professional development

Peripheral Vascular Access Device (VAD) Insertion

Health Professions Strategy and Practice extends sincere thanks to all Alberta Health Services staff who contributed to the revision of this learning module.

For any questions regarding this material, contact practice.consultation@albertahealthservices.ca or call 1-855-735-3043

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Introduction

This learning module replaces the 2012 Intravenous Therapy learning module.

Infusion therapy is an activity that requires time and practice in order to become proficient. This learning module is based on best practice, and is intended to enhance the knowledge and skills of health care professionals (HCP), for whom Scope of Practice permits this activity (See 1.3 Target Audience), in the major aspects of initiating, maintaining, and discontinuing peripheral vascular access devices (VAD).

Professionals are accountable for assessing their competencies and related skills in providing care. HCPs whose skills would benefit from additional support may refer to this learning module, repeat specific portions, or complete the entire module in collaboration with their Patient Care Manager, Clinical Nurse Educator, or designate. Please direct any questions or concerns to your manager, educator, or designate in your area.

The length of time required to complete this learning module will vary from individual to individual. If completing this module as a review, the estimated time is approximately 30 minutes.

Learning Objectives

On completion of this learning module, the learner will be able to:

1. Summarize the purpose of infusion therapy
2. Explain the categories of intravenous (IV) solutions
3. Classify peripheral vascular access devices (VAD) and administration sets by type
4. Describe the differences between an artery and a vein
5. Demonstrate the application of VAD site selection criteria
6. Summarize the required elements of preparing and inserting a peripheral VAD
7. Prevent vascular access complications
8. Simulate how to monitor and maintain the peripheral access site/system
9. Determine how to troubleshoot problems related to infusion therapy
10. Describe treatment strategies to address complications of infusion therapy
11. Identify key teaching points patients need to learn
12. Produce the various supplies required to discontinue a peripheral VAD
13. Put in order the steps required to discontinue a peripheral VAD

On completion of the Skills Checklist (see Appendix B), the learner will be able to demonstrate, with 100% accuracy, successful insertion of a peripheral vascular access device (over the needle catheter) independently.

Definitions

Patient
Term used to represent any variation of patient, client, resident, or health care consumer.

Peripheral Vascular Access Device (VAD)
A vascular access device (VAD) is a device used to access the vascular system. A VAD can be peripheral or central. In a peripheral VAD, the end of the venous **catheter** remains in a surface vein (peripheral) and does not extend into deeper central veins. Peripheral VADs are most commonly inserted into surface veins on the extremities, primarily the hands and arms, but in certain clinical scenarios after consultation with the most responsible health practitioner, may include the feet, or the scalp (infants).

Target Audience

This learning module is intended for all HCPs in Alberta Health Services for whom Scope of Practice (as determined by the Health Professions Act, List of Restricted Activities and Professional Colleges) permits this activity. For the purpose of this learning module, the terms "health care professionals" refer to the target audience.

Instructions for Completion

1. The learning module is based on best practice. Please check for and become familiar with any Alberta Health Services governance documents (policies, procedures, practice support documents) applicable to your area regarding infusion therapy prior to continuing with this module.

2. Review the infusion therapy learning objectives.

3. Complete the prerequisite reading.

4. Review each section of the learning module.

5. Complete the learning activities in each section of the module and compare with the answers found in Appendix A.

6. Complete the post learning assessment available on Insite http://insite.albertahealthservices.ca/8567.asp. To successfully complete the theoretical portion of the module, you must achieve a pass mark of 80% on the post learning assessment.

7. Complete the clinical application portion of the module by demonstrating the correct process for initiating and maintaining a peripheral VAD on a patient in the clinical area (see Appendix B). **Prior skills lab/simulated practice is encouraged beforehand where available.**

Prerequisite Reading

Pre-read the following resources:

- Patient Identity Verification Policy https://extranet.ahsnet.ca/teams/policydocuments/1/clp-patient-identity-verification-ps-06-policy.pdf
- Four Moments for Hand Hygiene resources and applicable Alberta Health Services governance documents (policies, procedures, and practice support documents) http://insite.albertahealthservices.ca/5154.asp
- Personal Protective Equipment (PPE)
    - Duty to use PPE http://insite.albertahealthservices.ca/Files/hr-whs-worker-safety-moment-ppe.pdf
    - Don PPE http://insite.albertahealthservices.ca/edm/tms-edm-rrmic-donning-ppe.pdf
    - Doff PPE http://www.albertahealthservices.ca/hp/if-hp-ipc-doffing-ppe-poster.pdf
- Line Labelling and Tracing: Invasive Infusion Line and Tubing Verification Policy http://insite.albertahealthservices.ca/8470.asp
- Reporting and Learning System (RLS) and Reporting of Clinical Adverse Events, Close Calls and Hazards Policy http://insite.albertahealthservices.ca/1820.asp
- Patient Engagement resources http://insite.albertahealthservices.ca/patientengagement.asp including NOD (Name, Occupation, Duty) http://insite.albertahealthservices.ca/pe/tms-pe-feature-leading-practices-in-pfcc.pdf

Health care professionals must familiarize themselves with Alberta Health Services governance documents applicable to their area regarding Infusion Therapy.

Section One: Purpose of Infusion Therapy, Solutions, and Supplies

1.1 Learning Objectives

On completion of this section, the learner will be able to:

1. Summarize the purpose of infusion therapy
2. Explain the categories of intravenous (IV) solutions
3. Classify peripheral vascular access devices (VAD) and administration sets by type

1.2 Purpose of Infusion Therapy

To understand the purpose or rationale for the infusion therapy prescribed, information can be obtained from various sources, including the authorized prescriber's order, the patient record, and patient assessment.

Indications for infusion therapy include:

- Restoration / maintenance of fluid and electrolyte balance
- Restoration / maintenance of nutritional status (parenteral nutrition)
- Administration of medications, blood components/blood products, diagnostic reagents, and general anaesthesia or procedural sedation
- Vascular access for emergencies

Ensure that the order for initiation and management of infusion therapy is complete and includes patient identification, fluid type, volume, specific infusion rate, specific medication(s), dosage(s), route, and frequency of administration, and any special considerations (Infusion Nurses Society, 2011a).

1.3 Intravenous Solutions

Intravenous (IV) solutions are used to prevent or correct problems with fluid and/or electrolyte status. Many prepared IV solutions are available for use as volume expanders, and can be categorized by two main types: crystalloid and colloid.

Crystalloids are so named because they are made of substances that form crystals that dissolve in water, e.g., salt, and have particles small enough to easily pass in and out of pores that line the walls of cells and capillaries (David, 2007). Crystalloids are categorized by their tonicity, which

is a comparison of osmolarity between two fluids. Fluids or solutions can be isotonic, hypertonic, or hypotonic.

Osmolarity, or osmotic concentration, is the concentration of osmotically active particles in solution, which may be quantitatively expressed in osmoles (Osm) of solute per liter (L) of solution (Osm/L). A solution is considered **isotonic** in the body if osmolarity is the same as blood plasma (range of 280 – 300 mOsm/L), and therefore expands the body's fluid volume without causing a fluid shift from one compartment to another (Potter, Perry, Stockert, & Hall, 2014). An example of an isotonic solution is 0.9% sodium chloride.

A **hypertonic** solution, such as 3% sodium chloride, has a higher osmotic pressure than plasma and pulls fluid from cells through osmosis, causing them to shrink. A **hypotonic** solution, such as 0.45% sodium chloride, has an osmotic pressure lower than plasma and pulls fluids into the cells, causing them to enlarge (Potter, Perry, Stockert, & Hall, 2014).

In general, isotonic fluids are mostly commonly used for extracellular volume replacement. The use of hypertonic or hypotonic solutions depends on the specific fluid and electrolyte imbalances (Potter, Perry, Stockert, & Hall, 2014).

Colloids, unlike crystalloids, are solutions in which particles do not dissolve or break down into smaller pieces in water (David, 2007). Colloid solutions contain larger molecules that typically cannot penetrate the capillary wall, thus tend to stay within the vascular space (blood vessels). See Table A for a comparison of colloid and crystalloid solutions.

Table A: Two Main Types of Volume Expanders - Colloids and Crystalloids

	Colloid	Crystalloid
Description	• Solution that contains suspended substance particles in water • Particles do not dissolve completely • Does not pass through a semi-permeable membrane • Stays within the intravascular space	• Contain solutes that are completely dissolved in water • Readily passes through a semi-permeable membrane • Comprised of dextrose, electrolytes or a combination of the two • Can be classified into **isotonic, hypertonic,** and **hypotonic** solutions
Examples	Two types: 1) Natural, e.g., human blood and blood products such as albumin and plasma, and 2) Artificial, e.g., gelatine and dextran solutions, hydroxyethyl starches (HES). *Warning: do not use HES products in critically ill adult patients including patients with sepsis due to mortality and renal replacement therapy.*	See Table B: Types of Crystalloids
Uses	Plasma expanders used to replace circulating blood volume	• To expand intracellular or extra cellular fluid volumes and replace electrolytes • Choice of solution depends on desired outcome

Table B - Types of Crystalloids

	Osmolarity	Indications	Precautions	Solution
Isotonic	Between 250–330 mOsm/L Blood plasma is between 280–300 mOsm/L	• No net increase in cell size • Increases the intravascular volume • Replaces water loss • Treatment of dehydration and fluid replacement	• Excessive amounts can lead to circulatory overload and pulmonary edema. Monitor electrolytes; alterations can occur depending on the volume of solution administered • Use with caution in patients with CHF, renal impairment and cardiac insufficiency	• Dextrose 5% in Water (D5W)* • 0.9% NaCl (see Diagram A) • Lactated Ringers • 3.3% dextrose
Hypotonic	Less than 250 mOsm/L	• Will cause fluid to shift into the cells • Used for cellular re-hydration	• Contraindicated in increased intra-cranial pressure (ICP) and hypovolemia • Monitor for water intoxication	• Dextrose 5% in 0.45% sodium chloride (D50.45 NaCl) • 0.45 NaCl • 0.33 NaCl
Hypertonic	Greater than 330 mOsm/L	• Will cause fluid shift from the cells into intravascular space • Restores electrolytes and nutrients • Often used as a diuretic	• Cellular dehydration • Fluid overload	• 3-5% NaCl • Mannitol 10–20% • D5 Lactated Ringers • 10% and greater Glucose solutions
**Dextrose in IV solutions is rapidly metabolized. Dextrose-only solutions become hypotonic in the body once all the dextrose is metabolized. Close monitoring for water intoxication is therefore indicated. Signs and symptoms include headache, fatigue, nausea, vomiting, muscle cramps, disorientation, and shortness of breath.*				

See Diagram A for a picture of a bag of 0.9% sodium chloride (Normal Saline) with osmolarity circled in red.

Diagram A: Bag of 0.9% Sodium Chloride (Normal Saline)

1.4 Vascular Access Device Selection

1.4.1 Gauge & Length

Most peripheral VADs are described by the gauge and length (e.g., 18G x 5/8 inch) on the outside of the package. The gauge is the internal diameter of the catheter; the smaller the number, the larger the internal diameter. The length of the catheter can range from 13 mm (½ inch) to 50.8 mm (2 inches) or greater.

When selecting a peripheral VAD, consider the following:

- Type of solution or medication to be infused. More viscous solutions have decreased flow and may require a larger bore (wider diameter)
- Type of therapy to be delivered. (e.g., Rapid fluid resuscitation is optimized with a larger bore catheter, certain diagnostic imaging procedures require a specific gauge)
- Patient diagnosis and history of infusion therapy. The condition of a patient's vein is influenced by both their current medical status and medical history
- Patient activity level
- Patient age
- Condition and size of the vein

A central vascular access device (CVAD) should be considered for anticipated infusion therapy if the medication or solution has a pH of less than (<) 5 or greater than (>) 9, osmolarity greater than 600 mOsm/L, a final dextrose concentration above 10%, or for continuous vesicant therapy (Infusion Nurses Society, 2011b).

