td>12.</td>
<td>Assess integrity of the catheter that was removed. Compare catheter to original insertion length to ensure entire catheter is removed. If catheter is not removed intact, notify physician immediately.</td>
</tr>
<tr>
<td>13.</td>
<td>Once hemostasis is achieved, apply a sterile dressing to exit wound as needed.</td>
</tr>
<tr>
<td>14.</td>
<td>Discard expended equipment in appropriate receptacles. Note: Do not discard catheter if it was not intact on removal.</td>
</tr>
<tr>
<td>15.</td>
<td>Remove gloves, disposes in appropriate receptacle, and perform hand hygiene.</td>
</tr>
<tr>
<td>17.</td>
<td>Documents removal procedure in patient’s permanent health record on PIV Insertion and Maintenance Record. a. Site assessment pre- and post-catheter removal b. Time IV was discontinued c. Catheter condition and length d. Achievement of hemostasis and dressing materials e. Ancillary procedures such as culture of exit wound and catheter f. Patient response and education g. Name and title of clinician</td>
</tr>
</tbody>
</table>

*Figure 30 – Dressing Removal Images courtesy of 3M®*
**DOCUMENTATION**

*Always document in black ink.*

Documentation must include the number of insertion attempts, insertion vein location, extremity accessed, and removal. The preferred form for documentation is the PIV Insertion and Maintenance Record (see Figure 31).

![PIV Insertion and Maintenance Record](image)

**Figure 31**

**PIV Insertion and Maintenance Record:**
- Date and time of insertion – start, re-site or removal
- If not original site (re-site) - describe condition of the previous IV site (phlebitis, infiltration, infection, etc.)
- Length and gauge of catheter inserted
- Location of site
- # of attempts, type of dressing applied and patient’s response to the procedure
- Daily assessments, cap and tubing changes, patency assessment
- NS flushes

**IV Flow Sheet/ Fluid Balance Record:**
- NS flush
- Amount and type of IV solution infusing

**Kardex:**
- Date IV extension tubing with intermittent IV cap is due (every 96 hrs)
- Date next tubing change is due (every 96 hrs)
COMPLICATIONS OF IV THERAPY

Complications of IV therapy include Phlebitis, Thrombophlebitis, Infiltration, Extravasation, Hematoma, Infection, Catheter-Related Thrombus, Air Embolism, Catheter Embolism, Pulmonary Edema, and Speed Shock:

Phlebitis and Thrombophlebitis

Phlebitis is inflammation of the wall of a vein. Thrombophlebitis is when a blood clot in the vein causes the inflammation.

The condition is characterized by pain, erythema, swelling, and palpable thrombosis of the cannulated vein. Risk factors for phlebitis include:
- Patients who are female
- Patients with poor-quality peripheral veins
- Insertion in the lower extremity, antecubital fossa, and points of flexion (particularly at the wrist)
- The presence of underlying medical conditions including cancer and immunodeficiency
- Insertion in an emergency

There are 3 major types of phlebitis: mechanical, bacterial, and chemical:

Inserting a vascular access device causes mechanical disruption to the skin, the body’s first line of defense against infection. Movement of the cannula in the site also causes mechanical injury to the vein, as does using a catheter too large for the site.

When the skin is breached, patients are at risk for bacterial infection. Hand hygiene and cleansing the insertion site thoroughly before insertion and applying a dressing after are the major steps to prevent bacterial infection. The number of PIV restarts increases the risk of contamination and may also influence bacterial phlebitis.

Chemical phlebitis can be related to the tonicity of the fluid, the number and dosage of medications, the pH of the medications, or wet skin. In particular, 5% dextrose in water is isotonic in the bag but hypotonic in the body after the dextrose is infused and metabolized. Hypertonic fluids pull fluids from the endothelium, causing the cells to shrink and making them vulnerable to infiltrations and phlebitis. C (Washington & Barrett, 2012)

Chemical irritation also happens when the skin is not allowed to dry after cleaning and before insertion of the catheter.
The most frequent and under-reported complication of PIV infusion is phlebitis, which may occur at rates as high as 50% or even as high as 75% in patients with infectious diseases; however, the incidence rate in patients who do not have diabetes, burns, or a need for urgent catheter insertion is approximately 20%. This inflammation may occur while the catheter is in place and up to 96 hours after removal. The residual occurrence of phlebitis may still be a problem to the patient as long as 5 months after the incident.


All vascular access sites should be routinely assessed for the signs and symptoms of phlebitis. Due to the high rates in patients with a PIV, patients with a PIV will be assessed using the PIV Insertion and Maintenance Record, documented daily using a Phlebitis Scale, and further actions taken based on the Grade of Phlebitis (see Table 7 below).

Table 7 - PHLEBITIS SCALE  ***adapted with permission from (Infusion Nurses Society, 2011)

<table>
<thead>
<tr>
<th>GRADE</th>
<th>CLINICAL CRITERIA</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No symptoms</td>
<td>No action</td>
</tr>
<tr>
<td>+1</td>
<td>Erythema at insertion site with or without pain</td>
<td>Observe, remove PIV and re-site if necessary</td>
</tr>
<tr>
<td>+2</td>
<td>Pain at insertion site with erythema and/or edema</td>
<td>Remove PIV and re-site if necessary on opposite arm, notify MRP if patient febrile</td>
</tr>
<tr>
<td>+3</td>
<td>Pain at insertion site with erythema, streak formation, palpable venous cord</td>
<td>Remove PIV and re-site if necessary on opposite arm, notify MRP, apply warm, moist heat to phlebitis site for 20 min periods, 3 to 4 times per day</td>
</tr>
<tr>
<td>+4</td>
<td>Pain at insertion site with erythema, streak formation, palpable venous chord greater than 3 cm in length, purulent drainage</td>
<td>Remove PIV and re-site if necessary on opposite arm, notify MRP, apply warm, moist heat to phlebitis site for 20 min periods, 3 to 4 times per day, if purulent drainage present, collect swab and send for C&amp;S.</td>
</tr>
</tbody>
</table>
Infiltration and Extravasation

