Halton Healthcare GEORGETOWN · MILTON · OAKVILLE	**Clinical Management of Central Vascular Access Devices (CVAD) in Adults Policy and Procedure**			
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Clinical Management of Central Vascular Access Devices (CVADs) in Adults

1.0 Purpose

To outline practice standards and guidelines for the management of Central Vascular Access Devices (CVADs) in adults.

2.0 Scope

All nurses and credentialed staff

3.0 Policy

3.1 All nurses and credentialed staff managing CVADs are accountable for ensuring their competency.

3.2 Aseptic Non-Touch Technique (ANTT) must be followed for all CVAD management procedures, as a critical aspect of infection prevention.

3.3 Personal Protective Equipment (PPE) for CVAD procedures must be worn according to the level of risk as outlined in Table 1.

3.4 Prior to accessing the CVAD for the first time, it must be verified that correct tip placement was confirmed post insertion procedure on all CVADs inserted at Halton Healthcare.

3.5 All CVADs inserted outside of Halton Healthcare must have correct placement verified by accessing Connecting Ontario to view the post-insertion tip confirmation report, and if not available, confirmation of tip positioning assessment must be verified with x-ray at Halton Healthcare prior to use.

3.6 A Hemodialysis Apheresis line may ONLY be accessed in an urgent situation with an order received from a Nephrologist or by a Registered Nurse (RN) that has received additional training as outlined in the Hemodialysis Central Venous Catheter: Accessing by Non-Dialysis Nursing Staff Policy and Procedure.

3.7 For a non-dialysis apheresis line, an order is not needed from a Nephrologist when access is required.

3.8 Patency of a CVAD must be confirmed at access prior to initiating an infusion and at the intervals indicated in Table 2.

3.9 All IV infusions administered via CVAD must be infused utilizing an infusion pump and in accordance with the Infusion Pump Drug Library Policy and Procedure and Adult High-Alert Drug Policy and Procedure.

3.10 The patient's arm on the side with the CVAD shall be avoided for blood pressure measurements and venipuncture.

3.11 Initial and ongoing assessment and management of a CVAD must occur as per CVAD Assessment and Management Procedure as outlined in Section 4.

3.12 The initial CVAD dressing must be changed using sterile technique and following the time schedule:

- 3.11.1 7 days after insertion if initial dressing is a transparent semipermeable membrane (TSM).
- 3.11.2 24 hours after insertion if initial dressing is a gauze alone or gauze under a TSM.
- 3.11.3 Thereafter according to the CVAD maintenance care schedule as outlined in Table 2.

3.13 CVAD Blood Culture Collection.

- 3.13.1 Use of a CVAD for drawing blood cultures is only indicated when the catheter is suspected of being the source of infection.
- 3.13.2 Time blood culture draw from CVAD and peripheral vein as close together as possible when a catheter related infection is suspected.
- 3.13.3 Draw blood cultures before all other blood collection samples and prior to antibiotics administered if possible.

3.13.4 Do not draw blood cultures through existing needleless connector. Remove it prior to blood culture sample and draw directly from the CVAD lumen.
3.13.5 Do not flush or draw discard sample prior to obtaining blood cultures.
3.13.6 For multi-lumen CVADs, draw separate blood culture samples from each lumen and label appropriately.

3.14 CVAD Blood Sample Collection.
3.14.1 Blood sample collection should be drawn using the vacutainer access device directly attached to the CVAD needleless connector. If this approach is not successful, a syringe with a vacutainer blood transfer device can be used.
3.14.2 Stop infusion for at least 1 minute prior to blood collection.
3.14.3 Only in emergency situations should blood samples be obtained from a CVAD lumen infusing Total Parenteral Nutrition (TPN).
3.14.4 Do not stop inotropes or vasoactive infusions to complete blood sampling from the CVAD. An alternate route for blood sampling is required.
3.14.5 Blood must be drawn from the largest available lumen (usually distal) to avoid the risk of a hemolyzed sample. Anything from the distal lumen must be drawn slowly to avoid entrainment of fluids from other upstream infusions.
3.14.6 Adhere to additional requirements for pre/post flushing and discard amounts as outlined in Table 2.
3.14.7 If the CVAD has additional lumens that are not accessed, follow the flushing and locking procedure for each CVAD lumen as outlined in Section 10.

3.15 A Provider order is required for the locking solution as outlined in Table 2, Alteplase administration for occlusion, and for removal of a CVAD.

3.16 If the cuff is exposed at the exit site of a cuffed CVAD, it should not be used. Secure the line in place with tape, place label "do not use" over the dressing and notify the most responsible Provider.

3.17 For the assessment and management of a potential CVAD thrombotic occlusion:
3.17.1 Follow the CVAD Thrombotic Occlusion Assessment and Management Algorithm in Section 11.
3.17.2 In a multi-lumen CVAD, Alteplase must be administered only into the blocked lumen.
3.17.3 Do not use Alteplase to unblock a CVAD with known/suspected catheter infection or for a block potentially from a chemical occlusion. A chemical occlusion may be suspected when a visible drug precipitate is present in the line. If visible, contact Provider for further management.

3.18 The CVAD and insertion site requires regular assessment to prevent the risk of developing CVAD related infections.
3.18.1 Assess the clinical need for CVAD daily.
3.18.2 Assess the skin integrity at CVAD insertion/exit site and CVAD device once per shift and as necessary following the CVAD Assessment and Management Procedure as outlined in Section 4.