Assess the purpose of the therapy first, and then **select the smallest-size catheter to accommodate the prescribed therapy** (Infusion Nurses Society, 2011b). Refer to Table C for further guidance.

Table C – Guidance on Selecting Catheter Gauge

Smaller diameter (20-24G)	Larger diameter (14-20G)
Medical therapy	Surgical therapy
Cardiovascularly stable	Resuscitation anticipated
Difficult or small veins	

1.4.2 Needle-Safety Mechanism

Alberta Health Services promotes the use of needleless systems as a safety measure to reduce needle-stick injuries. Unless a safety device is not available or cannot be used, a safety engineered device (SED) should be used wherever possible.

Alberta Health Services has transitioned to safety engineered devices (SEDs) in all health care settings. For more information, contact safety.sharps@albertahealthservices.ca

1.4.3 Types of Vascular Access Devices

There are two types of peripheral VADs: over-the-needle catheter and winged infusion set (butterfly device).

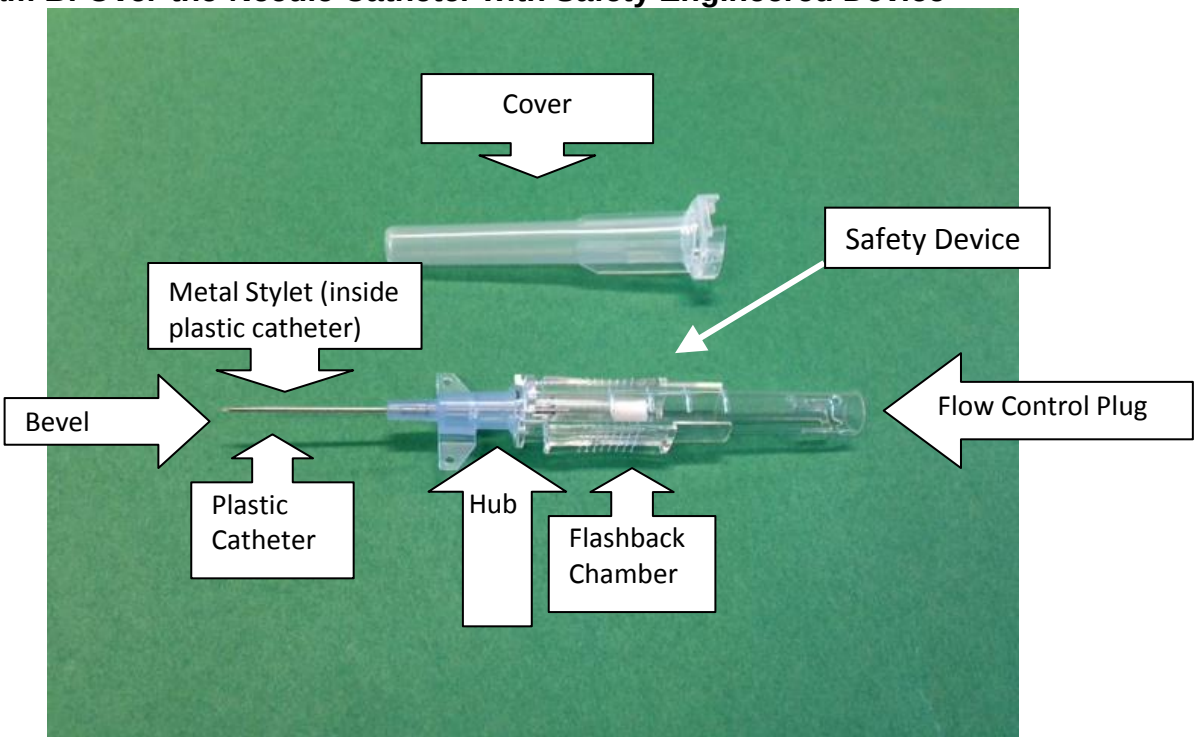
Over-the-Needle Catheter (ONC)

ONCs are the most commonly used devices for vascular access. ONCs have two major components: a metal stylet (or needle) and a flexible catheter. The metal stylet, used to pierce the skin, is enveloped by a plastic or silicone catheter (hence the name "over-the-needle"). After the insertion of the metal stylet, the catheter is threaded into the vein. At the distal end of the stylet, a "flashback" chamber allows clinicians to visualize the flow of blood into the catheter, helping to confirm placement. A catheter with a safety engineered device (SED) allows the clinician to retract the needle into a hard plastic casing, or to push a sheath onto the needle. The stylet is then properly discarded without exposure to a contaminated sharp.

In contrast, a non-safety catheter requires that the metal stylet is manually removed and discarded, leaving the clinician exposed to a contaminated sharp.

Refer to your site for the specific brand of catheter with SED used. Diagram B shows a picture of an ONC with a safety device.

Diagram B: Over-the-Needle Catheter with Safety Engineered Device



Obtaining Blood Samples via Peripheral Catheter:

There is evidence against collecting specimens from peripheral catheters due to greater association with hemolysis. Some clinical exceptions include patients receiving thrombolytic agents or patients at increased risk of bleeding, or possibly in emergency situations with limited vascular access (Halm & Gleaves, 2009).

Consider blood sampling through a short peripheral catheter for patients who require multiple laboratory tests, are at risk for bleeding, and/or have limited or difficult venous access (Infusion Nurses Society, 2011b)

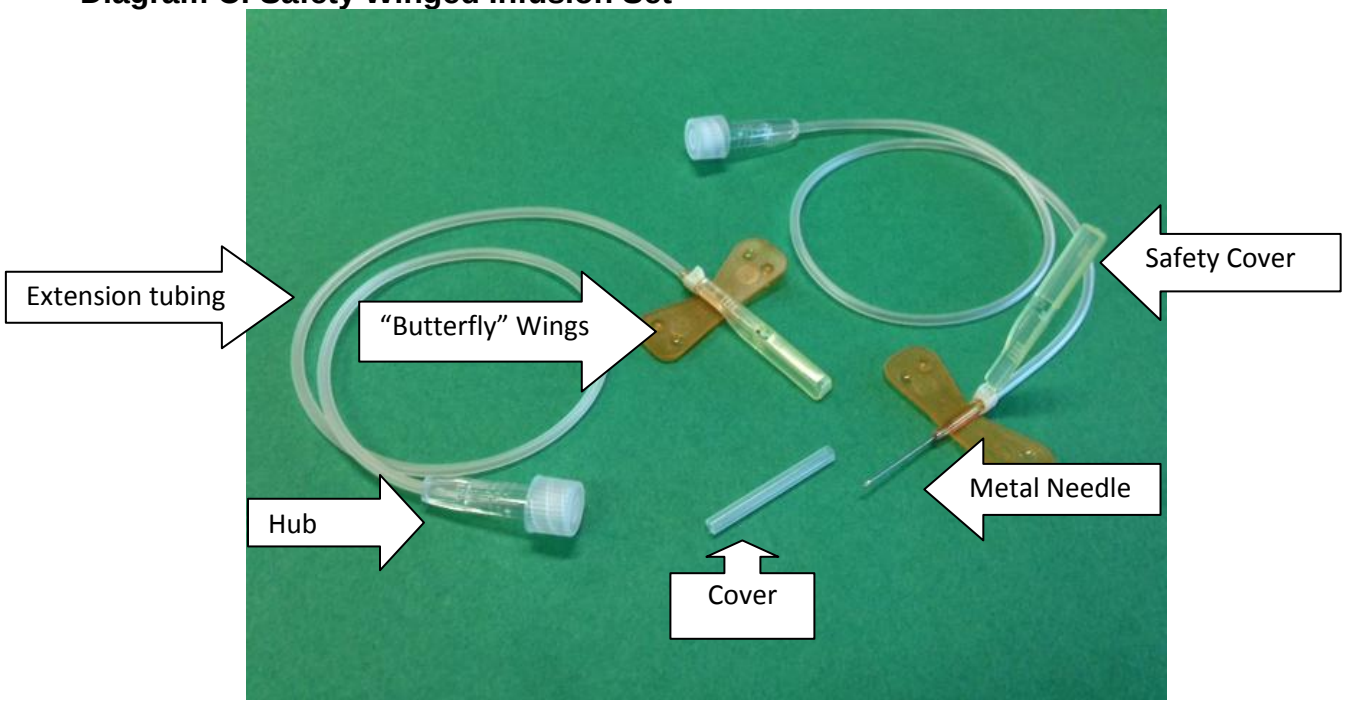
Winged Infusion Set

The winged infusion set is not commonly used. **Limit the use of steel winged devices to single-dose administration** (Infusion Nurses Society, 2011b).

The winged infusion set, also known as a "butterfly" device, contains a steel needle attached to soft, flexible wings (hence the name "butterfly") that readily conform to the body's contour. The extension tubing can range in length from 3.5 to 12 inches. See Diagram C for a picture of a winged infusion set with a safety shield that is flipped over the needle when the set is discontinued prior to disposal.

Because of the indwelling needle, winged infusion sets carry an increased risk of needle stick injury because of their potential for displacement. As a result, additional caution must be exercised.

Diagram C: Safety Winged Infusion Set



The winged infusion set is not commonly used. **Limit the use of steel winged devices to single-dose administration** (Infusion Nurses Society, 2011b).

1.5 Administration Sets, Add-On Devices, and Infusion Pumps

1.5.1 Administration Sets

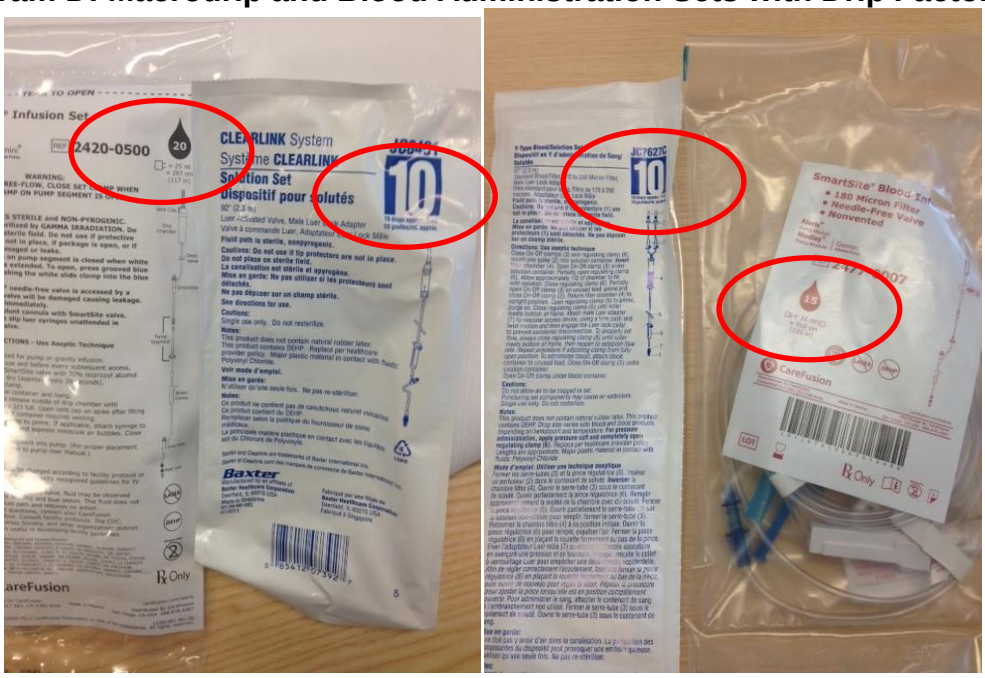
Alberta Health Services stocks several types of administration sets. Clinicians are responsible to understand the differences, including specific drip factors and correct priming technique for their unit/site/facility.

The drip factor describes how many drops form a millilitre of solution (gtt/mL). Drip factors range from macrodrip (10 – 20 gtt/mL) to microdrip (60 gtt/mL) depending on the manufacturer. When infusing fluids via gravity, the administration set drip factor (how many drops per mL) is important for calculating the flow rate, which is the number of drops (gtt) infusing per unit of time.