**Infiltration** is defined as the inadvertent leakage of a non-vesicant solution or medication into surrounding tissue.

**Extravasation** is the leakage of a drug or fluid from a vein into the surrounding tissue during intravenous administration (NHS Cheshire and Merseyside Strategic Clinical Networks, 2016). These injuries range from less significant erythematous reactions to skin sloughing and necrosis. Whilst extravasation is possible with any intravenous injection it is considered to be especially problematic with compounds known to have irritant or vesicant properties. The onset of symptoms may occur immediately or several days to weeks after administration. If left undiagnosed or inappropriately treated, necrosis and functional loss of tissue and limb concerned may ensue. (WOSCAN Cancer Nursing and Pharmacy Group, 2012)

Extravasation is associated with cytotoxic chemotherapy agents such as doxorubicin, paclitaxel, and vinca alkaloids, as well as a number of non-cytotoxic drugs, including phenytoin, sodium bicarbonate (>5%), calcium chloride and gluconate, amphotericin B, acyclovir, ganciclovir, digoxin, dazepam, potassium (>40 mmol/L), dextrose 50%, cefotaxime, IV contrast media, and mannitol, that can also cause tissue necrosis. The incidence of infiltration and extravasation is hard to determine because of limited reporting; however, extravasation injury from cancer chemotherapy is reported to be 11% in children and 22% in adults. One study found that, of all the complications associated with PIVs, 33.7% occurred as a result of infiltration. Rates of extravasation with cancer chemotherapy infused through implanted ports range from 0.3% to 6%. (Dychter, Gold, Carson, & Haller, 2012) (Hadaway, 2007)

***See also Extravasation Drug and Antidote Table on the FH Pulse.

1. **Vesicant** - A drug which has corrosive properties and has the potential to cause tissue destruction if extravasated. Varying degrees of pain, edema, erythema, blistering and necrosis may occur. Vesicants are further divided into two groups. When extravasated, non-DNA binding agents (vinblastine, vinorelbine, vincristine) are inactivated or quickly metabolized and follow the normal healing process whereas DNA binding agents (epirubicin, mitomycin, doxorubicin, daunorubicin, idarubicin) remain in the tissues resulting in long-term injury.

2. **Exfoliant** - A drug capable of causing inflammation and shedding of skin but less likely to cause tissue death.

3. **Irritant** - This has the potential to cause pain, aching, tightness and phlebitis with or without inflammation, rarely progressing to tissue breakdown.

4. **Inflammitant** - Drug with the potential to cause mild to moderate inflammation and flare in local tissues.

5. **Neutral Drugs** – Drugs that cause very little or no tissue damage when extravasation occurs.


All vascular access sites should be routinely assessed for the signs and symptoms of infiltration and extravasation. Due to the high rates in patients with a PIV, patients with a PIV will be assessed using the PIV Insertion and Maintenance Record, documented daily using an Infiltration Scale (see Table 8 below), and further actions taken based on the Grade of infiltration (see table below). Children and infants are vulnerable populations requiring special attention and the use of appropriate assessment tools. Pediatric assessment has been incorporated into this tool.

**Measures to prevent infiltration and extravasation** include:
- Selection of an appropriate site for catheter insertion - Avoid areas of joint flexion such as wrist and antecubital fossa
- Selection of an appropriate size catheter - Use the smallest size catheter needed for the prescribed therapy
- Use of appropriate fluids depending on vascular access type – Medications/fluids with an osmolarity of greater than 900 mOsm/L, a pH of less than 5 or greater than 9, and vesicants need to be given via a CVC.
- Stabilization of the catheter – Always use a securement device/dressing. Avoid circumferential taping of the limb.
- Use of proper administration techniques - The patency of the catheter and vein should be assessed frequently so that infiltration or extravasation can be prevented. Before administering each dose of medication, the nurse should visually inspect and palpate the site, checking for vein cording, edema, skin temperature, and tenderness or discomfort. Check for a positive blood return. Flushing the catheter with normal saline while palpating the site also makes detection of swelling at the PIV catheter tip easier. Each drug should be diluted in a separate syringe. When dilution is done either in a syringe or by slow injection through an infusing, compatible IV fluid, according to the PDTM, the injection can be stopped if the patient complains of any problems. (Hadaway, 2007)
- **More frequent site assessments:**
  - Every 5 to 10 minutes for patients receiving peripheral intermittent infusions of vesicants (NOTE: The nurse should advocate for central vascular access administration of vesicant medications whenever possible. The peripheral infusion of vesicant agents should be limited to less than 30 to 60 minutes. In addition to visual assessment of the site, a blood return should be verified every 5 to 10 minutes during the infusion.) (Infusion Nurses Society, 2012)
  - Patients receiving chemotherapeutic vesicants: The RN will remain with the patient, and will check blood return and assess the IV site every 2 minutes throughout the procedure. (BC Cancer Agency, 2014)

**Common signs and symptoms of IV infiltration**
include:
- Cool skin temperature at the insertion site
- Skin that looks blanched, taut, or stretched or that the patient says feels “tight”
- Edema at the insertion site
- Discomfort and/or tenderness
- Change in quality and flow of the infusion
- Frequent IV infusion pump downstream occlusion alarms (do not rely on an IV infusion pump to alert you to an infiltration as this alarm is often a late sign; an IV infusion pump will exacerbate the problem until the IV infusion pump is stopped) (Pennsylvania Patient Safety Authority, 2007)

**Signs and symptoms of extravasation** are the same as those of infiltration but also include burning/stinging pain, redness followed by blistering, tissue necrosis, and ulceration. Both infiltration and extravasation can have serious consequences including full-thickness skin loss, compartment syndrome, and muscle and tendon necrosis. The patient may need surgical intervention resulting in large scars, experience limited function, or even require amputation. Another long-term effect is complex regional pain syndrome, a neurologic syndrome requiring long-term pain management. (Amjad, Murphy, Nylander-Housholder, & Ranft, 2011) (Dychter, Gold, Carson, & Haller, 2012) (Hadaway, 2007) (Infusion Nurses Society, 2016) (Simona Pop, 2012)