3.19 CVAD maintenance care shall be followed as outlined in Table 2 below.

Table 1: Infection, Prevention and Control: Closed Vs Open CVAD System

System Type	Implications	Care Requirements	Examples for Care Requirements
Closed CVAD System CVAD lumen(s) are "closed" when a needleless connector is in place to protect the internal lumen and/or when a dressing covers the insertion site	A closed system has a lower risk of contamination and are shown to significantly reduce the incidence of central line-associated blood stream infection (CLABSI)	• Non-sterile gloves • Active disinfection using 2% chlorohexidine/70% alcohol swab pad	• Blood sampling through a needleless connector • Tubing change to needleless connector • Starting/stopping infusion to needleless connector • Needle removal and de-accessing an implanted port • Flushing and locking for maintenance through needleless connector
Open CVAD System CVAD lumen(s) are open or exposed when there is no needleless connector insitu	An open system has a higher risk of contamination to the lumen and interior surfaces of the CVAD and is associated with increased risk of CLABSI	• Sterile gloves • Mask for everyone at the bedside including the patient • Active disinfection of CVAD lumen using 2% chlorohexidine/70% alcohol swab pad	• Needleless connector change • Needle insertion to access an implanted port • CVAD dressing change

Table 2: CVAD Maintenance Care				
	PICC or Non-Tunneled (e.g. PICC, Short-term)	**Tunneled Line (e.g. Hickman)**	**Tunneled Line (e.g. Dialysis Line or Apheresis Line for Non-dialysis)**	**Implanted Port**
Accessing	IV tubing or syringe via Needleless Connector			Non-coring needle primed with sterile 0.9% sodium chloride
Check Placement	Gently aspirate, then withdraw 3-5mL of the locking solution and discard			
Flushing & Locking Frequency	Flush and lock after each access or **every 7 days if not in use**			Flush and lock after each access or **every 30 days if not in use**
Flushing Solution & Volume	For Flushing Before: Sterile 0.9 % sodium chloride 10mL before medication or blood administration or blood withdrawal For Flushing After: Sterile 0.9 % sodium chloride 20mL after medication, blood administration, discontinuing TPN, or blood withdrawal			
Locking Solution & Volume	Sterile 0.9 % sodium chloride 10 mL*	Heparin 500 units/5 mL	a. Heparin 500 units/5 mL when accessed daily b. 4% (Sodium) Na Citrate 3-5 mL if not accessed daily	Heparin 500 units/5 mL (when needle not in situ) Sterile 0.9% sodium chloride (when needle in situ)
Dressing Changes	• Transparent semipermeable membrane (TSM) dressing every 7 days or immediately if dressing integrity is disrupted (lifted/detached at border edge, visibly soiled, presence of drainage, or blood) or compromised skin integrity under the dressing • Gauze dressing every **2 days** and if dressing integrity disrupted (damp, loosened, soiled)			
Needleless Connector Change	• Change no more frequently than 96-hour intervals or according to manufacturers' directions. • When used with continuous infusion system, change when primary administration set is changed. • Additionally, change if removed for any reason, there is residual blood or debris within the needleless connector and prior to drawing a sample for blood culture.			
Securement Device	• Change adhesive securement device with each dressing change if present			
Blood Sampling Discard Volume	• One discard tube of 6 mL			
Additional Daily Maintenance Care	• Review line necessity: ✓ Assess clinical need for CVAD with the healthcare team daily ✓ Assess patency and function of the line (if in use) and condition of dressing each shift • Patient Care: ✓ Daily bath required for all patients with a CVAD ✓ Change bed linens and gown/clothing daily			

*Some brands require different flushing solutions. Check with Home Care, patient or manufacturer

4.0 CVAD Assessment and Management Procedure

4.1 Assess the clinical need for CVAD daily by reviewing with team (e.g. interprofessional patient rounds).

4.2 Assess the skin integrity at the CVAD insertion site and surrounding area through the dressing at least once per shift.

- 4.2.1 Visualize and palpate for signs and symptoms of complications at site and along CVAD pathway (e.g., swelling, leaking, redness, warmth, cording, and drainage.
- 4.2.2 Verify dressing and method of securement is intact to prevent dislodgement.
- 4.2.3 Ask patient if they are experiencing any symptoms of discomfort, tenderness, pain, tingling, or numbness.
- 4.2.4 Remove non-transparent dressing to allow thorough examination of site only if patient has fever, tenderness at insertion site or other signs/symptoms of infection; otherwise, use palpation for assessment.
- 4.2.5 Ensure clamps are engaged when CVAD is not in use.
- 4.2.6 For midline catheters and PICCs in the presence of edema and with signs and symptoms of deep vein thrombosis measure arm circumference midway between insertion site and axilla and compare to previous assessment.

4.3 Document findings of each assessment and whenever an adverse event has occurred including:

- 4.3.1 Assessment of need for the CVAD line by the team in the last 24 hours.
- 4.3.2 Dressing care indicating dressing is dated within 7 days and transparent dressing is clean and dry.
- 4.3.3 Catheter care indicating dates of last tubing and each CVAD lumen needleless connector changes.
- 4.3.4 Daily patient care indicating daily bath within the last 24hours, daily linen change and daily gown change.

5.0 Accessing and De-accessing PICC, Non-Tunneled, and Tunnelled Apheresis Lines and for Infusions Procedure

5.1 Procedure for Accessing PICC, Non-Tunneled, and Tunnelled Apheresis Lines with Needleless Connectors

Collect Supplies

a. Two -2% chlorhexidine /70% alcohol swab pads
b. One - 10 mL empty syringe to needleless connector
c. Two - 10mL sterile preservative-free prefilled 0.9% sodium chloride syringes
d. Non-sterile gloves

Procedure

a. Perform hand hygiene and don gloves
b. Perform active disinfection of the hub of the needleless connector by a vigorous scrub with a 2% chlorhexidine /70% alcohol swab pad for 15 seconds and allow to air dry for at least 20 seconds.
c. Attach empty 10 mL syringe to needleless connector, unclamp the CVAD line, and withdraw 3-5mL to remove locking solution and discard
d. If no blood return, proceed to flush 10 mL of sterile preservative-free prefilled syringe of 0.9% sodium chloride using a push-pause flushing method and attempt to withdrawal again. If flush has confirmed patency, clamp the CVAD line, then disconnect and discard the syringe.
    i. If resistance to flush is met or there is no blood return, follow algorithm as outlined in Section 11 for CVAD Occlusion Assessment and Management.

e. Perform active disinfection of the hub of the needleless connector by a vigorous scrub with a 2% chlorhexidine /70% alcohol swab pad for 15 seconds and allow to air dry for at least 20 seconds.
f. Connect infusion line and unclamp the CVAD line allowing the infusion to run

5.2 Procedure for De-accessing PICC, Non-Tunneled, and Tunnelled Apheresis Lines with Needleless Connectors

Collect Supplies

a. Two -2% chlorhexidine /70% alcohol swab pads
b. Needleless connector – for each lumen
c. 10mL sterile preservative-free prefilled 0.9% sodium chloride syringes (one for each lumen)
d. Syringe filled with locking solution as outlined in Table 2 (one for each lumen)
e. Non-sterile gloves