Drip factors of the following administration sets:

- Macrodrip: 10-20 gtt/mL
- Microdrip: 60 gtt/mL
- Blood Administration Sets: 10-15 gtt/mL

Diagram D: Macrodrip and Blood Administration Sets with Drip Factor Circled



Example on calculating an infusion flow rate:

An authorized prescriber has ordered 1L of Normal Saline to infuse over 10 hours. The administration set is macrodrip tubing with a drop factor of 10 gtt/mL. Calculate the infusion flow rate in drops per minute (gtt/min)

Step 1: Determine the formula.

$$\frac{\text{Volume (mL)}}{\text{Time (min)}} \times \text{drip factor (gtt/mL)} = \text{infusion flow rate (gtt/min)}$$

Step 2: Enter values into formula to calculate infusion flow rate

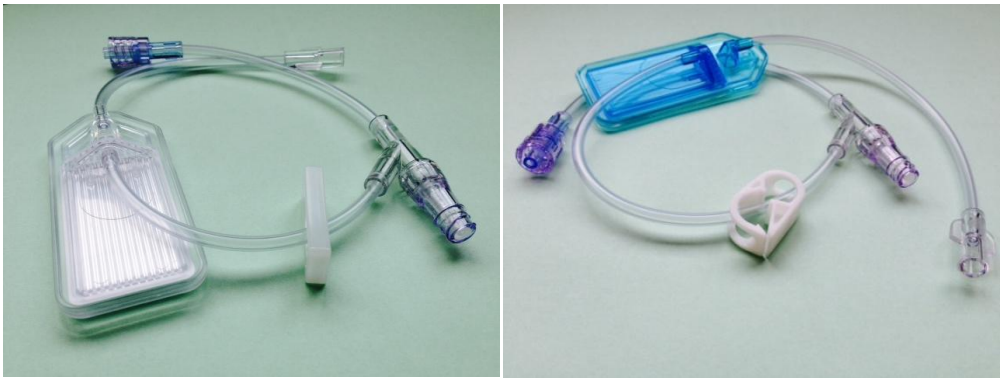
Answer:

$$\frac{1000 \text{ mL}}{10 \times (60 \text{ min})} \times 10 \text{ gtt/mL} = 16.66 \text{ gtt/min} = 17 \text{ gtt/min}$$

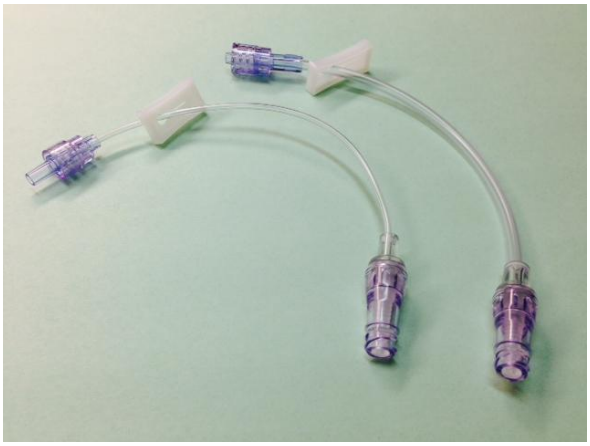
1.5.2 Add-On Devices

When an integral in-line administration system is unavailable, add-on devices may be required to facilitate the delivery of the prescribed therapy (Infusion Nurses Society, 2011b). Limit use of these devices due to the risk of contamination from manipulation, accidental disconnection, or misconnection (Infusion Nurses Society, 2011b). Examples of add-on devices include:

- **Micron filter,** which filters out particulate matter in certain solutions/medications to prevent pulmonary or cardiovascular complications, and to protect patients with inter-cardiac shunting from air. The use of the micron filter for an IV fluid is indicated by a Parenteral Drug Manual or manufacturer's directions. Micron filters are available in a variety of sizes, most commonly at 0.22 microns or 1.2 microns.

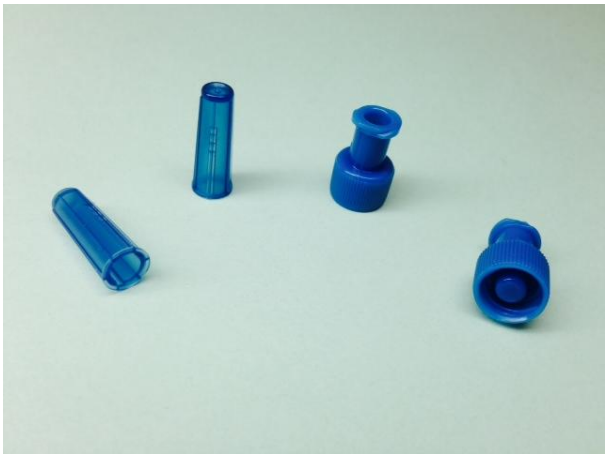


- **Extension set / loop,** which provides additional length and allows for easier securement. When attached to a VAD, an extension set provides additional closed system access.

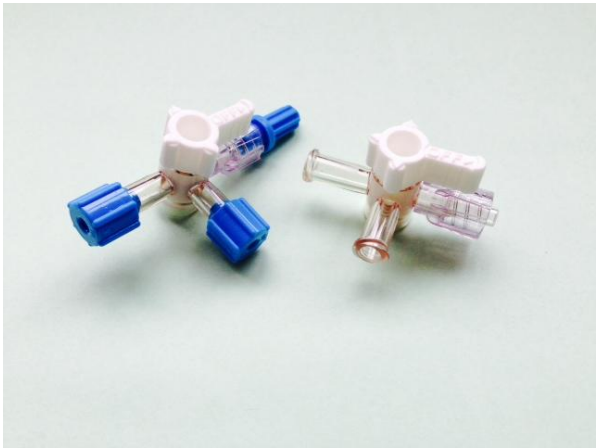


- **Connector,** which can be used on all peripheral, arterial, and central venous catheters for the administration of IV fluids or medications, and can be used with blood products.

- **End cap,** which helps prevent environmental contamination between intermittent uses.



- **Stopcock (**or manifold set if multiple stopcocks are needed), which is used in specific care areas where intermittent access to the closed system is required.



Add-on devices will be:

- Attached aseptically and changed in conjunction with the administration set
- Changed immediately upon suspected contamination, evidence of blood, or upon a break in integrity (Infusion Nurses Society, 2011b)

The use of add-on devices increases the risk of infection due to greater manipulation and risk of separation. Use only when indicated and implement proper infection control practices.

1.5.3 Infusion Pumps

Flow-control devices, such as infusion pumps, regulate the administration rate of parenteral solutions and medications (Infusion Nurses Society, 2011b). When selecting the most appropriate device, consideration includes patient age and condition, prescribed infusion therapy, and care setting (Infusion Nurses Society, 2011a and 2011b).

An infusion pump is required when:

- Indicated in the parenteral monograph,
- There is risk of fluid overload (congestive heart failure, renal failure)

To gain competency in the specific infusion pumps used in your clinical area, consult with your manager or clinical educator. Infusion pumps with smart technology (programmable pumps with dose error reduction software) are preferred. Learning resources and opportunities are available on MyLearningLink http://mylearninglink.albertahealthservices.ca/elearning/bins/index.asp and Insite, such as Provincial Infusion Pump Education http://insite.albertahealthservices.ca/6064.asp

As well, refer to applicable Alberta Health Services governance documents (policies, procedures, practice support documents).

1.6 Learning Activity #1

Instructions: Choose the best answers.

1. Crystalloids:
   a. readily pass through a semi-permeable membrane
   b. stay in the intravascular space

2. The purpose of infusion therapy may include: (circle all that apply)
   a. administration of blood or blood products
   b. restoration of electrolyte balance
   c. restoration of nutritional status
   d. vascular access for emergency situations

3. This type of crystalloid can be used as a diuretic:
   a. isotonic
   b. hypertonic
   c. hypotonic

4. The drip factor from micro drip tubing can be:
   a. 10-15 gtt/mL
   b. 10-20 gtt/mL
   c. 20-45 gtt/mL
   d. 60 gtt/mL

5. An infusion pump should be used when:
   a. infusing NS at 75 ml/hr
   b. infusing Morphine 2.5 mg over 30 minutes
   c. saline lock is in place
   d. all of the above

For #6-10, match the content in Column A to the best answer in Column B.

	Column A	Column B
_____	6. surgery	a. 14 gauge
_____	7. cardiac arrest	b. 16 gauge
_____	8. fragile veins	c. 18 gauge
_____	9. GI bleed	d. 20 gauge
_____	10. medication administration	e. 22 gauge

See Appendix A for the answer key.

Section Two: Selecting an Insertion Site

2.1 Learning Objectives

On completion of this section, the learner will be able to:

1. Describe the differences between an artery and a vein.
2. Demonstrate the application of a venous access device (VAD) site selection criteria

2.2 Differences between Arteries and Veins

It is important to understand the anatomy of the peripheral blood vessels in order to choose the appropriate vessel for venipuncture and avoid inserting a VAD into an artery. Table D provides a comparison of arteries and veins.

Table D – Physiological/Anatomical Comparison between Arteries and Veins

Arteries	Veins
Pulsatile	Non-pulsatile
High pressure system carrying oxygenated blood from the heart to the rest of the body	Low pressure system carrying de-oxygenated blood back to the heart for re-oxygenation
Elastic and thick walled	Thin-walled and flaccid
Generally not visible on arms and legs	Visible on limbs, bluish in color
Blood in vessel appears “bright red”	Blood in vessel appears “dark red”
Do not collapse	Collapse easily
Do not contain valves	Valves present

2.3 Blood Vessel Anatomy

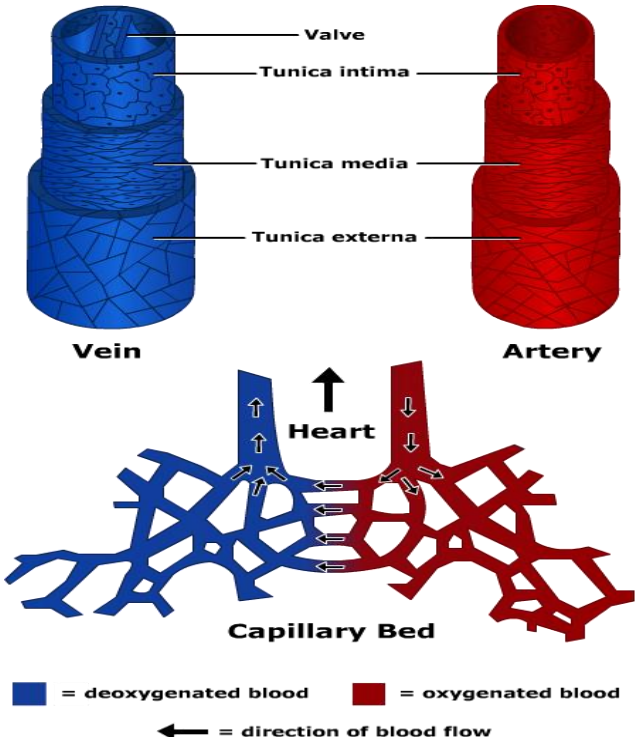
The anatomy of a blood vessel consists of three layers (see Diagram E):

- **Tunica intima,** the internal layer of arteries and veins. It is made of endothelial tissue and consists of a flat, smooth, single layer of cells which allows for free flow of cells and platelets through the vessels. Semilunar folds form valves in veins that assist with the unidirectional flow of blood back to the heart.

- **Tunica media,** the middle layer of artery and veins. Tunica media is composed of muscle, nerve and elastic tissue. This layer provides structure and support to the vessel. In veins, this layer is reactive to the rise and fall of systemic pressure therefore distend and collapse. The nerve tissue responds to the change in temperature through vasoconstriction and vasodilation.