For extravasation of contrast media, see *Extravasation of Non-Ionic Intravascular Contrast: Patient Management Guidelines*
**Table 9 - Distinguishing Extravasation from other conditions:**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Flare reaction</th>
<th>Vessel irritation</th>
<th>Venous shock</th>
<th>Extravasation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Immediate Symptoms</strong></td>
<td>Itchy blotches or hives; pain and burning uncommon</td>
<td>Aching and tightness</td>
<td>Muscular wall of the blood vessel in spasm</td>
<td>Severe pain or burning at the PIV site and/or anywhere along the vein that lasts minutes or hours and eventually subsides; usually occurs while the drug is being given.</td>
</tr>
<tr>
<td><strong>Colouration</strong></td>
<td>Raised red streak, blotches or “hive-like” erythema along the vessel; diffuse or irregular pattern</td>
<td>Erythema or dark discolouration along vessel</td>
<td>Erythema around area of needle or around the venipuncture site</td>
<td></td>
</tr>
<tr>
<td><strong>Timing</strong></td>
<td>Transient and usually resolves with or without treatment within 30 min, sometimes within 1 – 2 hours, and rarely takes up to 24 hrs.</td>
<td>Usually appears within minutes after injection. Colouration may only appear later in the process.</td>
<td>Usually appears right after injection</td>
<td>Symptoms start to appear right after injection, symptoms endure</td>
</tr>
<tr>
<td><strong>Swelling</strong></td>
<td>Unlikely</td>
<td>Unlikely</td>
<td>Occurs often; does not dissipate for several days</td>
<td></td>
</tr>
<tr>
<td><strong>Blood return</strong></td>
<td>Usually, but not always intact</td>
<td>Usually, but not always intact</td>
<td>Often absent</td>
<td>Usually absent or sluggish</td>
</tr>
</tbody>
</table>

**FLARE:** painless local reaction along the vein or near the intact injection site characterised by:
- Immediate, red blotches or streaks (histamine release phenomenon), or local wheals; edema may sometimes occur
- With or without pruritus or irritation
- Symptoms usually subside with or without treatment 30 min after the infusion is stopped, although they may last for 1-2 hours and rarely more than 24 hours
VESSELS IRRITATION: Aching and tightness occurs along the vein. Seen with drugs such as vinorelbine and dacarbazine. Applying warmth to dilate the vein can relieve this. Blood return is usually intact although erythema or redness may be present.

VENOUS SHOCK: Rapid administration or the administration of very cold drugs can cause the muscle wall of the vein to go into spasm. Blood return may be lost. Heat can help to relax and dilate the vein.

NOTE: For oncologic agents for cancer treatment, you may defer to the BCCA Systemic Therapy Guidelines for drug categories and administration procedures.

Immediate Treatment

If extravasation is suspected, it is important to act quickly to prevent tissue necrosis. A Plastic Surgery consult is recommended for further advice to discuss removal of the device and immediate and future treatment as this may differ with each event.

1. Stop the infusion or injection immediately – DO NOT remove the PIV at this point.
2. Seek assistance if needed.
3. Disconnect the infusion (not the PIV catheter).
4. Leave the PIV catheter in place and try to aspirate as much of the drug as possible from the cannula using a 10 mL syringe. Avoid applying direct manual pressure to suspected extravasation site.
5. Remove the PIV. Elevate and apply gentle pressure to site till hemostasis is achieved. **Exception:** With extravasation of Mechlorethamine the antidote Sodium Thiosulfate is to be given through the existing IV line immediately after the extravasation and preferably though the same needle to insure injection into the same tissue plane as the extravasation.
6. Mark the affected area and take digital images of the site (with patient consent).
7. Obtain extravasation kit or appropriate antidote and notify the MRP, and PCC or Charge Nurse.
8. Decide on how the extravasation should be treated. See Error! Reference source not found..
9. Apply warm towel or ice pack wrapped in towel/cold compresses to the extravasation site for 1 hour as per Extravasation Drug and Antidote Recommendation Table. Care must be taken to avoid tissue injury from excessive heat or cold.
10. Administer pain relief as needed.
11. For vesicants, consult Plastic Surgery ASAP.
12. Document the injury with a digital image if possible. See Fraser Health Media Consent Form.
13. Provide patient education and complete all documentation, including PSLS. See Also FH Policy: Disclosure of Unintended Medical Outcomes

Extravasation kits should be stocked on or available to all inpatient and outpatient Oncology Units. For access to the medications on other sites/units, contact the Oncology Unit or Site Pharmacy. They may include the following:

- Pain Ease® spray
- 25 gauge needles
- Dimethylsulfoxide (DMSO) 99% topical solution
- 3 mL syringes
- Hyaluronidase 1500 units /mL injection (HYALASE®) ampoule**
- Black indelible ink marker
- Hydrocortisone 1% cream
- Phentolamine 10 mg
- Ice pack - in freezer
- Sodium thiosulfate 25% injection, 10 mL via***
- Sterile gauze dressings and tape
- 10 mL syringe (for preparing sodium thiosulfate)***

** Available through Health Canada Special Access Program

*** Only if intravenous mechlorethamine is available for use

Hematoma

Hematoma – A localized mass of blood located outside the vessel, usually creating a hard, painful lump.