Procedure

a. Obtain an order for the locking solution as outlined in Table 2
b. Perform hand hygiene and don non-sterile gloves
c. Stop the infusion and disconnect infusion line from the needleless connector
d. Clamp the CVAD line and perform active disinfection of the hub of the needleless connector by a vigorous scrub with a 2% chlorhexidine /70% alcohol swab pad for 15 seconds and allow to air dry for at least 20 seconds.
e. Following ANTT and attach 10mL sterile preservative-free prefilled 0.9% sodium chloride syringe to the new needleless connector and prime, leaving the syringe attached.
f. Detach the used needleless connector and discard.
g. Perform active disinfection of the hub of the needleless connector by a vigorous scrub with a 2% chlorhexidine /70% alcohol swab pad for 15 seconds and allow to air dry for at least 20 seconds.
h. Following ANTT attach the new, primed connector to the CVAD lumen. Remove syringe.
i. Attach the pre-filled syringe of locking solution, unclamp the lumen, instill final locking solution using a push-pause flushing method, clamping off with the final 0.5 mL See Table 2 for locking solution required
    i. Repeat for all lumens of the CVAD even if not used.

6.0 Accessing and De-accessing Implanted Ports for Infusions

6.1 Procedure for Accessing an Implanted Port with Needle

Collect Supplies

a. 1 pair non-sterile gloves
b. 1 pair sterile gloves
c. Two - 10 mL sterile preservative-free prefilled 0.9% sodium chloride syringe
d. One - 2% chlorhexidine /70% alcohol swabs stick
e. One - Transparent Semi-Permeable Membrane (TSM) dressing – 10x12 cm or gauze dressing
f. Patient specific non-coring needle set (needle & extension tubing attached)
g. One - needleless connector
h. Dressing tray for sterile procedure
i. Surgical masks for all present at the bedside including the patient

Procedure

a. Prior to the procedure, assess patient's pain experience with accessing the port and need for transdermal anesthetic cream prior to accessing. If transdermal anaesthetic e.g. eutectic mixture of local anesthetics (EMLA cream) is required, obtain order, apply, and keep covered

with transparent semi-permeable membrane as per product monograph before accessing port. Wipe off any excess cream prior to starting procedure.

b. Inspect the skin over the port for integrity and palpate for port position.
c. Perform hand hygiene.
d. Don surgical masks, everyone present at the bedside including the patient.
e. Don non-sterile gloves.
f. Open dressing tray and drop transfer all sterile equipment required onto the sterile field.
g. Cleanse the skin over the port site with 2% Chlorhexidine/ 70% Alcohol swab stick using repeated back-and-forth strokes for 15 seconds (horizontally) and 15 seconds (vertically) if site is dry or 1 minute (horizontally) and 1 minutes (vertically) if site is moist. Continue moving outward toward the periphery of the procedure site using back-and-forth strokes. Allow area to air dry for 20 seconds.
h. Doff gloves, perform hand hygiene and don sterile gloves.
i. Connect needleless connector to the non-coring needle set.
j. Prime non-coring safety needle and extension tubing with 10 mL sterile preservative-free prefilled 0.9% sodium chloride syringe.
k. Clamp extension tubing on the non-coring needle set and leave syringe attached
l. Place sterile drapes around port site.
m. With non-dominant hand, locate the septum and secure the port.
n. Insert non-coring needle into the septum at 90 degrees to the port until you feel the needle touch the posterior wall of the port. Pull back on the syringe slightly to confirm blood return.
o. Aspirate 5mL of blood to withdraw indwelling heparin solution and discard blood filled syringe.
p. Attach 10 mL sterile preservative-free prefilled 0.9% sodium chloride syringe and flush using push-pause method. Clamp extension tubing while applying positive pressure.
q. If resistance to flush is met or there is no blood return, follow algorithm in Section 11 for Thrombotic Occlusion Assessment and Management
r. Remove syringe.
s. Place the transparent dressing over the site, ensuring the entire needle and access site is covered.
t. Label the dressing with date and initials of individual who changed the dressing.
u. Doff gloves and perform hand hygiene.
v. Doff mask and perform hand hygiene.
w. Document on the "IV/Invasive Line Assessment" intervention in Expanse and include the gauge/length of non-coring needle, blood return, instillation flush, appearance of the access site, and the patient's tolerance to procedure.

6.2 Procedure for De-accessing an Implanted Port with Needle

Collect Supplies

a. Heparin 500 units/5 mL (100 unit/mL concentration) using a 10mL syringe.
b. One - 10 mL sterile preservative-free prefilled syringes of 0.9% sodium chloride
c. One - 2% chlorhexidine/70% alcohol swab pad
d. One-sterile gauze
e. One - adherent bandage
f. Surgical masks for all present at the bedside including the patient
g. Non-sterile gloves

Procedure

a. Verify Provider order for discontinuing access and for heparin locking solution.

b. Perform hand hygiene.
c. Don surgical masks, everyone present at the bedside including the patient
d. Don non-sterile gloves.
e. Perform active disinfection of the hub of the needleless connector by a vigorous scrub with a 2% chlorhexidine /70% alcohol swab pad for 15 seconds and allow to dry for at least 20 seconds.
f. Unclamp extension set of the non-coring needle and aspirate for blood return followed by flush with 10 mL sterile preservative-free 0.9% sodium chloride prefilled syringe using a push-pause flushing method.
g. Instill the locking solution and clamp the extension set in the final 0.5 mL. Remove syringe.
h. Carefully remove dressing.
i. Remove non-coring needle by securing the port with non-dominant hand and remove non-coring needle without twisting, using a steady perpendicular motion, engaging the safety device as directed.
j. If required, apply pressure to site with a gauze until hemostasis is achieved.
k. Cover site with adherent bandage.
l. Doff non-sterile gloves.
m. Perform hand hygiene.
n. Document on the "IV/Invasive Line Assessment" intervention and the MAR in Expanse and include the appearance of the site, administration of the heparin and the patient's tolerance to procedure in the patient electronic health record.