- **Tunica adventitia (or externa),** the outer layer of artery and veins. The tunica adventitia is composed of connective tissue. The connective tissue provides a barrier and support to the vessels and is notably stronger in arteries because of the pressure exerted on these vessels.

Diagram E: Three Layers of the Blood Vessel



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http://lyceum.algonquincollege.com/lts/onlineCourses/anatomy/content/module11-4.htm

2.4 Venipuncture Site Selection

Selecting an appropriate vein for infusion therapy is crucial to optimize treatment and reduce the risk of complications. The vein needs to accommodate the gauge and length of the catheter required for the prescribed therapy (Infusion Nurses Society, 2011a). Assessment includes the patient's condition, age, diagnosis, comorbidities, condition of the skin and vasculature at and proximal to intended insertion site, history of previous venipunctures and access devices, type and duration of infusion therapy, and patient preference (Infusion Nurses Society, 2011a).

Do:

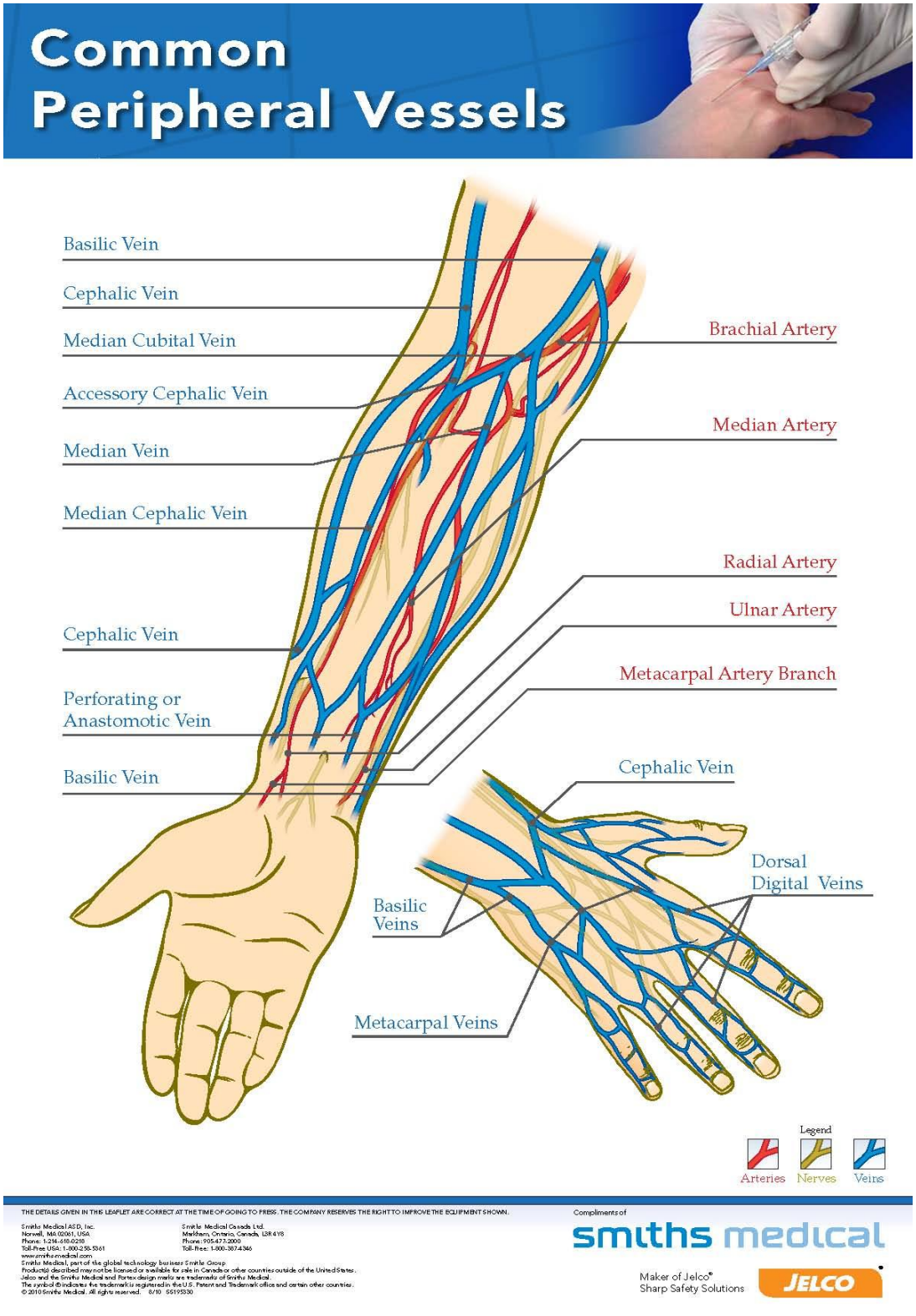
- Routinely select distal sites in the upper extremities; subsequent attempts at vascular access should be made proximal to previously accessed sites (Infusion Nurses Society, 2011a)
- Consider dorsal and ventral surfaces of the upper extremities, especially the non-dominant hand, including the metacarpal, cephalic, basilica, and median veins (Infusion Nurses Society, 2011a).

Avoid:

- The lateral surface of the wrist because of potential risk for nerve damage (Infusion Nurses Society, 2011a).
- Areas of flexion (antecubital veins), painful areas, compromised veins (bruised, infiltrated, corded), location of valve (often visible or palpated as small 'knots' along the length of the vein → use of a shorter catheter can help avoid them), and areas of planned procedures. If it is necessary to use an area of flexion, use shorter catheters and/or arm boards to immobilize.
- The upper extremity on the side of surgery
- Finger veins
- Extremities with reduced sensation, fractures, or impaired circulation of lymph and blood (e.g., CVA, third degree burn, post-mastectomy) as patients cannot report unusual sensations to alert HCPs of potential complications.
- Extremities with arteriovenous (AV) shunts, grafts, or fistulas.

Diagram F illustrates common peripheral veins.

Diagram F: Common Peripheral Vessels



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2.5 Learning Activity #2

Instructions: Chose the best response for # 1 – 5.

1. The internal layer of arteries and veins are called tunica _____.
   (adventitia, intima, media)
2. Arteries are _____ walled.
   (thick, thin)
3. Veins are _____ on arms and legs.
   (not visible, visible)
4. A common vein used to start a peripheral VAD is the _____ vein.
   (cephalic, antecubital)
5. When choosing an IV site, choose the most _____site.
   (distal, proximal)

For # 6 – 10, indicate whether you would use (U) or avoid (A) using the following sites:

_____ 6. Vein in a bruised area.

_____ 7. Operative site when surgery was on that arm.

_____ 8. Area above an existing phlebitis.

_____ 9. Arms with a shunt.

_____ 10. Veins that feel soft.

Note: See Appendix A for the answer key.

Section Three: Inserting a Peripheral Vascular Access Device

3.1 Learning Objectives

On completion of this learning module, the learner will be able to:

1. Summarize the required elements of preparing and inserting a peripheral vascular access device (VAD)
2. Prevent vascular access complications

In the following section, key techniques/steps for the insertion of a VAD are highlighted. The highlighted steps are not inclusive of all of the required steps; see skills checklist (Appendix B) for all steps required to initiate a VAD. Remember to review any Alberta Health Services governance documents that exist for your area.

3.2 Preparations Prior to Insertion

3.2.1 Prescriber's Order

The components of an order for infusion therapy must contain:

- At least two (2) patient identifiers
- Date and time order was written
- Intravenous (IV) solution
- Rate of infusion
- Duration (where applicable), and
- Prescriber's name, signature, and designation

3.2.2 Preparation of Patient

Upon approaching a patient/family, identify yourself using NOD (Name, Occupation, Duty), and let the patient and family know that infusion therapy has been ordered. Use at least two (2) patient identifiers, as per *Alberta Health Services Patient Identity Verification Policy*, available at https://extranet.ahsnet.ca/teams/policydocuments/1/clp-patient-identity-verification-ps-06-policy.pdf. Explain the rationale for infusion therapy and answer any questions. Communication helps to decrease potential anxiety and fear. When ready to insert a peripheral VAD, place the patient in a comfortable recumbent position at semi-Fowlers or lower with the insertion arm extended.

For more information about NOD, see http://insite.albertahealthservices.ca/pe/tms-pe-feature-leading-practices-in-pfcc.pdf or visit the Patient Engagement webpage at http://insite.albertahealthservices.ca/patientengagement.asp.

3.2.3 Four Moments for Hand Hygiene

To protect the safety of the patients we serve, adhere to the basic principles of hand hygiene and aseptic technique The potential for infectious complications increases in a healthcare setting, especially when skin integrity is broken to administer peripheral infusion therapy.

Hand hygiene is a general term referring to practices which remove micro-organisms with or without soil from the hands. It refers to the application of alcohol-based hand rub (ABHR) or the use of soap and water. ABHR should be used unless hands are visibly soiled. Plain soap and water should be used when hands are visible soiled or when caring for patients with diarrhea and/or vomiting.

There are Four Moments for Hand Hygiene:

Moment 1: Before contact with a patient or patient's environment, including but not limited to: putting on (donning) Personal Protective Equipment (PPE); entering a patient's room; and providing patient care. For Moment 1, consider the patient environment like a personal bubble around the patient

Moment 2: Before a clean or aseptic procedure, including but not limited to: wound care; handling intravenous devices; and handling medications or food

Moment 3: After exposure (or risk of exposure) to blood and/or body fluids, including but not limited to: when hands are visibly soiled; following removal of gloves

Moment 4: After contact with a patient or patient's environment, including but not limited to: removing (doffing) PPE; leaving a patient's environment; and after handling patient care equipment.

For further information and resources on Hand Hygiene, including *Alberta Health Services Hand Hygiene Policy* and procedure, visit http://insite.albertahealthservices.ca/5154.asp

3.2.4 Supplies

Perform hand hygiene. Gather necessary supplies. As each site/zone has a variety of products that are used, become familiar with products and procedure used within your practice setting.

Required supplies include:

- Tourniquet
- Alberta Health Services approved antimicrobial agent (E.g., chlorhexidine with alcohol swab)
- Transparent dressing
- Extension set (Add an extension set to decreases the risk of vein damage by decreasing manipulation of peripheral VAD)
- Solution set

- 0.9% Normal Saline Flush or prescribed solution (check expiration date)
- Non-sterile, non-latex gloves
- Variety of VAD sizes
- Tape
- Sharps container
- Absorbent pad

3.2.5 Standard Precautions and Personal Protective Equipment (PPE)

The potential for coming into contact with a patient's blood while inserting a VAD is high; therefore, gloves **must** be worn. If the risk of a blood spatter is high, such as when caring for an agitated patient, the HCP should wear eye protective gear as well as a gown. To reduce the risk of a needle stick injury, as soon as the protective sheath of an ONC is removed, the catheter should either be immediately used for insertion, or be immediately discarded into an appropriate sharps container.

Recapping of needles is one of the most common causes of preventable needle stick injuries in health care workers.

Alberta Health Services leaders and HCPs have a joint legal obligation regarding the use of personal protective equipment (PPE) as indicated in Part 18 (Personal Protective Equipment) of the Occupational Health and Safety Code 2009. This code supersedes organizational policy and requires employers (unit managers or program leaders) to ensure HCPs use and wear appropriate PPE as determined by a hazard assessment. PPE offers protection to our HCPs from exposures to communicable diseases, debris, chemicals and other hazards found on the job. Examples of PPE include eye protection, masks, N95 respirators, gloves, and gowns.

For more information about the duty to use PPE, go to http://insite.albertahealthservices.ca/Files/hr-whs-worker-safety-moment-ppe.pdf

For information on how to put on (don) PPE, visit http://insite.albertahealthservices.ca/edm/tms-edm-rrmic-donning-ppe.pdf

For information on how to remove (doff) PPE, visit http://www.albertahealthservices.ca/hp/if-hp-ipc-doffing-ppe-poster.pdf

3.2.6 Assembly of Equipment

Perform Hand Hygiene. Prepare equipment using aseptic technique. Assemble and open equipment immediately prior to use.