Prevention:
• Apply firm pressure to insertion site with sterile gauze after unsuccessful attempt start
• Do not reapply tourniquet to the same limb after an unsuccessful start
• Be aware of patients taking anti-coagulants

Signs and Symptoms:
• Swelling at the site
• Discomfort at site
• Raised area of ecchymosis
• Occasionally bleeding at the site

Interventions
• Discontinue IV and re-site IV in opposite limb if possible
• Elevate the affected limb and apply direct pressure to the site with sterile gauze
• Apply cold compress
Infection

**Infection** – Catheter Related Bloodstream Infections (CR-BSI) are a preventable nosocomial infection and adverse event. (Stevens & Schulman, 2012) These infections increase hospital length of stay and facility costs. Studies of CR-BSIs that control for the underlying severity of illness suggest that mortality attributable to these infections is between 4-20%. (Safer Healthcare Now, 2012)

Infective organisms may access the vascular access device surface by either:
- Invasion of the percutaneous tract
- Contamination of the catheter hub
- Seeding from a remote source of localized infection
  (Association for Professionals in Infection Control and Epidemiology, 2009)

Increased CR-BSI rates are associated with a PIV inserted in the antecubital fossa, a PIV placed in the Emergency Department, or a PIV placed outside of hospital (e.g. EHS). (Trinh, et al., 2011)

The nurse and/or IV Therapy Practitioner shall assess patients for suspected infusion related and CR-BSIs and document signs and symptoms, interventions implemented and patient response to treatment in the patient’s permanent health record and the Patient Safety Learning System (PSLS). (Infusion Nurses Society, 2016)

**Prevention:**
- Use aseptic technique when caring for IV
- Thoroughly inspect medication and solution containers prior to use
- Inspect access site and equipment regularly
- Change administration set and solution according to IV Therapy Guideline (see Table 3 pg. 18)
- Utilize single-use intermittent medication tubing

**Signs and symptoms** of CR-BSI include:
- Erythema, edema, induration, or drainage at the vascular device insertion site
- Elevated body temperature

**Diagnosis:** Purulent drainage from the catheter-skin junction of a PIV should be collected using the Levine Technique (cleanse site with normal saline prior to collecting swab for culture and twirl the end of the cotton-tipped applicator on a 1-cm² area of the wound bed with enough pressure to cause minimal bleeding). (Spear, 2014)

**Treatment:** PIVs with purulent drainage present should be removed and re-sited based on patient need and condition. Send the catheter to Microbiology for culture if purulent drainage is noted on removal. When seen in conjunction with elevated body temperature, consult physician for order for Blood Cultures and treatment plan.

Catheter Embolism

Catheter Embolism – Catheter embolism is the result of catheter damage or rupture, resulting in the breaking off of a portion of the PIV into the bloodstream. (Canadian Vascular Access Association, 2013)

Prevention:
- Never use vascular access devices for power-injection that are not rated for this purpose.
- The size of the flush syringe should be in accordance with the type of vascular access device and its intended use.
- The most frequent cause for catheter embolism is re-insertion of the stylet into a PIV catheter.
- Catheter dysfunction, such as the inability to aspirate blood or fluid with localized pain and/or subcutaneous swelling, may be a precursor to catheter embolism. Leaking at the catheter insertion may indicate catheter rupture. PIVs which exhibit these signs should be carefully discontinued and re-sited (note any damage to the PIV tip upon removal).
- Catheter embolism should be suspected when the patient exhibits symptoms such as palpitations, arrhythmias, dyspnea, cough, or thoracic pain not associated with patient's diagnosis or comorbidities.
- Upon removal, inspect all catheters for damage and possible fragmentation. (Infusion Nurses Society, 2016)

When vascular access device removal is difficult or if damage to the catheter is seen:
1. Carefully assess the patient for signs and symptoms of catheter fragmentation and;
2. Save catheter and report via PSLS and BCCSS Product Concern Form.
Pulmonary Embolism

Pulmonary Embolism occurs when a substance (usually a blood clot) becomes free and circulates to the pulmonary artery causing occlusion. Even small recurrent emboli may cause pulmonary hypertension and right heart failure.

Risk Factors:
- Irrigation of a clogged IV
- Use of veins in lower limbs (increased risk)
- Debris in IV solution (some may require filter -refer to PDTM)
- Debris caused by incompletely dissolved, reconstituted drugs
- Unfiltered blood or plasma

Prevention:
- NEVER irrigate the catheter if the IV is not flowing
- Use in-line filters where applicable (see PDTM)
- Avoid siting IV’s in the lower extremities in adult patients when possible
- Thoroughly inspect medication and solution containers for particulate matter prior to use

Signs and Symptoms:
- Apprehension
- Pleuritic discomfort
- Dyspnea, tachypnea
- Cyanosis
- Cough, unexplained
- hemoptysis
- Diaphoresis
- Tachycardia
- Low-grade fever
- Chest pain radiating to neck and shoulders

Treatment:
- Place patient on strict bed rest in semi-Fowler’s position
- Notify physician immediately
- Monitor vital signs
- Administer Oxygen
- Assess IV and re-site if needed (for emergency drugs)
- Document in permanent health record

Figure 38 – Image courtesy Natalia Design Co. ©
**Air Embolism**

*Air Embolism* is the presence of air in the vascular system. (Infusion Nurses Society, 2016)

A venous air embolism occurs when air is introduced into the venous system and travels to the right ventricle and/or pulmonary circulation. An arterial air embolism results from air entry into the arterial system and can produce ischemia of and organ with poor collateral circulation. (Broadhurst, 2013) Air embolism is reported to occur more frequently during catheter removal than during insertion. (Truscott, 2013)

The minimum amount of air that is lethal to humans is not known, however, the risks from smaller amounts increase with a device closer to the central vasculature (CVC) or with pediatric and neonatal patients, particularly in presence of a patent foramen ovale. (Cook, 2013)

The introduction of microbubbles into the vascular system is also related to the development of an air embolism and may go unnoticed. Cardiopulmonary bypass, hemodialysis, mechanical heart valves, major surgeries, warming of cold infusates, and high IV infusion flow rates during trauma resuscitation can produce large amounts of microbubbles. (Broadhurst, 2013) (Cook, 2013)

**Factors:**
- Failure to occlude the needle hub and/or catheter during insertion or removal
- An improperly primed IV administration set
- An incorrect technique when administering drugs via the IV route
- Inadvertent infusions of air
- An accidental disconnection at the catheter hub, connector, or IV administration set
- A stopcock placed in the wrong position
- A ruptured catheter
- Poor technique during needless connector changes
- IV fluid infusions that are completed or rapid infusion through an air-filled drip chamber with an IV administration set that is unclamped