6.3 Procedure for Changing Needle and Dressing of Implanted Port

Collect Supplies

a. One pair non-sterile gloves
b. One pair sterile gloves
c. Two - 10 mL sterile preservative-free prefilled 0.9% sodium chloride syringe
d. One - 2% chlorhexidine /70% alcohol swabs sticks
e. One - Transparent Semi-Permeable Membrane (TSM) dressing – 10x12 cm or gauze dressing
f. Patient specific non-coring needle set (needle & extension tubing attached)
g. One - needleless connector
h. Dressing tray for sterile procedure
i. Surgical masks for all present at the bedside including the patient

Procedure

a. Perform hand hygiene.
b. Don surgical masks, everyone present at the bedside including the patient.
c. Don non-sterile gloves.
d. Open dressing tray and drop transfer all sterile equipment required onto the sterile field.
e. Carefully remove the dressing.
f. Inspect the skin over the port for integrity and palpate for port position.
g. Remove non-coring needle by securing the port with non-dominant hand and remove non-coring needle without twisting, using a steady perpendicular motion, engaging the safety device as directed.
h. Cleanse the skin over the port site with 2% Chlorhexidine/ 70% Alcohol swab stick using repeated back-and-forth strokes for 15 seconds (horizontally) and 15 seconds (vertically) if site is dry or 1 minute (horizontally) and 1 minutes (vertically) if site is moist. Continue

moving outward toward the periphery of the procedure site using back-and-forth strokes. Allow area to air dry for 20 seconds.

i. Doff non-sterile gloves, perform hand hygiene and don sterile gloves.
j. Connect needleless connector to the non-coring needle set.
k. Prime non-coring safety needle and extension tubing with 10 mL sterile preservative-free prefilled 0.9% sodium chloride syringe.
l. Clamp extension tubing on the non-coring needle set and leave syringe attached.
m. Place sterile drapes around port site.
n. With non-dominant hand, locate the septum and secure the port.
o. Insert non-coring needle into the septum at 90 degrees to the port until you feel the needle touch the posterior wall of the port.
p. Attach 10 mL sterile preservative-free prefilled 0.9% sodium chloride syringe and pull back on the syringe slightly to confirm for blood return. Then flush using push-pause flushing method. Clamp extension tubing while applying positive pressure.
q. If resistance to flush is met or there is no blood return, follow algorithm in Section 11 for Thrombotic Occlusion Assessment and Management.
r. Remove syringe.
s. Place the transparent dressing over the site, ensuring the entire needle and access site is covered.
t. Label the dressing with date and initials of individual who changed the dressing.
u. Doff gloves and perform hand hygiene.
x. Doff mask and perform hand hygiene.
y. Document on the "IV/Invasive Line Assessment" intervention in Expanse and include the gauge/length of non-coring needle, blood return, instillation flush, appearance of the access site, and the patient's tolerance to procedure.

7.0 CVAD Dressing Change Procedure

Collect Supplies

a. Non-Sterile gloves
b. Sterile gloves
c. Two - 2% Chlorhexidine / 70% Alcohol swab stick
d. Dressing tray for sterile procedure
e. Skin protectant prep pad
f. Transparent Semi-permeable membrane (TSM) dressing
g. Surgical masks for everyone at the bedside including the patient
h. Securement device (e.g. StatLock®), when applicable

Procedure

a. Perform hand hygiene.
b. Don surgical masks for all present at the bedside including the patient.
c. Don non-sterile gloves.
a. Place the patient in supine position, if tolerated.
b. Open dressing tray and drop sterile supplies onto the sterile field.
c. Remove the TSM dressing.
d. Loosen the securement device by moistening the dressing with one chlorhexidine/alcohol swab stick. Gently stroke the underside of the pad with the swab stick to dissolve the adhesive as the pad lifts away from the skin. Once loose, take hold of the securement device

being careful not to pull on the line. Lift the plastic doors one side at a time to release the line.

e. Assess the insertion site for signs and symptoms of infection, including pain/tenderness, redness, swelling, exudate, and for bleeding.
f. Cleanse the skin at the insertion site with 2% Chlorhexidine/ 70% Alcohol swab stick. Apply solution to the insertion site; use repeated back-and-forth strokes for 15 seconds (horizontally) and 15 seconds (vertically) if site is dry or 1 minute (horizontally) and 1 minutes (vertically) if site is moist. Continue moving outward toward the periphery using back-and-forth strokes. Allow area to air dry for 20 seconds.
g. Doff non-sterile gloves.
h. Perform hand hygiene.
i. Don sterile gloves.
j. To apply new dressing and securement device, prepare the skin with the skin protectant prep pad and allow skin to air dry
k. Position the securement device with the arrows pointing towards the insertion site and attach the CVAD
l. Apply TSM dressing over the insertion site and the securement device
m. Label dressing with date and initials of individual that changed the dressing
n. Doff gloves and perform hand hygiene
o. Doff mask and perform hand hygiene
p. Document dressing change date, time, condition of site and skin, any difficulties and catheter length if measured in the electronic patient heath record

8.0 CVAD Blood Collection Procedure

8.1 Procedure for Blood Sampling with Vacutainer

Collect Supplies

a. Non-sterile gloves
b. Two - 2% chlorhexidine/70% alcohol swab pads
c. Three - 10mL sterile preservative-free prefilled 0.9% sodium chloride syringes
d. Vacutainer luer-lock access device
e. Appropriate blood specimen tubes
f. Specimen labels

Procedure

a. If connected to an infusion, stop the infusion for one minute prior to collecting required blood samples. Disconnect the IV tubing from the CVAD needleless connector and apply dead end cap to IV tubing.
b. Perform hand hygiene
c. Don non-sterile gloves
d. Perform active disinfection of the hub of the needleless connector by a vigorous scrub with a 2% chlorhexidine /70% alcohol swab pad for 15 seconds and allow to air dry for at least 20 seconds.
e. Flush the needleless connector with one 10 mL sterile preservative-free prefilled 0.9% sodium chloride syringe using a push-pause flushing method ensuring positive blood return.
f. Remove syringe and attach vacutainer luer-lock access device to the CVAD needleless connector. Insert discard tube and hold tube in place until blood ceases to flow (approximately 6mL). Remove the discard tube.