3.2.7 Disposal

Have a biohazard container close to your work area and dispose of the stylet, regardless of safety device, as soon as it is removed from the catheter. The sharps container should be puncture proof, tamper-proof and marked with a biohazardous waste symbol. Garbage and laundry bins must be in place to dispose of gowns/masks soiled with blood/body fluids.

3.2.8 Hair Removal

If required, trimming of excess hair is recommended to facilitate catheter insertion and dressing adherence. Do not shave a site (the micro-abrasions increase the risk for infection), nor use depilatory creams (due to risk of an allergic reaction). Instead, use surgical clippers or sharp scissors to trim hair.

3.2.9 Optimizing the Visibility of the Vein: Dilation Techniques

Vein dilation increases the visualization of veins. There are two strategies or techniques for vein dilation, as well as several additional and complementary strategies. Choose the techniques that are appropriate for the practice setting and the patient.

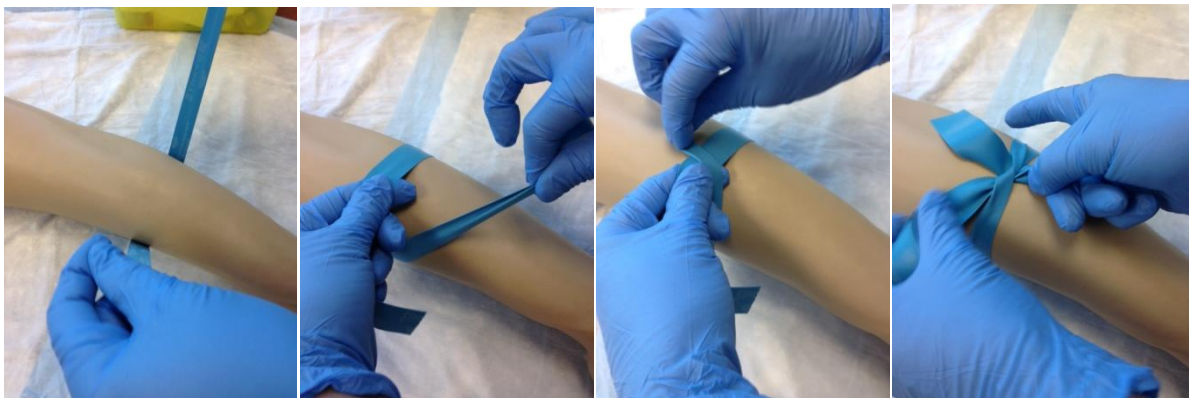
- **Tourniquet**: For **single patient use only**. Place the tourniquet at an appropriate location above the intended insertion site. Ensure that arterial flow is not impeded; an arterial pulse should easily be palpated distal to the tourniquet location (Infusion Nurses Society, 2011b). Remove tourniquet promptly at the conclusion of assessment or venipuncture procedure. A tourniquet is not always necessary in hypertensive patients, nor recommended if the patient has fragile veins.

- **Blood Pressure Cuff:** If a cuff is used to promote venous distention, inflate to just below diastolic pressure (Infusion Nurses Society, 2011b). A pulse distal to the cuff should still be palpable when inflated.

Do not leave a tourniquet on for an extended period of time. If you are not ready to insert a catheter soon after applying a tourniquet, remove the tourniquet. When ready, reapply the tourniquet 10-15cm above the selected site.

Steps to apply a Tourniquet:

1. Lay the tourniquet under the arm
2. Pull the tourniquet ends until they are taut
3. Cross the ends and tuck one end underneath, as if to tie a knot
4. Do not completely pull one end from underneath, but instead, form a loop (so that the tourniquet can be quickly undone with a gentle tug of the looped end)



In addition to using a tourniquet, also try:

- Chlorhexidine/Alcohol wipe – Press and wipe pad several times along the suspected path of the vein; the blood vessels close to the surface will dilate
- Relaxation – Teach deep breathing exercises for patients who are particularly nervous
- Gravity – Dangle the arm below the level of the heart.
- Heat – Wrap a warm blanket around the arm (have the patient check the temperature first; it should not feel too hot or uncomfortable in any way). Applied heat is usually effective within 10 minutes.
- Pumping the fist – Have the patient quickly open and close his/her fist
- Gentle palpation of the vein – Place finger on vein, and gently start to press up and down with a slight bouncing action, after 20-30 seconds, the vein should expand slightly. Do **not** slap or flick the vein because the reaction to pain will cause the vein to contract.

3.2.10 Cleansing of the Site

Correct preparation of the intended insertion site helps reduce the risk of infection. It is vital to cleanse an area larger than the outer size of the dressing. Site preparation must start at the insertion site.

If gross contamination is visible, wash the area with warm water and soap before starting the procedure.

For skin preparation, use an Alberta Health Services approved anti-microbial agent. The **standard method recommended by Alberta Health Services Infection Prevention and Control** is to clean the area in a circular motion, starting in the centre and moving outwards. Do **not** go back toward the centre with the same swab. If more than one application is required, *new swabs* are used in the same manner (centre out). This technique prevents recontamination of the site with skin flora carried by the swab. After the intended insertion site has been prepared, do **not** palpate again as doing so will contaminate the site, unless sterile gloves are worn (Infusion Nurses Society, 2011b).

A specific manufacturer may recommend cleaning in a grid-like pattern; however, this method is **only** applicable to the manufacturer's specific product, and is **not** universally applicable. The method that can be applied to all situations is to use the standard method recommended by Alberta Health Services Infection Prevention and Control, which is to clean the area in a circular motion, starting in the centre and moving outwards, and **not** to go back toward the centre with the same swab.

Wipe the area from the centre of the injection site working outwards, without going over the same area (World Health Organization, 2010).

Allow to air dry. Do not blow or wave your hand on the area.

3.3 Insertion of Over-the-Needle Catheter

3.3.1 Steps to Insert an Over-the Needle Catheter (ONC)

1. When possible, sit in a chair at the bedside .Place absorbent pad under patient's arm.
2. Open the catheter package. Ensure that the stylet and catheter are intact. Follow the manufacturer's instructions for preparing the catheter prior to insertion.
3. Don non-sterile gloves.
4. Position yourself with the catheter in your dominant hand and inspect the intended insertion site. If further palpation is necessary (with the non-dominant hand), take care not to touch the insertion site directly.

5. To prevent 'vein rolling', use the thumb of your non-dominant hand to provide traction to the skin below the intended venipuncture site. Pull the skin downward to prevent the vein from moving
6. Insert the catheter into the vein using either the indirect or direct method. You may feel a "pop" sensation, but this is not always the case. Watch for flashback of blood in the chamber.

    a. **Indirect:** use for smaller veins, fragile veins (those that tend to collapse) or those that are extremely mobile when palpated. This technique is accomplished by insertion of the catheter into the skin from the side of the vein.

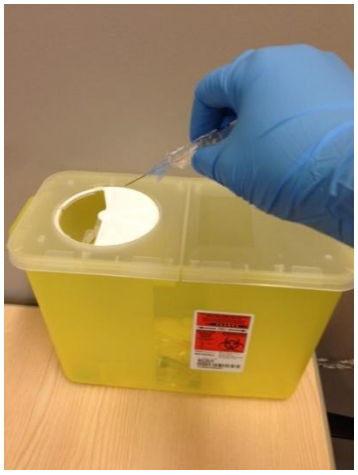
    b. **Direct**: use for all other veins as required. Enter the vein directly on top at a 10–30 degree angle. (The more superficial the vein, the smaller the degree of entry.)

7. Once flashback of blood is seen, lower the catheter to almost parallel with the skin and then advance the catheter a further 6–7 mm.
8. Occlude the blood flow above the insertion site and remove the tourniquet.
9. Activate the needle-safe function by retracting the stylet as per manufacturer's instructions.

Catheter should be inserted in the "bevel up" position.

If the stylet is inadvertently removed from the catheter prematurely, NEVER re-insert the stylet. Doing so could cause shearing of the catheter and an embolus to your patient.

10. Use a sharps container to dispose of the stylet, regardless of safety device, as soon as it is removed from the catheter
11. Attached primed extension set
12. See Section 3.4 regarding stabilizing the device.



Never recap your stylet or place it on a bed or floor.

Alberta Health Services has transitioned to safety engineered devices (SEDs) in all health care settings. For more information, contact safety.sharps@albertahealthservices.ca

Hints for Insertion

If using metacarpal veins, hold and splint the patient's hand with your non-dominant hand. This technique further assists in stabilizing the vessel as you insert the catheter.

Select a site in the most distal position. This position assures the integrity of the vessel proximate to the site should the first attempt be unsuccessful.

No more than two (2) attempts will be made by any one clinician. Further attempts at insertion should be made only if venous access is felt to be adequate (Infusion Nurses Society, 2011b). Further discussion with the most responsible health practitioner is needed.

Patients with difficult veins may have a limited number of viable access sites. Be judicious when planning insertion attempts. If you predict access will be challenging and your attempts will be unsuccessful, ask for help sooner.

After two unsuccessful attempts, ask for assistance from a HCP experienced with VAD insertion. If the 3rd attempt is unsuccessful, further discussion is needed with the most responsible health care provider to explore alternate strategies. **Always put the patient first.**

3.3.2 Special Considerations

Elderly Patients (Potter, Perry, Stockert, Hall, 2014)

Because the veins are very fragile, use the smallest size catheter possible. Avoid the back of the hand which may compromise the need for independence and mobility, and avoid veins that are easily bumped because less subcutaneous support tissue is present.

If the patient has fragile skin and veins, use minimal tourniquet pressure or no tourniquet. A tourniquet causes venous pressure to rise rapidly and the vein to overstretch, making it easier for venipuncture to rupture the wall of the vein. If using a tourniquet, place it over the patient's sleeve to decrease shearing of fragile skin. Remove the tourniquet promptly. With loss of supportive tissue, veins tend to lie more superficially; lower the insertion angle to 5-15 degrees.

Obese Patients

Peripheral vascular access may be difficult due to an increased amount of subcutaneous fatty tissue, which makes it difficult to see or feel deep veins. These tips for may also help in patients with peripheral edema (Rosenthal, 2004):

- Warmth encourages vasodilation. Apply warm compresses to the site for 10 to 15 minutes before attempting venipuncture.
- Displace edema and extra tissue. An assistant could help hold extra or edematous tissue out of the way. Because adipose tissue may be compressible, hold firm finger pressure over a spot where it's likely to find a vein and look and feel for a vein in the depression. Before prepping, make an indentation on the skin with finger pressure, mark the spot using a sterile marker, or have prepping solution and cannula ready to use quickly.
- Use multiple tourniquets. To distend veins, progress distally from the most proximal joint toward the site.
- Use a transilluminator to illuminate a vein's size and location.

Patients with Kidney Disease: Vein Preservation

Initiate vein preservation strategies for patients with known Stage 4 or 5 (eGFR<30) chronic kidney disease, including patients currently on dialysis (hemo or peritoneal), or with a functional kidney transplant (BC Renal Agency, 2012). These patients may have been issued an information card from a Chronic Kidney Disease clinic.

For patients requiring chronic hemodialysis (HD), the order of preference for HD access is (BC Renal Agency, 2012):

1. Arterio-venous fistula (AVF), then
2. Arterio-venous graft (AVG), then
3. Catheter.

The ability to establish an AVF is dependent on having a patent peripheral vein of sufficient size and elasticity to allow for dilation and maturation after surgical construction. Further, the function of the AVF is dependent on a healthy venous circuit back to the heart. Frequent venipuncture and the indiscriminate use of peripheral intravenous lines and peripherally inserted catheters can damage veins, impair venous circulation and jeopardize future AVF construction or function. (BC Renal Agency, 2012).