**Prevention:**
- Minimize PIV manipulations
- Remove all air from syringes, IV administration sets, needleless connectors, stopcocks, and all other devices added to a PIV
- Trace all IV lines from the catheter hub to the IV fluid container to prevent misconnections
- Remove air bubbles detected during an IV infusion. Infrequent tiny pinhead bubbles, even though not desirable, can be left but should be monitored.
- Never use scissors near a PIV to prevent accidental severing of the catheter.
- Carefully fill and prime IV administration sets and filters and ensure vented tubing in clamped off before the container is completely empty.
- Use IV infusion pumps with air sensing technology for IV fluid and medication infusions.
- Instruct patients and caregivers to not disconnect and reconnect any IV administration sets or connectors from the catheter hub to properly prime tubing, to check connections frequently, how to prevent displacement/disconnection, and actions to take in case of PIV displacement or damage. (Broadhurst, 2013) (Cook, 2013) (Infusion Nurses Society, 2016)

**Signs and Symptoms:**
- Sudden onset of dyspnea
- Continued coughing
- Breathlessness
- Agitation or irritability, often expressed as a feeling of impending doom
- Shoulder and chest pain
- Lightheadedness
- Hypotension
- Jugular venous distention
- Tachyarrhythmias
- Wheezing
- Tachypnea
- Altered mental status
- Symptoms that emulate stroke including altered speech, changes in facial appearance, numbness and paralysis (Cook, 2013) (Infusion Nurses Society, 2016)

**Diagnosis:**
Diagnosis may not be straightforward but prompt diagnosis and treatment will decrease potential mortality and morbidity. Radiological techniques including transthoracic echocardiography and precordial ultrasonography have been used to detect air embolisms. (Cook, 2013)

**Treatment:**
Treatment should begin immediately even if an air embolism is only suspected to prevent further air from entering the vasculature:
- Close, fold, or clamp the existing catheter to occlude entry of passive air.
- Occlude the puncture site of a catheter that had been removed.
- Place the patient in Trendelenberg left lateral decubitus position (left side, head flat, feet up, right side uppermost) if not contraindicated by other conditions such as increased intracranial pressure or respiratory illness. The goal of this positioning is to trap the air in the lower portion of the right ventricle and prevent it from travelling to the pulmonary arteries.
- Administer oxygen at 100%
- If possible, attempt to aspirate air from catheter.
- Monitor vital signs and start CPR as needed.
- Notify physician.

**Pulmonary Edema**

**Pulmonary Edema** is an increase in venous pressure with increased pressure in the right ventricle, pulmonary artery and subsequent fluid in the alveoli.

**Risk Factors:**
- Rapid or excessive fluid administration, especially in patients with impaired renal or cardiac function, or elderly or very young patients

**Prevention:**
- Maintain prescribed flow rate with regular patient assessment
- Use volumetric infusion pump for patients whenever possible to avoid accidental fluid overload

**Signs and Symptoms:**
- **EARLY Signs:**
  - Restlessness
  - Slow increase in pulse rate
  - Headache
  - Shortness of breath
  - Non-productive cough
  - Skin flushing
- **LATE Signs:**
  - Hypertension
  - Severe dyspnea with coarse crackles
  - Engorged neck veins (↑JVD)
  - Pitting edema
  - Pink, frothy sputum
  - Puffy eyelids
  - Shock, respiratory or cardiac arrest

**Treatment:**
- Place patient in high fowlers position
- Slow the IV to keep vein open
- Notify the physician
- Administer medications as requested by physician
- Monitor vital signs
- Administer high-flow Oxygen
- Document in permanent health care record
- Submit report via Patient Safety Learning System (PSLS) when due to accidental fluid overload
**Speed Shock**

*Speed Shock* is a sudden adverse physiologic reaction to IV medications or drugs that are administered too quickly.

**Risk Factors:** Caused by rapid infusion of drugs or solution causing toxic proportions to reach the heart and brain.

**Prevention:**
- Monitor gravity-flow administration sets closely to ensure correct prescribed flow rate
- Use volumetric infusion pump for medications as directed in the PDTM
- Follow recommended infusion rate for medication as per PDTM

**Signs and Symptoms:**
- **EARLY Signs:**
  - Dizziness
  - Facial flushing
  - Headache
  - Irregular Heart Rate
  - Chest pain/ tightness
  - Sudden onset of symptoms associated with particular medication being administered
- **LATE Signs:**
  - Syncope
  - Shock
  - Cardiac arrest

**Treatment:**
- Stop the infusion
- Maintain IV access for emergency treatment
- Notify physician immediately or Code Team if applicable
- Monitor vital signs
REVIEW QUESTIONS

1. A “Competency Assessed IV Therapy Practitioner” will:
A. Have successfully completed a theoretical and practical experience
B. Have had at least two years of experience in IV therapy
C. Be automatically certified if certified at another health agency
D. Will receive more money because of this skill

2. IV related standards, procedures and protocols may be found in which of the following manuals?
A. INS Infusion Standards of Practice
B. FHA Clinical Policy Office
C. Site-based policy manual

   1) A, B, C
   2) A, B, D
   3) A, C, D
   4) All of the above

3. Which of the following statements are true of the arterial circulatory system?
A. Arteries carry blood to the tissues
B. Blood is under high pressure in the arterial system
C. Arteries have valves to help blood flow
D. Arteries have a palpable pulse

   1) A, B, C
   2) A, B, D
   3) A, C, D
   4) All of the above

4. Which of the following statements are true of the venous circulatory system?
A. The venous system is a low pressure system
B. Veins have a weak pulse
C. Superficial and deep veins unite in the lower extremities
D. Damage to valves may result in varicosities