g. Collect blood specimen tube sample following Halton Healthcare recommended blood draw order as per Specimen Collection – Venipuncture Procedure
h. Gently invert the collection tube according to the manufacturers' directions to prevent erythrocyte damage and hemolysis to the sample.
i. Flush the needleless connector with the one 10mL sterile preservative-free prefilled 0.9% sodium chloride syringe using push-pause-flush method. Remove and discard. Repeat with the second syringe.
j. Perform active disinfection of the hub of the needleless connector by a vigorous scrub with a 2% chlorhexidine /70% alcohol swab pad for 15 seconds and allow to air dry for at least 20 seconds.
k. If CVAD was connected to infusion, reconnect the infusion.
l. If CVAD was locked off, follow locking off procedure found in Table 2: CVAD Maintenance Care.
m. If the CVAD has additional needleless connector that are not accessed, follow the flushing and locking procedure for each.
o. Label all samples at the bedside with preprinted specimen label, date, time and health care professional mnemonic who drew the sample as per Specimen Collection – Venipuncture Procedure
p. Doff non-sterile gloves.
q. Perform hand hygiene.
r. Send blood samples to the lab immediately.

8.2 Procedure for Blood Sampling Using a Syringe with a Vacutainer Blood Transfer Device

Collect Supplies

a. Non-sterile gloves
b. Two - 2% chlorhexidine/70% alcohol swab pad
c. Two - 10mL sterile preservative-free prefilled 0.9% sodium chloride syringes
d. 10mL luer-lock sterile syringes (# determined by the amount to be drawn for collection)
e. Vacutainer blood transfer device
f. Appropriate blood specimen tubes
g. CVAD needleless connector, when required
h. Specimen labels

Procedure

a. If connected to an infusion, stop the infusion for one minute prior to collecting required blood samples. Disconnect the IV tubing from the CVAD needleless connector and apply dead end cap to IV tubing.
b. Perform hand hygiene
c. Don non-sterile gloves
d. Perform active disinfection of the hub of the needleless connector by a vigorous scrub with a 2% chlorhexidine /70% alcohol swab pad for 15 seconds and allow to air dry for at least 20 seconds.
e. Flush the needleless connector with 10 mL sterile preservative-free prefilled 0.9% sodium chloride syringe using a push-pause flushing method ensuring positive blood return. Using the same syringe, obtain 6 mL discard by slowly aspirating blood.
f. Remove syringe, discard and attach sterile empty 10mL syringe and withdraw required amount of blood volume (slowly to avoid hemolysis) for specimen blood collection using number of syringes to be determined by the amount of blood required for sampling.

g. To transfer blood into collection tubes, attach blood filled syringe(s) to blood transfer device and insert blood tubes in correct order of draw.
h. Gently invert the collection tube according to the manufacturers' directions to prevent erythrocyte damage and hemolysis to the sample.
i. Flush the needleless connector with one 10mL sterile preservative-free prefilled 0.9% sodium chloride syringe using push-pause-flush method. Remove and discard. Repeat with the second syringe.
j. Perform active disinfection of the hub of the needleless connector by a vigorous scrub with a 2% chlorhexidine /70% alcohol swab pad for 15 seconds and allow to air dry for at least 20 seconds.
k. If CVAD was connected to infusion, reconnect the infusion.
l. If CVAD was locked off, follow locking off procedure found in Table 2: CVAD Maintenance Care.
m. If the CVAD has additional needleless connector that are not accessed, follow the flushing and locking procedure for each.
n. Label all samples at the bedside with preprinted specimen label, date, time and health care professional mnemonic who drew the sample as per Specimen Collection – Venipuncture Procedure
o. Doff gloves and perform hand hygiene.
p. Send blood samples to the lab immediately.

9.0 CVAD Blood and Site Culture Procedure

9.1 Blood Culture

Collect Supplies

a. Non-sterile gloves
b. Sterile gloves
c. Two - 2% chlorhexidine/ 70 % alcohol swab pads
d. Two - 10 mL sterile preservative free prefilled 0.9% sodium chloride syringes
e. Sterile 10 mL luer lock syringes (# determined by the amount of blood to be drawn for collection)
f. Aerobic and /or anaerobic blood culture bottles
g. One - Needleless connector
h. Dressing tray for sterile procedure
i. Surgical masks for all present at the bedside including the patient
j. Specimen labels
k. Blunt fill needles

Procedure

a. Ensure there is a Provider order for obtaining blood cultures.
b. Perform hand hygiene.
c. Don non-sterile gloves.
d. Don surgical masks for all present at the bedside including the patient.
e. Open sterile dressing tray and drop transfer all sterile equipment onto the sterile field. For a multi-lumen CVAD, ensure enough supplies for blood culture collection from each lumen.
f. If infusion running, stop the infusion, clamp the CVAD line and disconnect infusion line from the needleless connector.
g. Do not flush or draw discard sample prior to blood culture sample.

h. Do not draw blood through existing needleless connector.
i. Do not directly connect blood culture bottle to a CVAD device using a holder.
j. Perform active disinfection of the needleless connector by a vigorous scrub with a 2% chlorhexidine /70% alcohol swab pad for 15 seconds and allow to air dry for at least 20 seconds.
k. Perform hand hygiene.
l. Don sterile gloves.
m. Remove the existing needleless connector and discard.
n. Unclamp CVAD line, attach empty sterile 10mL syringe and withdraw 8-10 mL of blood for aerobic blood culture. Clamp the line, remove syringe, and then attach another 8-10mL of empty sterile syringe for the anaerobic culture. Reminder: Do not discard the first drawn sample
o. Following ANTT, attach the new, primed needleless connector to the CVAD lumen. Remove syringe.
p. Flush the CVAD lumen with at least two 10 mL sterile preservative-free prefilled 0.9% sodium chloride syringe using the push-pause flushing method.
q. Reconnect to infusion.
r. For multi-lumen CVADs, repeat steps "i-m" for each lumen.
s. Doff gloves and perform hand hygiene..
t. Doff mask and perform hand hygiene
u. Distribute blood into appropriate blood collection tubes using a blood transfer device (use separate blood transfer device for aerobic and anaerobic culture bottles)
Note: Air must be expelled from the dead space in the syringe before transferring sample to the culture bottles.
v. Label all samples at the bedside with date, time and health care provider mnemonic who drew the sample as per Specimen Collection – Venipuncture Procedure
w. Collect blood culture specimen peripherally following Specimen Collection - Blood Cultures procedure
x. Label all peripheral samples at the bedside with date, time and health care provider mnemonic who drew the sample as per Specimen Collection – Venipuncture Procedure