For further information on vein preservation strategies, contact Renal Services in Alberta http://insite.albertahealthservices.ca/renalservices.asp

3.4 Stabilizing the Vascular Access Device and Securing the Tubing

VAD stabilization should be used to preserve the integrity of the access device; minimize catheter movement at the hub; and prevent catheter dislodgment and loss of access (Infusion Nurses Society, 2011a). VADs should be stabilized using a method that does not interfere with assessment and monitoring of the access site, nor impede vascular circulation, nor obstruct delivery of the prescribed therapy (Infusion Nurses Society, 2011a).

Specially designed transparent, semi-permeable IV dressings, with a pre-cut notch to accommodate the hub of the catheter, offer more stabilizing support than a regular transparent, semi-permeable dressing. Check with your unit or area to determine what dressings are available.

Follow the manufacturer's instructions specific to the product on how to apply the dressing. In general:

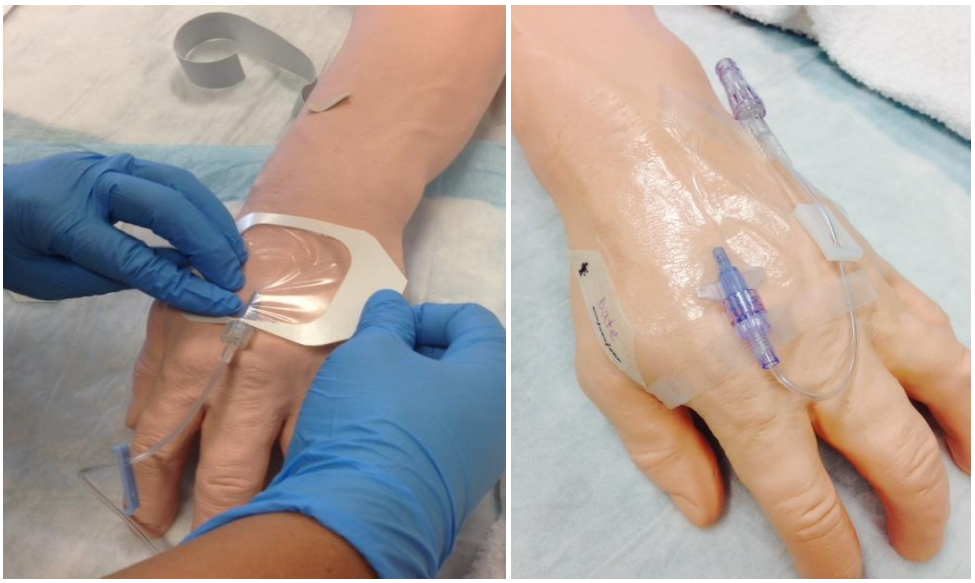
- Before applying the dressing, do **not** use tape to stabilize the catheter. Doing so will contaminate the site. In the uncommon occurrence that tape is necessary, use sterile tape
- Lay the dressing over the site; do not stretch it across.
- Gently press down to ensure adhesion, particularly around the catheter and hub.
- If a primed extension set is attached, loop and secure the tubing with clean tape to the patient's limb.
- Label the site with date and time.
- Remove gloves and perform hand hygiene (at end of procedure)

These pictures illustrate the application of a transparent, semi-permeable IV dressing that is uniquely designed for infusion therapy to help stabilize the catheter:

These pictures illustrate another type of a transparent, semi-permeable IV dressing that is specially designed with a pre-cut notch for infusion therapy:

Remove the backing of the transparent, semi-permeable dressing just prior to use in order to reduce the risk of contamination

These pictures illustrate a regular, transparent, semi-permeable dressing:



Joint stabilization devices are used to decrease complications associated with VAD placement near areas of flexion (Infusion Nurses Society, 2011b). Devices include single-patient-use arm boards, and finger or limb splints, and are secured with material for padding and tape.

If splinting devices are used, the immobilized joint should be positioned in slight flexion. Range of motion exercises should be performed periodically.

3.5 Documentation

Documentation of the VAD insertion and initiation of infusion therapy is required. Documentation must include:

- Date and time of initiation
- Location of the VAD
- Length/gauge of catheter inserted
- Number of attempts and attempt locations
- Rate of administration and type of fluid being infused
- How the patient tolerated the procedure
- Difficulties that may have occurred
- If an infusion pump is being used
- Patient education that was provided
- Your signature and designation

3.6 Troubleshooting

Table E: Troubleshooting VAD Insertion

Problem		Possible Causes	Treatment
Catheter not in vein	• No flashback • Swelling with infusion • Fluid will not infuse	• Catheter missed the vein • Poor body alignment • Poor lighting • Vein movement	• Place bevel directly on top of the vein • Reposition yourself or patient • Ensure adequate lighting • Reposition the vein and stabilize • Ensure adequate dilation of vein
Traumatic insertion causing haematoma	• Rapidly filling pocket of blood at the insertion site	• Vein trauma • Excessive force applied • Failure to reduce angle of device • Poor condition of veins • Catheter too large • Poor technique when separating the stylet from the catheter • Incorrect activation of safety device	• Decrease insertion angle • Reduce amount of force used • Reduce angle on device immediately after flash is noted • Use a smaller catheter • Smoothly separate stylet from catheter • Test stylet movement in catheter prior to insertion • Review appropriate activation
Unable to advance catheter into the vein	• Skin may “pucker” as threading is attempted • Catheter will not slide evenly into the vein	• Damaged vein (infusion drug use, damage from vesicant medications) • Resistance from a valve • Poor angle • Wrong catheter size • Stylet removed too early • Stylet tip hidden in catheter	• Choose a different vein • Maintain the catheter and stylet as a unit until you determine it is actually in the vein. If catheter on a valve, pull stylet back slightly and attempt to advance with solution flowing slowly • To correct angle, pull back on the entire device, lower the angle and advance

3.7 Learning Activity #3

Instructions: Reflect on a previous experience in which you (or a friend or a family member) had a peripheral VAD inserted.

- What did you like or not like about that experience?
- What would you like the health care provider to know about your experience?
- After the infusion was inserted, how did it feel to have a catheter attached to you?
- If you were the health care provider, what would you have done differently?

Section Four: Maintaining a Peripheral Vascular Access Device and Managing Complications

4.1 Learning Objectives

On completion of this learning module, the learner will be able to:

1. Simulate how to monitor and maintain the peripheral access site/system
2. Determine how to troubleshoot problems related to infusion therapy
3. Describe treatment strategies to address complications of infusion therapy
4. Identify key teaching points patients need to learn

4.2 Assessments of Site and Set, Frequency of Maintenance Interventions

After the initiation of infusion therapy, monitor the site and system regularly, and maintain the therapy to reduce the risk of complications and ensure the effectiveness of the treatment. Regular and thorough assessments of the infusion system help detect complications early so that immediate interventions can be provided in a timely manner (BC Children's Hospital, 2013):

- Assess vascular access site regularly for infiltration and signs of phlebitis by doing the following:
  - **TOUCH**: the infusion site (over the transparent semi-permeable dressing) feels soft, warm, pain free and dry to touch
  - **LOOK**: the uncovered infusion site is dry and visible
  - **COMPARE**: the extremity with the infusion site is free from swelling and is the same size as the other side

- Trace tubing from bag/bottle/syringe to site and assess for kinks, air bubbles, clamps (open or closed), loose connections, breaks in system, correct solution infusing via correct channels at correct rates (See Line Labelling & Tracing http://insite.albertahealthservices.ca/8470.asp)

- Ensure restraints or protective devices used are safe and effective (e.g. arm boards, mesh covering)

- Ensure tubing is secured (not pulling at site) and not posing risk of entanglement (patients at high risk for tubing entanglement are active children 3 month-3 years of age or developmentally delayed, with numerous lines or lengthy lines)

Peripheral vascular catheters should be re-sited when clinically indicated and not routinely, unless manufacturer's device-specific recommendations indicate otherwise ***(Infusion Nurses Society, 2011a; Loveday et al, 2014)***

The following table (Table F) describes the recommended frequency of maintenance interventions for the peripheral catheter, various administration sets, and the IV solution bag. Where applicable, refer to the Infusion Nurses Society (INS) Standards of Practice (2011a) for more information.

Table F: Site Care and Maintenance

Vascular Access Device / Administration Set			Frequency of Maintenance Interventions
Peripheral Catheter		Adults	No routine changing. Consider replacement when clinically indicated, based on assessment of patient's condition, access site, skin and vein integrity, length of type of prescribed therapy, venue of care, integrity and patency of device, dressing, and stabilization device (INS, 2011a)
		Pediatrics	Replace only when clinically indicated, not routinely (INS, 2011a)
		Transparent semi-permeable membrane dressing	Replace every 5-7 days (INS, 2011a), or when soiled or loose.
Administration Sets	**Continuous Use**	Primary continuous administration sets, including attached secondary sets and add-on devices	Change no more frequently than every 96 hours, or whenever peripheral catheter is rotated (INS, 2011a)
		Secondary sets (when connected to a continuous primary set)	Replace no more frequently than every 96 hours. Replace secondary set if disconnected from primary and tip not protected (INS, 2011a)
	Intermittent Use	Primary intermittent administration sets	Change every 24 hours. After each intermittent use, cover end with a new, sterile device (do not 'loop' exposed end to a port on the same set) (INS, 2011a)
		Secondary administration set detached from the primary set (now considered a primary intermittent administration set)	Replace every 24 hours (INS, 2011a)
	Parenteral Nutrition	For nonlipid-containing parenteral nutrition	Replace no more often than every 96 hours (INS, 2011a)
		For total nutrient admixtures containing intravenous fat emulsions (IVFE) with the amino acid and dextrose solution	Replace every 24 hours (INS, 2011a)
	IVFE and other Lipid Product Infusions	For intermittent units of IVFE	Replace with each new container (INS, 2011a)
		For consecutive units of IVFE	Replace every 24 hours (INS, 2011a)
		For propofol infusions	Replace every 12 hours (INS, 2011a)

Vascular Access Device / Administration Set			Frequency of Maintenance Interventions
	Blood and Blood Components	Administer through a standard blood transfusion set (170 – 260 micron filter).	Filter should be changed every 8 hours. Transfusion of each unit should be completed within 4 hours of removal from the blood band's cold storage (Alberta Health Services, 2013)
Primary IV solution bag			Infuse for no longer than 24 hours (Burton & Ludwig, 2010)

Change administration set immediately if contamination is suspected or product integrity is compromised. And remember, "new site, new lines."

Health care professionals must familiarize themselves with Alberta Health Services governance documents applicable to their area regarding infusion therapy.

4.3 Flushing and Locking

Flushing is performed prior to each infusion to assess peripheral catheter function; after each infusion to prevent mixing of incompatible medications and solutions; and after blood sampling (Infusion Nurses Society, 2011b).

Locking is performed to maintain device patency and prevent occlusion by instilling solution in an intermittently used peripheral vascular access device (VAD) (Infusion Nurses Society, 2011b).

4.4 Peripheral Access Site Care and Dressing Change

Short peripheral access site care and dressing changes will be performed when the integrity of the dressing is compromised; if moisture, drainage, or blood is present; or if site infection or inflammation is suspected (Infusion Nurses Society, 2011b). Transparent semi-permeable membrane dressings will be changed every 5-7 days (Infusion Nurses Society, 2011b).

4.5 Troubleshooting the Infusion

The following table (Table G) outlines common problems associated with infusions, the possible causes, strategies to prevent problems, and treatment options.