   1) A, B, C
   2) A, B, D
   3) A, C, D
   4) B, C, D

5. Arteries and veins have:
A. One layer
B. Two layers
C. Three layers
D. Four layers
6. Name the veins and arteries on the following diagram:

![Diagram of superficial veins of the upper limb]

Figure 4 - Superficial veins of the upper limb

7. The PIV catheter most frequently used today is:
   A. PICC
   B. Cutdown
   C. Needle-safe
   D. Internal jugular

8. The gauge of needle/cannula most commonly used for routine IV therapy is:
   A. #18g
   B. #20g
   C. #22g
   D. #24g

9. Prime factors to be considered when choosing a vein for infusion include:
   A. Location
   B. Condition
   C. Purpose
   D. Duration

   1) A, B, C
   2) A, B, D
   3) A, C, D
   4) All of the above
10. Which of the following statements are true about a needless connector (saline lock)?
   A. The needless connector lock requires short extension tubing to be added
   B. The site should be assessed and changed as required
   C. The needless connector is flushed every 12-24 hours (and/or after medication) with 2-3 mL of normal saline
   D. After removal check site for bleeding, edema, signs of infection

   1) A, B, C
   2) A, B, D
   3) B, C, D
   4) All of the above

11. Which of the following are nursing actions to be done before starting the PIV?
   A. Check patient's chart for allergies and doctor's order
   B. Identify the patient by identity band and by asking their name
   C. Involve the patient in site selection
   D. Ensure privacy

   1) A & B
   2) A, B, D
   3) B, C, D
   4) All of the above

12. Venous distention may be achieved by which of the following?
   A. Tourniquet to mid-forearm for use of the hand veins
   B. Tourniquet tight enough to occlude an arterial pulse
   C. Position the arm below heart level
   D. Application of warm packs 10-15 minutes prior to IV start

   1) A, B, C
   2) A, B, D
   3) A, C, D
   4) B, C, D

13. Stabilizing the vein minimizes the pain associated with venipuncture:
   A. True
   B. False

14. Factors affecting flow rate of the IV are:
   A. Phlebitis
   B. Height of the IV fluid container
   C. Positional IV
   D. Air trapped in the IV tubing

   1) A, B, C
   2) A, B, D
   3) B, C, D
   4) All of the above
15. Signs of infiltration include:
   A. Sluggish flow rate
   B. Warm, reddened skin at the site
   C. Swelling of the limb
   D. Slow backflow

   1) A, B, C
   2) A, B, D
   3) A, C, D
   4) B, C, D

16. Phlebitis is caused by injury or irritation from which of the following?
   A. Long term therapy
   B. Acidic or alkaline substances
   C. Trauma during insertion
   D. Poor aseptic technique

   1) A, B, C
   2) A, B, D
   3) B, C, D
   4) All of the above

17. Signs of Catheter-Related Bloodstream Infection (CR-BSI) include:
   A. Fever
   B. Increase in pulse rate
   C. Hypotension
   D. Sudden onset of chills

   1) A, B, C
   2) A, B, D
   3) B, C, D
   4) All of the above

18. To prevent Catheter-Related Bloodstream Infection (CR-BSI) which of the following are recommended?
   A. Examine solutions carefully
   B. Cut the fingertips off gloves of IV Therapy Practitioner prior to insertion
   C. Mix solutions at the bedside
   D. Mix solutions in Pharmacy in a laminar flow hood

   1) A & C
   2) A & D
   3) C & D
   4) B & D

19. Symptoms of Catheter Embolus include which of the following?
   A. Dyspnea
   B. Chest pain
   C. Diaphoresis
   D. Weak rapid pulse

   1) A, B, C
   2) A, B, D
   3) B, C, D
   4) All of the above
If an Air Embolus is suspected, the appropriate intervention is to:
   A. Turn patient on left side, head down
   B. Turn patient on right side, head down
   C. Turn patient on left side, head raised
   D. Turn patient on right side, head raised

Early signs of Pulmonary Edema include:
   A. Restlessness
   B. Headache
   C. Shortness of breath
   D. Fever
   
1) A, B, C
2) A, B, D
3) A, C, D
4) B, C, D

Factors predisposing the patient to Catheter-Related Bloodstream Infection (CR-BSI) including all the following except:
   A. Age less than one year or more than 60 years
   B. State of immune system
   C. Increased red blood cell count
   D. Presence of distant infection

The most common source of bacteria responsible for IV infection comes from:
   A. Airborne sources
   B. The patient's skin
   C. The cannula
   D. Healthcare worker's hands

Which of the following measures help to reduce IV related infections?
   A. Handwashing prior to venipuncture
   B. Use of a laminar hood for IV admixtures
   C. Protection of intermittent infusion IV tubing
   D. Sterile dressing using aseptic technique
   
1) A, B, C
2) A, B, D
3) B, C, D
4) All of the above

What percentage of the adult’s weight is body fluid?
   A. 5%
   B. 15%
   C. 40%
   D. 60%

What percentage of the adult’s weight is contained in intracellular fluid?
   A. 5%
   B. 15%
   C. 20%
   D. 40%
27. How often should needleless connectors and extension sets be changed in acute care?
   A. Every 6-7 days
   B. Every 24 hours
   C. Every shift
   D. Every 96 hours

28. Body water and electrolytes move in which of the following ways?
   A. Colloidal
   B. Diffusion
   C. Active transport
   D. Osmosis
   1) A, B, C
   2) A, B, D
   3) B, C, D
   4) All of the above

29. Which electrolyte is responsible for regulating water distribution in the body?
   A. Potassium
   B. Calcium
   C. Sodium
   D. Chloride

30. Which electrolyte is essential for the normal function of the heart muscle?
   A. Potassium
   B. Zinc
   C. Sodium
   D. Chloride

31. Which statements are true about acid-base balance?
   A. Kidneys, lungs and skin are the main regulating organs
   B. The normal pH is 7.35-7.45
   C. Acidosis is a decrease in pH
   D. Alkalosis is an increase in pH
   1) A, B, C
   2) A, B, D
   3) B, C, D
   4) All of the above