9.2 CVAD Site Culture

Collect Supplies

a. Culture and Sensitivity (C&S) swab and transport medium package
b. All the supplies needed for CVAD Dressing Change Procedure in section 7.0

Procedure

a. Perform hand hygiene.
b. Don sterile gloves.
c. Remove CVAD dressing by following CVAD Dressing Change Procedure in section 7.0
d. Without cleansing the area to be cultured, collect the sample by swabbing the site. If the site is dry, moisten the swab with transport medium before swabbing the insertion site. Rotate swab to collect as much exudate as possible.
e. Place C & S swab into transport medium.
f. Label culture container at the bedside with date, time and mnemonic of who collected the sample as per Specimen Collection – Venipuncture Procedure
g. Doff sterile gloves.
h. Perform hand hygiene.

i. Re-dress the CVAD site, following steps as outlined in the CVAD Dressing Change Procedure in section 7.0

10.0 Dormant CVAD Line Needleless Connector Replacement Procedure

Collect Supplies

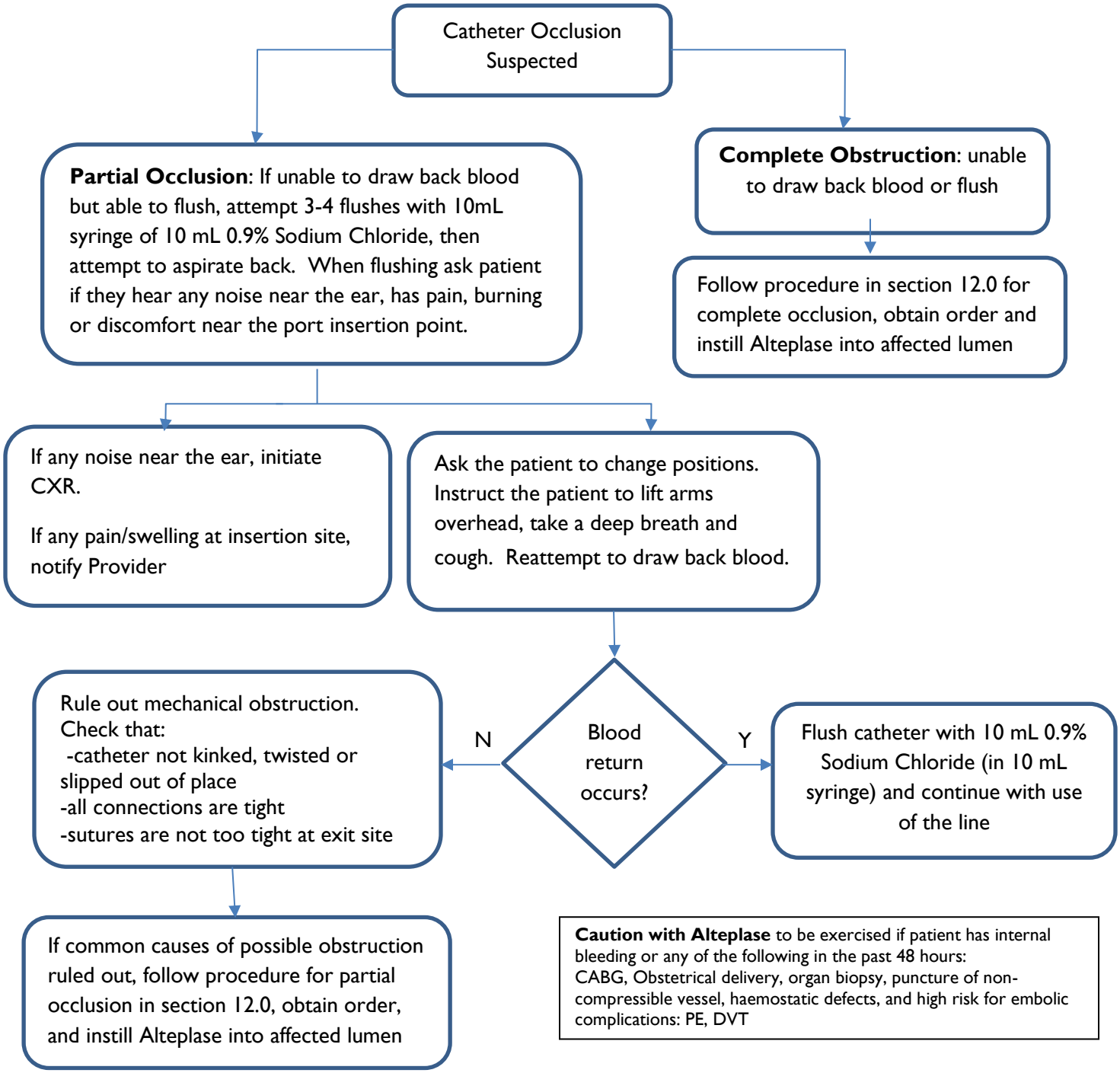
a. Sterile dressing tray
b. Sterile gloves
c. Surgical masks for all present at the bedside including the patient
d. 10 mL sterile preservative free prefilled 0.9% sodium chloride syringe (1 per each lumen and/or CVAD)
e. 2% chlorhexidine /70% alcohol swab pads (2 per each lumen and/or CVAD)
f. Needleless connector(s)

Procedure

a. Perform hand hygiene.
b. Ensure CVAD line(s) are clamped if clamps are present.
c. Open dressing tray and drop transfer all required sterile equipment's onto the sterile field.
d. Perform hand hygiene.
e. Don surgical masks, everyone present at the bedside including the patient.
f. Don sterile gloves.
g. Place sterile drape under work area.
h. Remove the cap from the new needleless connector attaching the 10 mL sterile preservative-free prefilled 0.9% sodium chloride syringe and prime the needleless connector.
i. Disinfect the connection surface of the needleless connector/CVAD line before changing the needleless connector. Grasp the connection between the needleless connector and central line catheter with one 2% chlorhexidine and 70% isopropyl alcohol swab pad. Use the second swab pad to perform active disinfection of the hub of the needleless connector and up to 10 cm of the CVAD line by a vigorous mechanical scrub for 15 seconds and allow to air dry for at least 20 seconds.
j. Remove existing needleless connector and scrub the lumen of the CVAD line with a 2% chlorhexidine and 70% isopropyl alcohol swab for 15 seconds and allow to air dry for 20 seconds.
l. Attach the new primed needleless connector to the lumen of the CVAD line and ensure that the connection is luer-locked and well secured.
m. Unclamp the catheter and aspirate blood to confirm patency. If blood is aspirated, slowly flush with 10 mL sterile preservative-free prefilled 0.9% sodium chloride syringe using the push-pause flushing method.
n. Repeat for each lumen.
o. Doff gloves.
p. Perform hand hygiene.