Table G: Troubleshooting the Infusion

Problem	Possible Causes	Prevention	Treatment
Fluids not infusing	Administration set tubing kinked	Check for kinks in tubing	If no visible kinks, remove dressing and check VAD and site
	Peripheral catheter bent	Stabilize and secure catheter with each infusion start Apply arm board	Re-secure VAD or restart infusion if required
	Catheter tip against vein wall	Avoid insertion over site of flexion	Gently reposition the catheter slightly Re-tape if repositioning successful
	Infusion occluded	Ensure continuous flow of solution Use of infusion pumps prevent infusions from running dry Ensure catheter is "locked" after infusion (flush after intermittent infusion to ensure patency for subsequent doses)	Disconnect administration set; directly connect a 3-5 mL syringe, gently attempt to aspirate the catheter. **Never** irrigate the VAD. Follow manufacturer's instructions for locking catheter
	Blood back-up with ambulation	Maintain or increase pressure from above the site	Adjust the height of infusion pole with gravity infusions
	Blocked in-line filter or air-lock in filter	Prime filters correctly	Inspect filters; replace if needed
Venous spasm as evidenced by pain at site	Trauma	Use slow, gentle, fluid insertion techniques, insert bevel-up May use a smaller catheter and a large vein if appropriate	Apply warm compresses on skin above insertion site for comfort Slower rate of infusion
	Chemical irritation	Dilute fluids as indicated	Increase dilution as indicated Reduce flow rate Flush vein if appropriate Add an inline filter Remove VAD and apply compresses. Monitor site.
	Viscous fluids	Select correct size of catheter Follow parenteral monograph for dilution	Use large bore catheter Dilute fluids if not contraindicated
	Cold IV fluid	Remove fluids from fridge 30 min prior to use and	

Problem	Possible Causes	Prevention	Treatment
		allow to warm to room temp Do **not** use a microwave to warm fluids Apply warm compress over infusion site to reduce venous spasm	
	Rapid infusion	Slow infusion rate if not contraindicated	
Air in line	Incorrect priming of the infusion tubing	Prime the line as per manufacturer's recommendations, pay attention to y-ports, back check valves and filtering devices Prime slowly and invert injection ports during priming to prevent trapped air	Close tubing below the air with the roller or slide clamp, gently tap the infusion tubing below the air bubbles to force air into drip chamber Lock a syringe onto the medication port below the air bubbles and gently aspirate the air **OR** Remove the tubing from the VAD, maintaining sterility of VAD and run the air out of the line
	Failure to close clamps when changing infusion bags	Always close clamps before removing an existing infusion bag to replace with a new one	Remove air if required using one of the techniques described above
	IV fluid runs out	Check infusion hourly Use infusion pump	Close roller clamp Ensure adequate solution levels Remove air as required Ensure correct volume programmed into pump Teach competent patients to call when infusion fluid bag less than 100mL
Painful infusion site	Phlebitis	Monitor site and patient closely	Remove VAD. Monitor site. Provide comfort measures. See Table I: Visual Infusion Phlebitis Score
	Chemical irritation	See phlebitis	Increase dilution as indicated Reduce flow rate Flush vein if appropriate Add an inline filter Remove VAD and apply compresses. Monitor site.
	Catheter inserted too far	Do **not** insert beyond 2 mm of the hub of the catheter Check patient's comfort	Loosen tape and pull VAD back and re-tape
	Infection – local and systemic	Follow proper insertion protocol Monitor patient and infusion site closely	Culture site if indicated, remove catheter, restart on other arm; apply warm compresses and notify the most responsible health practitioner. Monitor for systemic infection

Problem	Possible Causes	Prevention	Treatment
	Infiltration	Follow proper insertion protocol Monitor patient and infusion site closely	Remove catheter; apply warm, moist compresses
	Catheter too large for vein	Use the smallest size catheter possible for purpose of the infusion Consider patient anatomy	Remove VAD and select a smaller bore catheter
Peripheral neuropathy	Infusion catheter against a nerve	Select infusion site carefully Be familiar with anatomy	Remove the infusion Assess for motor or sensory impairment Record and inform most responsible health practitioner

4.6 Complications of Infusion Therapy

Like any medical treatment, infusion therapy comes with risks and complications. HCPs should be aware of the most common and dangerous localized and systemic complications. Adhering to best practices and recognizing these complications early reduces the likelihood or their occurrence and the extent of their severity.

Common infusion therapy complications are listed in Tables H and J (MacEwan Faculty of Health and Community Studies, 2011).

4.6.1 Localized Complications

Table H: Localized Complications

Problem	Definition	Signs and Symptoms	Treatment
Infiltration	The inadvertent administration of a nonvesicant medication or solution into the surrounding interstitial tissues.	Pain, swelling, blanching at insertion site, inability to palpate the tip of the infusion catheter, cool skin, wet site, continued infusion even when manually occluded.	Discontinue the catheter, elevate the limb, and apply warm moist compresses as necessary. Do **not** lower the infusion container to check for infiltration; this action may dislodge blood clots that have formed at the site.
Extravasation	The inadvertent administration of a vesicant medication or solution into the surrounding interstitial tissues	Pain, burning, itching, swelling, wet site, redness/change in colour of surrounding skin, necrosis	Check with AHS governance documents, pharmacy and most responsible health practitioner for treatment options (e.g., aspirating medication from surrounding tissues) prior to removing catheter
Phlebitis	Inflammation of the vein caused by trauma or chemical irritation. May be accompanied by thrombus	Warmth, tenderness or pain at infusion site, redness, streaking along vein, palpable cord-like vein, area of hardness, edema (with thrombophlebitis)	See Table I: Visual Infusion Phlebitis Score
Infection	Invasion of the insertion site by micro-organisms.	Generalized redness and heat to the infusion site, may involve redness progressing up the arm, purulent drainage may be present, fever. See Table J.	Discontinue the infusion; notify the most responsible health practitioner; antibiotics and a swab of any drainage may be required. Monitor the site and patient closely for spread of infection and signs of systemic infection such as fever and general malaise. If restarting infusion, do so in the other arm.
Hematoma	Transfusion of blood into subcutaneous spaces.	Discoloration, swelling, tenderness.	Remove catheter, rest affected limb, and apply pressure over the infusion site
Thrombosis	The formation of a blood clot (thrombus) inside a blood vessel. Injury to endothelial cells of vein wall causes platelets to adhere and a thrombus to form	Painful, reddened and swollen vein, infusion is sluggish or stopped	Discontinue VAD, restart infusion in opposite limb if possible. Apply warm soaks. Monitor.

The Infusion Nurses Society (Infusion Nurses Society, 2011) recommends the use of a standardized phlebitis scale that is valid, reliable, and clinically feasible; two such scales are the:

1. Visual Infusion Phlebitis scale, developed by A. Jackson (1998). This scale includes recommended actions for each score (See Table I).
2. Phlebitis Scale, developed by the Infusion Nurses Society (2011a).

Table I: Visual Infusion Phlebitis Score (Jackson, 1998)

IV site appears healthy	**0**	No signs of phlebitis **OBSERVE CANNULA**
One of the following is evident: • Slight pain near IV site OR • Slight redness near IV site	**1**	Possibly first signs of phlebitis **OBSERVE CANNULA**
Two of the following are evident: • Pain at IV site • Erythema • Swelling	**2**	Early stage of phlebitis **RESITE CANNULA**
All of the following signs are evident: • Pain along path of cannula • Induration	**3**	Medium stage of phlebitis **RESITE CANNULA**
All of the following signs are evident and extensive: • Pain along path of cannula • Induration • Erythema • Palpable venous cord	**4**	Advanced stage of phlebitis or the start of thrombophlebitis **RESITE CANNULA** **CONSIDER TREATMENT**
All of the following signs are evident and extensive: • Pain along path of cannula • Induration • Erythema • Palpable venous cord • Pyrexia	**5**	Advanced stage of thrombophlebitis **INITIATE TREATMENT** **RESITE CANNULA**

Adapted with permission from Andrew Jackson.

4.6.2 Systemic Complications

Table J: Systemic Complications

Problem	Definition	Signs and Symptoms	Treatment
Septicemia	Systemic infection resulting from invasion of the bloodstream by microorganisms, including bacteria.	Chills, fever, headache, disorientation, signs of shock, nausea and or vomiting.	Assess airway, breathing, circulation, provide supportive therapy (e.g., oxygen), possible VQ/CT scan.
Catheter Embolism	Catheter fragment in the bloodstream.	Chest pain, signs of shock, shortness of breath, evidence of missing catheter fragment after catheter removal.	Apply tourniquet proximal to the site, assess airway, breathing, circulation, provide supportive therapy (e.g., oxygen). As the catheter is radiopaque, notify the most responsible health practitioner to consider radiography.
Pulmonary Embolism	One or more pulmonary arteries are blocked. With respect to infusion therapy, the blockage is most often caused by a thrombosis (See Section 4.6.1 Local Complications)	Chest pain, shortness of breath, haemoptysis, signs of shock.	Assess airway, breathing, circulation, provide supportive therapy, possible VQ/CT scan.
Air Embolism	A significant amount of air introduced into the circulatory system causing blockage of the pulmonary capillaries.	Anxiety, chest pain, shortness of breath, signs of shock.	Stop infusion, check for air in system, and turn patient to left side with head down to trap air in right atrium. Assess airway, breathing, circulation, provide supportive therapy (e.g., oxygen). Notify most responsible health practitioner
Circulatory Overload	Excessive fluid in the alveoli of the lungs. Also known as pulmonary edema; prevalent among those who have received excessive infusion fluids.	Dyspnea, cyanosis, increased work of breathing, tachycardia, frothy pink sputum, distended neck veins.	Semi-fowlers position; assess airway, breathing, circulation; provide supportive therapy (e.g., oxygen); notify most responsible health practitioner.
Inadvertent Arterial Cannulation	Accidental insertion of an infusion catheter into an artery.	Bright red flashback, pulsation of blood in tubing, infusion will not infuse.	Remove VAD immediately, apply firm pressure for 5 minutes, add pressure dressing for 24 hours, and observe for continued bleeding.

4.7 Reporting and Learning System (RLS) for Patient Safety

In the event of a hazard, close call, or adverse event related to peripheral VAD insertion, infusion therapy, or any other aspect of care, use the AHS Reporting and Learning System for Patient Safety (RLS). The RLS is a province-wide, single system for patient safety reporting that supports a just culture and includes reporting and learning as a key element. To learn more, and to read the *Alberta Health Services Reporting of Clinical Adverse Events, Close Calls and Hazards Policy*, visit http://insite.albertahealthservices.ca/1820.asp

4.8 Patient Teaching

Patient teaching empowers patients to be involved in their own care, and also facilitates communication among patients and their health care providers. When educating patients, their families, and/or decision-makers, HCPs should explain the purpose of the infusion therapy, a typical experience, potential risks, and signs of potential complications. Patients need to be aware that infusion therapy should not be painful. Instruct the patient to report pain, redness, swelling, numbness, or the sensation of hot or cold at the insertion site or up the arm. Also instruct the patient to:

- Cover the site when bathing or showering
- **NOT** adjust the rate/flow
- Keep the site below heart level to prevent backflow of blood
- Call for assistance if the infusion bag is almost empty, the infusion device is alarming, or if the dressing appears to be loose and/or soiled

Provide patient education materials that may be available.

4.9 Learning Activity #4

Instructions: For #1, choose the best answer.

1. Complications of infusion therapy include: (circle all that apply)
   a. catheter embolism
   b. circulatory overload
   c. pulmonary embolus
   d. aneurysm

For #2-8, match the content in Column A to the best answers from Column B.

Note: there may be more than one correct answer from Column B.

Column A	**Column B**
_____ 2. Air in line	a. Apply warm, moist compress
_____ 3. Chemical irritation	b. Aspirate catheter
_____ 4. Infection	c. Close roller clamp
_____ 5. Infiltration	d. Flush catheter
_____ 6. Infusion catheter bent	e. Gently tap infusion tubing
_____ 7. Infusion occluded	f. Increase dilution
_____ 8. Phlebitis	g. Irrigate VAD catheter
	h. Loop tubing around pen
	i. Notify most responsible health practitioner
	j. Perform C&S swab if ordered
	k. Remove VAD
	l. Re-secure infusion catheter
	m. Restart infusion if required
	n. Slow infusion rate

Note: See Appendix A for the answer key.