32. Hypotonic is a term which means that a solution has:
   A. A higher osmotic pressure than the blood
   B. A lower osmotic pressure than the blood
   C. The same osmotic pressure as blood
   D. Ability to carry O2 to the cells

33. Which of the following statements are true of a hypertonic solution?
   A. Draws water out of the cells and interstitial space and into the intravascular space
   B. Has a higher osmotic pressure than the blood
   C. Has a lower osmotic pressure than the blood
   D. Dextrose 10% and 50% in water are examples of a hypertonic solution
   1) A, B, C
   2) A, B, D
   3) B, C, D
34. 3% and 5% saline have been called dangerous solutions because:
   A. They move water out of the cell and interstitial space and into the intravascular space
   B. They cause imbalance in the intracellular water and sodium
   C. They are isotonic
   D. They contain a lot of potassium

35. Which of the following statements are true regarding Infusion Pumps?
   A. Only appropriate vendor-specific IV tubing should be used with IV Infusion pumps
   B. Different Infusion devices should be used when therapies are administered via different routes (e.g. IV, epidural, subcutaneous)
   C. IV Infusion pumps do not have a safety clamp (anti-free flow clamp) which is activated by opening the door
   D. An IV Infusion Pump should be used for most IV fluid and medication administration

   1) A, B, C
   2) A, B, D
   3) A, C, D
   4) B, C, D

36. Which of the following statements are true about the immediate treatment for extravasation?
   A. Stop the infusion immediately
   B. Leave the PIV catheter in place and try to aspirate as much of the drug as possible
   C. Apply direct manual pressure to suspected extravasation site
   D. Obtain extravasation kit or appropriate antidote

   1) A, B, C
   2) A, B, D
   3) B, C, D
   4) All of the above

37. Which of the following should be charted on the patient’s permanent health record?
   A. Length and gauge of the IV catheter
   B. Site of venipuncture
   C. Number of missed insertion attempts
   D. Patient’s response to the procedure

   1) A, B, C
   2) A, B, D
   3) B, C, D
   4) All of the above

38. Which of the following statements are true about PIV Assessment?
   A. All PIV sites should be assessed routinely
   B. Neonatal and pediatric patients should have their PIV sites assessed every 4 hours
   C. PIV sites should be assessed every 5-10 min when administering vesicants
   D. PIV sites should be assessed with every Home or Outpatient visit

   1) A, B, C
   2) A, B, D
   3) B, C, D
   4) A, C, D
39. All patients with a PIV should be assessed daily using the Phlebitis Scale and the Infiltration Scale.
   A. True
   B. False

40. The most frequent cause for catheter embolism is re-insertion of the stylet into a PIV catheter.
   A. True
   B. False
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<tr>
<th>Question</th>
<th>Answer</th>
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REFERENCES


Fraser Health Authority. (2010). Scope of Practice. Fraser Health Authority.


Fraser Health Authority. (2012). Pediatric Considerations for Peripheral Intravenous Initiation. Fraser Health Authority.


APPENDIX A: EDUCATION AND COMPETENCY GUIDELINES

1) PIV INSERTION EDUCATION AND COMPETENCY – ADULTS

***NOTE: Does not apply to the insertion of Extended-Dwell PIVs, where insertion is limited to a competent PICC Nurse***

<table>
<thead>
<tr>
<th>RN/ RPN/ LPN</th>
<th>INTRAVENOUS THERAPY PRACTITIONER</th>
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<tbody>
<tr>
<td><strong>Initial Training:</strong></td>
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<tr>
<td>IV Insertion Skills Session</td>
<td>Initial Training: IV Insertion Skills Session</td>
</tr>
<tr>
<td>Self-Learning Module</td>
<td>Self-Learning Module</td>
</tr>
<tr>
<td>Emphasis on initiation, maintenance, and becoming clinical experts</td>
<td>Emphasis on initiation and maintenance</td>
</tr>
<tr>
<td><strong>Training done by:</strong></td>
<td></td>
</tr>
<tr>
<td>Clinical Nurse Educator or expert RN (may be provided during Nursing Orientation)</td>
<td>Training done by: Clinical Nurse Educator or expert Intravenous Therapy Practitioner in their area</td>
</tr>
<tr>
<td><strong>Demonstration of competency to:</strong></td>
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<tr>
<td>Novice</td>
<td>Novice</td>
</tr>
<tr>
<td>Minimum 3 successful starts with expert RN - expert RN would be defined as a person who can mentor, teach, observe.</td>
<td>Minimum 3 successful starts with expert Intravenous Therapy Practitioner - expert Intravenous Therapy Practitioner would be defined as a person who can mentor, teach, observe.</td>
</tr>
<tr>
<td>Experienced</td>
<td>Experienced</td>
</tr>
<tr>
<td>Demonstration x1 with expert RN</td>
<td>Demonstration x1 with expert IV Therapy Practitioner</td>
</tr>
</tbody>
</table>

**Note:** Use appropriate competency guidelines listed above, dependent upon skill requirements for clinical area and scope of practice.

<table>
<thead>
<tr>
<th>Peripheral IV Skill</th>
<th>RNs/ RPNs</th>
<th>LPNs</th>
<th>IV Therapy Practitioners</th>
<th>ESNs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PIV initiation</strong></td>
<td>Yes</td>
<td>Yes, <em>adults pts only</em></td>
<td>Yes (depending on care area)</td>
<td>Yes, only ESNs who have completed education within their Nursing Program and under direct supervision of their Clinical Nurse Educator or Mentor RN may insert PIVs.</td>
</tr>
<tr>
<td><strong>Extended-Dwell PIV initiation</strong></td>
<td>Advanced Competency Assessed PICC RN</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>PIV and needleless connector discontinuation</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td><strong>IV Maintenance</strong></td>
<td>Adjusts rates, changes bags &amp; tubing of all medicated IV solutions appropriate for practice area and scope</td>
<td>Adjusts rates, changes bags &amp; tubing of all medicated IV solutions (with additional education) appropriate for practice area and scope for patients with stable and predictable states of health</td>
<td>Adjusts rates, changes bags &amp; tubing of NaCl, D5W, 2/3/1/3 &amp; RL with NO added medications Including KCl</td>
<td>Adjusts rates, changes bags &amp; tubing of all medicated IV solutions appropriate for practice area and scope.</td>
</tr>
<tr>
<td><strong>Maintenance of Needleless Connectors</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (extra training may be required)</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Evaluates response to IV therapy and takes actions to prevent complications related to IV therapy</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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APPENDIX B: CLINICAL COMPETENCY VALIDATION - PIV CATHETER INSERTION