11.0 CVAD Occlusion Assessment and Management Procedure

Algorithm for Thrombotic Occlusion Assessment and Management



Caution with Alteplase to be exercised if patient has internal bleeding or any of the following in the past 48 hours:
CABG, Obstetrical delivery, organ biopsy, puncture of non-compressible vessel, haemostatic defects, and high risk for embolic complications: PE, DVT

12.0 Administration of Alteplase Procedure

Collect Supplies

a. Sterile water for injection
b. Alteplase 2mg vial per lumen
c. Two - 2% chlorhexidine/ 70 % alcohol swab pads
d. One - 10 mL empty syringe with blunt end needle
e. One - 10 mL empty syringe with stop cock if complete occlusion
f. Two - 10 mL empty syringe to aspirate line when assessing for occlusion clearance per CVAD lumen
g. Two - 10 mL sterile preservative-free prefilled 0.9% sodium chloride syringe per CVAD lumen
h. Needleless connectors
i. Non-sterile gloves

12.1 Reconstitution of Alteplase as per Alteplase (For Catheter Occlusion) Parenteral Guideline

12.1.1 Inject 2.2 mL of sterile water (not bacteriostatic water) into the Alteplase 2mg vial. Final concentration = 2mg/2ml. Foaming is common.
12.1.2 Let vial stand to allow foam to dissipate.
12.1.3 Continue to reconstitute by gentle swirling, without shaking, until the contents dissolved.
12.1.4 Reconstituted solution is colorless to pale yellow transparent solution.
12.1.4 Alteplase lacks antibacterial preservatives and should be used as soon as possible.
12.1.5 Reconstituted solution may be used if labeled and stored at 2-30°C for up to 8 hours.

12.2 Administration of Alteplase

12.2.1 Obtain Provider order for Alteplase to manage CVAD occlusion.
12.2.2 Perform hand hygiene.
12.2.3 With a 10 mL syringe withdraw ordered amount of solution from the reconstituted vial.
12.2.4 Clamp all non-valved CVAD's before disconnecting.
12.2.5 Perform hand hygiene
12.2.6 Don sterile gloves
12.2.7 Disinfect the connection surface of the needleless connector / CVAD line before removing the existing needleless connector. Grasp the connection between the needleless connector /catheter with one 2% chlorhexidine and 70% isopropyl alcohol swab pad. Use the second swab pad to perform active disinfection of the hub of the needleless connector and up to 10 cm of the CVAD line by a vigorous mechanical scrub for 15 seconds and allow to air dry for at least 20 seconds.
12.2.8 Remove existing needleless connector.
12.2.9 Alteplase instillation:

i. **Partial Occlusion**: Luer-lock the Alteplase filled syringe to the blocked lumen of the CVAD. Instill Alteplase using a direct push while maintaining syringe in upright position.
ii. **Complete Occlusion**: using the stopcock method, attach one end to the occluded CVAD. Attach an empty 10 mL syringe to stopcock end in line with the CVAD. Attach Alteplase syringe at 90° side. Pull plunger back of empty syringe to create a vacuum, then turn stopcock off to the empty syringe. Open stopcock to the Alteplase syringe to allow medication to be pulled to the occlusion.

12.2.10 Avoid injecting quickly or with force to prevent damage to the CVAD lumen and/ or cause a blood clot to dislodge.
12.2.11 Only a small amount of Alteplase may flow into the blocked catheter. It is unnecessary to instill the full volume into the catheter to produce clot lyses. Success can result with small amount of Alteplase.
12.2.12 Clamp line or turn stopcock off to the patient before removing syringe. Remove syringe (and stopcock if used) and apply sterile dead-end cap to CVAD line to ensure the lumen is not used.
12.2.13 Label CVAD line with the dwelling Alteplase.
12.2.14 Explain to the patient/family that no additional medication can be administered through the CVAD line while the Alteplase is dwelling.
12.2.15 Instruct the patient to report any new signs of bleeding immediately.
12.2.16 Doff gloves and perform hand hygiene

12.2 Dwelling time
12.3.1 Stop all infusions into CVAD during thrombolysis to achieve maximum effectiveness (if possible).
12.3.2 Leave Alteplase to dwell in CVAD line for 30 minutes.
12.3.3 After 30 minutes assess CVAD line patency by attempting to aspirate blood and line contents. Perform active disinfection of the hub of the needleless connector and up to 10 cm of the CVAD line by a vigorous mechanical scrub for 15 seconds and allow to air dry for at least 20 seconds. Attach an empty 10 mL syringe and aspirate back.
12.3.4 If CVAD line function is restored, withdraw 4-5 mL of blood to remove Alteplase and any residual clot and discard. Flush the affected CVAD line with 20 mL of sterile 0.9% Sodium Chloride.
12.3.5 If CVAD line function is not restored, a second dose may be instilled. A Provider order will need to be obtained if it was not included in the first order
12.3.6 If a second dose is instilled, allow it to dwell in the CVAD line for 90 minutes.
12.3.7 After 90 minutes of dwell time, assess CVAD line patency by attempting to aspirate blood and line contents. Perform active disinfection of the hub of the needleless connector and up to 10 cm of the CVAD line by a vigorous mechanical scrub for 15 seconds and allow to air dry for at least 20 seconds. Attach an empty 10 mL syringe and aspirate back.
12.3.8 If CVAD line function is restored, withdraw 4-5 mL of blood to remove Alteplase and any residual clot and discard.
12.3.9 Flush the affected CVAD line lumen with 20 mL of sterile preservative free prefilled 0.9% Sodium Chloride syringe.
12.3.10 If CVAD line lumen remains blocked after second Alteplase attempt, clearly label CVAD line lumen with the Alteplase and apply sterile dead-end cap to CVAD line to ensure the lumen is not used. Notify Provider of continued line occlusion.