Section Five: Discontinuing a Peripheral Vascular Access Device

5.1 Learning Objectives

On completion of this learning module, the learner will be able to:

1. Produce the various supplies required to discontinue a peripheral vascular access device (VAD)
2. Put in order the steps required to discontinue a peripheral VAD

5.2 Supplies

As each site/zone has a variety of products that are used within each facility, become familiar with products and procedure used within the practice setting. Remember to perform hand hygiene before you gather the necessary supplies.

Required supplies include:

- Non-sterile, non-latex gloves
- Tape, e.g., paper
- Sterile 2" x 2" gauze
- Sharps container (if necessary)
- Normal Saline (if necessary)
- Swab for C&S (if necessary)
- Small bandage

5.3 Discontinuing Infusion Therapy

Infusion therapy may need to be discontinued for many reasons: prescribed therapy complete, complications, authorized prescriber's orders, or site discontinued after single use (e.g., to inject dye for a diagnostic procedure).

Safe removal of the existing VAD is essential to protect the patient and the health care provider.

1. Perform hand hygiene and gather the required supplies
2. Verify that there is a patient care order discontinuing infusion therapy.
3. Verify that the device to be discontinued is a peripheral infusion and that it is safe to be removed (peripheral line vs. central line).
4. If an infusion is running, stop by clamping.
5. Prepare your supplies
6. Perform hand hygiene and don gloves.

7. Remove tape and dressings.
8. Examine insertion site for complications (e.g., purulent discharge, swelling or inflammation). See Section 4.6, Complications of Infusion Therapy.
9. Gently hold sterile gauze over the insertion site. Keeping the catheter level with the skin, remove the catheter by pulling it straight back
10. Apply firm pressure with gauze and elevate the limb. Maintain pressure until bleeding stops.
11. Examine the catheter to ensure it is intact. If you suspect the catheter is not intact, see "Catheter Embolism" in Section 4.6.2 Systemic Complications.
12. If catheter is connected to infusion tubing, disconnect.
13. If catheter has an indwelling sharp needle, e.g., winged infusion set ("butterfly" device), dispose of catheter directly into sharps container. (If no indwelling sharp needle, dispose of used plastic catheter in biohazard waste.)
14. Apply small bandage.
15. Dispose of supplies into garbage (does not need to be in biohazard waste unless infectious).
16. Dispose of infusion fluids with medication in biohazard waste or appropriate container. Do **NOT** drain into the sink because the wastewater treatment facility may not be able to remove all of the medication, causing contamination to local waterways and harm to humans, fish, and wildlife.
17. Remove and dispose of gloves, perform hand hygiene.
18. Document the removal of the infusion catheter

5.4 Learning Activity #5

Instructions: Your patient has Normal Saline infusing at 50 cc/hr via peripheral VAD. She is discharged home today. There is an order to discontinue infusion therapy. Number the following steps in the correct order. There are a total of 16 steps.

_____ a. Apply bandage or small dressing
_____ b. Stop infusion by clamping
_____ c. Don gloves
_____ d. During 1 minute of pressure, examine catheter for intactness
_____ e. Examine infusion site
_____ f. Gather supplies
_____ g. Doff gloves
_____ h. Remove peripheral vascular access device with one hand while applying pressure dressing with other hand
_____ i. Remove tape and dressing securing infusion
_____ j. Perform hand hygiene (1st of 4 moments for hand hygiene)
_____ k. Perform hand hygiene (2nd of 4 moments for hand hygiene)
_____ l. Perform hand hygiene (3rd of 4 moments for hand hygiene)
_____ m. Perform hand hygiene (4th of 4 moments for hand hygiene)
_____ n. Dispose of used supplies
_____ o. Provide patient teaching
_____ p. Document in patient record

Note: See Appendix A for the answer key

Post Learning Assessment

Instructions:

The on-line post-learning assessment is posted on Insite http://insite.albertahealthservices.ca/8567.asp. You can access Insite via an Alberta Health Services computer, or from your home computer using this portal http://my.albertahealthservices.ca

The passing grade for the test is 80%. If this score is not achieved, review the learning module again and repeat the test.

Upon successful completion of the post-learning assessment, a **Certificate of Completion** will be generated for the theoretical portion of this learning module. You can print a copy and submit to your manager, clinical educator, or designate.

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Appendix A: Answer Key

Learning Activity #1

1. a
2. a, b, c, d
3. b
4. d
5. b
6. c
7. a
8. e
9. b
10. d

Learning Activity #2

1. intima
2. thick
3. visible
4. cephalic
5. distal
6. A
7. A
8. U
9. A
10. U

Learning Activity #3

Answer key not applicable.

Learning Activity #4

1. a, b, c

2.

c, e, h	Air in line
a, d, f, k, n	Chemical irritation
a, i, j, k, m	Infection
a, k, m	Infiltration
l, m	infusion catheter bent
b	infusion clotted
a, k, m	Phlebitis

Learning Activity #5

10	a.	Apply bandage or small dressing
3	b.	Stop infusion by clamping
5	c.	Don gloves
9	d.	During 1 minute of pressure, examine catheter for intactness
7	e.	Examine infusion site
2	f.	Gather supplies
12	g.	Doff gloves
8	h.	Remove infusion catheter with one hand while applying pressure dressing with other hand
6	i.	Remove tape and dressing securing infusion
1	j.	Perform hand hygiene (1st of 4 moments for hand hygiene)
4	k.	Perform hand hygiene (2nd of 4 moments for hand hygiene)
13	l.	Perform hand hygiene (3rd of 4 moments for hand hygiene)
15	m.	Perform hand hygiene (4th of 4 moments for hand hygiene)
11	n.	Dispose of used supplies
14	o.	Provide patient teaching
16	p.	Document in patient record

OR

1. Perform hand hygiene (1st of 4 moments for hand hygiene)
2. Gather supplies
3. Stop infusion by clamping
4. Perform hand hygiene (2nd of 4 moments for hand hygiene)

5. Don gloves
6. Remove tape and dressing securing infusion
7. Examine infusion site
8. Remove infusion catheter with one hand while applying pressure dressing with other hand
9. During 1 minute of pressure, examine catheter for intactness
10. Apply bandage or small dressing
11. Dispose of used supplies
12. Doff gloves
13. Perform hand hygiene (3^{rd} of 4 moments for hand hygiene)
14. Provide patient teaching
15. Perform hand hygiene (4^{th} of 4 moments for hand hygiene)
16. Document in patient record

Appendix B: Insertion of Peripheral Vascular Access Device using Over the Needle Catheter Skills Checklist

Learning Objective:

On completion of the Skills Checklist, the learner will be able to demonstrate, with 100% accuracy, successful insertion of a peripheral vascular access device (over the needle catheter) independently.

Instructions:

Review the skills checklist. **Taking advantage of opportunities to simulate practice in a skills lab where available is encouraged.**

At the clinical bedside, perform the procedure on a patient (who has an order for infusion therapy) with an Observer (e.g., Clinical Educator or designate). The Observer will use the checklist to ensure that you have successfully performed the steps in the correct order.

After the first successful attempt, you and the Observer can mutually discuss if further practice and observed attempts are necessary. Repeat the procedure until you and the Observer are confident in your skills to perform this procedure independently.

The same Observer does not have to be present for repeat attempts.

Perform the skills checklist on an annual basis, or as recommended by your unit manager or clinical educator.

Name: **Location and Unit:**

Skills Checklist: Initiating Infusion Therapy	**1**	**2**	**3**	**4**
Date				
1. Confirms authorized prescriber's order.	☐	☐	☐	☐
2. Indicates the purpose of infusion therapy.	☐	☐	☐	☐
3. Chooses the correct IV solution and administration set and selects appropriate gauge and length of peripheral vascular access device.	☐	☐	☐	☐
4. Performs hand hygiene.	☐	☐	☐	☐
5. Primes the administration set with IV solution, ensuring air is purged from the tubing.	☐	☐	☐	☐
6. Confirms patient identity with at least two unique patient identifiers and presence of allergies.	☐	☐	☐	☐
7. Explains procedure and rationale for therapy to the patient.	☐	☐	☐	☐
8. Performs hand hygiene.	☐	☐	☐	☐
9. Sets up necessary supplies.	☐	☐	☐	☐
10. Uses appropriate dilation techniques (e.g., tourniquet) to visualize and select potential catheter insertion site	☐	☐	☐	☐
11. Cleanses the site using appropriate cleansing solution and friction, in a circular motion, from site outwards for 5-7 cm, for a required amount of time. Allow to air dry.	☐	☐	☐	☐
12. Dons gloves.	☐	☐	☐	☐
13. Visually inspects peripheral catheter prior to insertion. If palpating vein further, does not touch the insertion site directly.	☐	☐	☐	☐
14. Stabilizes the skin and anchors the vein.	☐	☐	☐	☐
15. Enters vein at appropriate angle, bevel up. Decreases angle once blood flashback is obtained. Advances catheter ¼ inch (or 6-7mm) further into vein.	☐	☐	☐	☐
16. Occlude blood flow above insertion site and remove tourniquet.	☐	☐	☐	☐
17. Activates the needle-safety function by retracting the stylet as per manufacturer's instructions.	☐	☐	☐	☐
18. Disposes of stylet into appropriate sharps container as soon as removed from catheter	☐	☐	☐	☐
19. Stabilizes the catheter, occludes the vein, and connects extension set / primary infusion administration set, or flushes and locks access device.	☐	☐	☐	☐
20. Cleanses skin if necessary. Applies transparent semi-permeable dressing.	☐	☐	☐	☐
21. If IV fluids ordered, begins infusion slowly.	☐	☐	☐	☐
22. Secures tubing with tape. Labels site with date and time.	☐	☐	☐	☐
23. Sets infusion rate accurately.	☐	☐	☐	☐
24. Disposes of used items appropriately.	☐	☐	☐	☐
25. Doffs gloves and performs hand hygiene.	☐	☐	☐	☐
26. Provides patient education.	☐	☐	☐	☐
27. Performs hand hygiene.	☐	☐	☐	☐
28. Documents in patient record.	☐	☐	☐	☐
Initials of Observer				

Attempt #1

Observer's Name:	Initials:
Signature:	Contact Number:
Recommendations: (repeat procedure when opportunity presents/ no further practice required)	

Attempt #2

Observer's Name:	Initials:
Signature:	Contact Number:
Recommendations: (repeat procedure when opportunity presents/ no further practice required)	

Attempt #3

Observer's Name:	Initials:
Signature:	Contact Number:
Recommendations: (repeat procedure when opportunity presents/ no further practice required)	

Attempt #4

Observer's Name:	Initials:
Signature:	Contact Number:
Recommendations: (repeat procedure when opportunity presents/ no further practice required)	

This form is designed to validate the skill proficiency of venipuncture; it is not for performance review. Return completed checklist to unit/site educator, manager or appropriate designate.

Confirmation of Completion:

I, _____(name, position) confirm that

_____ (learner name) is able to demonstrate, with 100% accuracy, successful insertion of a peripheral vascular access device (over the needle catheter) independently.

Manager/Educator/Designate Signature: _____ Date:_____

Evaluation

Site:_____ **Unit/Area**:_____ **Date:**_____

1.	The module was easy to read and comprehend.	Yes	No
2.	The directions and learning objectives were clear and easy to understand.	Yes	No
3.	The amount of detail was appropriate.	Yes	No
4.	The learning activities were appropriate.	Yes	No

5. What, if any, additional resources did you access in order to complete this module?

6. Having completed this module, how confident do you feel in peripheral VAD insertion?

7. Is there any information in the module that you think is **not** relevant to the topic? If so, please identify the information specifically.

8. Is there any additional relevant information that you think needs to be included in the module? If so, please identify it.

9. How long did it take for you to complete this learning module? _____

10. Any other comments:

Please scan completed evaluation to Health Professions Strategy & Practice:
practice.consultation@albertahealthservices.ca

Thank you. Your feedback is greatly appreciated.