<table>
<thead>
<tr>
<th>Decision Criteria</th>
<th>#1</th>
<th>#2</th>
<th>#3</th>
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<tbody>
<tr>
<td>1. Purpose and intended outcome of prescribed infusion therapy</td>
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<tr>
<td>2. Patient Assessment:</td>
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<tr>
<td>a. Physical assessment</td>
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<td>b. Allergies</td>
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<tr>
<td>c. Education and consent</td>
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<tr>
<td>d. Infusion history</td>
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<tr>
<td>3. Site selection based on:</td>
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<tr>
<td>a. Patient age and physical condition</td>
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<tr>
<td>b. Patient education</td>
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<tr>
<td>c. Prescribed therapy</td>
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<tr>
<td>d. Anticipated device dwell time</td>
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<tr>
<td>4. Equipment selection based on patient age &amp; physical condition and prescribed therapy</td>
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<thead>
<tr>
<th>Performance Criteria</th>
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<tbody>
<tr>
<td>1. Verified Physician’s or authorized prescriber’s written order</td>
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<td>2. Verified patient’s identification, using at least 2 independent identifiers, not including the patient’s room number</td>
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<td>3. Explained procedure to the patient</td>
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<td>4. Obtained patient consent (if possible)</td>
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<td>5. Positioned patient as condition allows</td>
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<td>7. Performed hand hygiene. Donned non-sterile gloves and any other PPE that will be required.</td>
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<tr>
<td>8. Assessed extremities for an appropriate venipuncture site. Ensured adequate arterial flow by palpating for a pulse distal to the intended venipuncture site.</td>
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<tr>
<td>9. Applied tourniquet to extremity, 10 – 15 cm above intended venipuncture site or applied blood pressure cuff instead of tourniquet (inflated to just below patient’s normal diastolic pressure and maintained at that pressure until complete).</td>
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<td>10. Selected optimal site for catheter insertion.</td>
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<td>11. Removed excess hair as needed using single patient use clippers or scissors.</td>
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<tr>
<td>12. Applied cutaneous antiseptic agent (CHG 2%/ Alc 70% in FHA) to intended venipuncture site and allowed it to dry completely.</td>
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<td>13. Performed venipuncture:</td>
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<tr>
<td>a. One catheter per attempt</td>
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<td>b. Maximum two attempts</td>
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<td>c. If unsuccessful catheter insertion:</td>
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<tr>
<td>i. Removed catheter</td>
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<td>ii. Applied manual pressure to minimize bleeding</td>
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<tr>
<td>iii. Applied sterile gauze dressing to achieve hemostasis and wound protection</td>
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<td>iv. Communicated procedure failure to appropriate resource</td>
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<tr>
<td>14. Obtained positive blood return through flashback chamber of catheter.</td>
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### Performance Criteria

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<tr>
<td>15.</td>
<td>Advanced catheter into vein lumen</td>
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<td>16.</td>
<td>Stabilized catheter with one hand and released tourniquet or BP cuff with the other.</td>
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<td>17.</td>
<td>Removed stylet from IV cathalon according to manufacturer’s instructions.</td>
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<td>18.</td>
<td>Connected end of prepared needleless connector with or without continuous infusion set to end of catheter and secured connection.</td>
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<td>19.</td>
<td>Flushed injection cap of needleless connector with 1 – 3 mL preservative-free 0.9% sodium chloride using a positive pressure technique, or began continuous infusion by slowly opening the slide clamp or adjusting the roller clamp of the IV tubing.</td>
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<td>20.</td>
<td>Observed site for swelling, or patient complaints of discomfort or pain, removing the PIV if present.</td>
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<td>21.</td>
<td>Secured and stabilized the catheter using a transparent semi-permeable (TSM) dressing. If the TSM does not have securement properties, apply a manufactured securement device before applying TSM dressing.</td>
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<td>22.</td>
<td>Secured any tubing to the arm. Avoided taping over tubing connections. Avoided circumferential taping.</td>
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<td>23.</td>
<td>If patient will be receiving IV fluids, rechecked flow rate and correct drops per minute, and connected to electronic infusion device if applicable and when available.</td>
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<td>24.</td>
<td>Records date, time, and clinician’s initials on dressing margin.</td>
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<td>25.</td>
<td>Discards used supplies in appropriate receptacles.</td>
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<tr>
<td>26.</td>
<td>Removes gloves, disposes in appropriate receptacle, and performs hand hygiene.</td>
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| 27. | Documents insertion procedure in patient’s permanent health record per organizational policy  
   a. Patient education and consent  
   b. Size, length, type of device  
   c. Use of local anesthesia and/or pre-medications  
   d. Location of vein used for venipuncture  
   e. Number of insertion attempts  
   f. Method, material for device stabilization dressing  
   g. Needleless connector with extension set used  
   h. Flushing procedure  
   i. Patient response  
   j. Name and title of clinician |    |    |

**Date of Successful Start**

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**Clinician Name** ____________________________ **Designation** ______ **Unit** ______

**Start #1 Validated by** ____________________________ **Designation** ______ **Date** __ / __ / __

**Start #2 Validated by** ____________________________ **Designation** ______ **Date** __ / __ / __

**Start #3 Validated by** ____________________________ **Designation** ______ **Date** __ / __ / __

**Print Name**

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