13.0 Removal of Non-Tunnelled Catheter and PICC Line Procedure
13.1 Tunneled devices and implanted ports must only be removed by a Provider.
13.2 Temporary Hemodialysis Lines can be removed by a Hemodialysis Unit RN or Intensive Care Unit RN who has demonstrated competency.
13.3 Confirm Provider order for the removal of the non-tunneled CVAD line or a PICC line.

13.4 If the CVAD line breaks external to the patient during removal, clamp the line with a disposable clamp and continue removal.

13.5 If the CVAD line breaks at the insertion site notify the Provider immediately and

a. Monitor the patient's vital signs and condition closely
b. Place the patient in left lateral recumbent position, when possible.

(The physical breakage of the catheter during removal could result in an embolus.)

Collect Supplies

a. Non-sterile gloves
b. Sterile gloves
c. Dressing tray for sterile procedure
d. Sterile gauze
e. Suture removal kit (when applicable)
f. 2% chlorhexidine/ 70 % alcohol swab stick
g. Occlusive dressing
h. Warm compresses (if required)
i. Surgical masks for all present at the bedside including the patient
j. Disposable clamp

Procedure of Line Removal

a. Perform hand hygiene
b. Positioning:
    i. For subclavian or jugular line removal, place patient in Trendelenburg position if tolerated, otherwise supine with pillow removed, asking the patient to turn head away from the insertion site
    ii. For femoral line removal, have the patient lie flat.
    iii. For PICC line removal, place patient in Trendelenburg position if tolerated, otherwise supine with pillow removed and position the arm at 45-90degree angle from the body to aid in catheter removal
c. Perform hand hygiene.
d. Don mask and assist patient to don mask as tolerated.
e. Perform hand hygiene don non-sterile gloves.
f. Open the dressing tray and lay out the equipment on sterile field.
g. Remove transparent semi-permeable Dressing (TMS) dressing
h. Doff gloves.
i. Perform hand hygiene.
j. Don sterile gloves.
k. Remove the securement device (e.g. StatLock or sutures, where applicable)
l. Cleanse the skin with 2% Chlorhexidine/ 70% Alcohol swab stick. Apply solution to the procedure site; use repeated back-and-forth strokes for 15 seconds (horizontally) and15 seconds (vertically) if site is dry or 1 minute (horizontally) and 1 minute (vertically) if site is moist. Continue moving outward toward the periphery using back-and-forth strokes. Allow area to dry for 20 seconds.
m. Instruct patient to perform Valsalva maneuver or to bear down and hold their breath during removal. If patient is unable to bear down, remove the line during expiration
n. Holding sterile gauze in one hand, begin to apply pressure over the site and use other hand to steadily withdraw the catheter, pulling short 3-5cm segments at a time
o. If resistance is met:

i. Stop (vasospasm may be occurring), reposition the arm and re-attempt removal
ii. If resistance remains, cover insertion site with sterile dressing and apply a warm dry compress for 15-30 min to release vasospasm.

p. Encourage the patient to relax. Re-attempt removal. If still unable to remove, contact the Provider.
q. Upon removal, continue to apply pressure with sterile gauze until bleeding stops (approximately 5 minutes).
r. Once hemostasis is achieved, cover the site with new sterile gauze and occlusive dressing.
s. Leave patient supine for 30 minutes, when possible.
t. Confirm catheter is intact
   i. For PICC, measure the removal catheter length and compare it with the catheter insertion length on the insertion report. If discrepancy in length exists, notify Provider immediately.
   ii. For subclavian, femoral or jugular lines, ensure the tip of catheter is intact.
u. Inform the patient to report HCP if bleeding persists or any shortness of breath occurs. Advise patient to limit the use of affected arm for 24 hours post.
v. Doff gloves.
w. Perform hand hygiene.
x. Doff mask.
y. Perform hand hygiene.
z. Document on the "IV/Invasive Line Assessment" intervention in Expanse and include the appearance of the access site, length of the PICC line and the patient's tolerance to procedure.

14.0 Definitions

Apheresis Line:	Hemodialysis and apheresis catheters are specialized large-bore tunneled double-lumen catheters designed for the exchange of large volumes of blood at high flow rates.
Aseptic Non-Touch Technique ANTT	A method of aseptic technique used to prevent microbial contamination of aseptic parts and sites by ensuring that that are not touched either directly or indirectly. There are six core principles which help promote safe ANTT. 1) Handwashing 2) Correct glove use 3) Using non-touch technique 4) Key part and key site protection 5) Aseptic field management 6) Key part and key site disinfection
Central Line-Associated Blood Stream Infection (CLABSI):	A laboratory-confirmed, primary blood stream infection related to central venous access devices; a surveillance definition used to determine rate of infection, measured in catheter days.
Central Venous Access Device (CVAD):	A catheter that is inserted into a peripheral or large vein of the chest or groin with the tip advanced to a central position, either the superior or inferior vena cava. They can be classified as non-tunneled, tunneled, peripherally inserted or implantable. (See table below)

Cathflo® Activase® (Alteplase):	A thrombolytic agent that gives a viable treatment option for central venous access device (CVAD) occlusions.
Credentialed Staff:	Physicians, dentists, midwives or extended class nursing staff (Nurse Practitioners RN(EC))who are appointed by the Halton Healthcare Board of Directors and who are granted specific privileges to practice medicine, dentistry, midwifery or extended class nursing (Nurse Practitioners RN(EC)) respectively, in one or more Halton Healthcare hospital sites.
Flushing Solution:	Sterile solution used to flush CVADs to assess and maintain patency and prevent occlusions.
Hemodialysis Central Venous Line (HDCVL):	A type of central venous access device specifically designed to facilitate kidney replacement therapy in patients without a functioning long-term hemodialysis vascular access. The lumen of a HDCVC has a larger diameter compared with that of a typical central venous catheter used for infusion.
Hub:	The end of the vascular access device that connects to an intravenous line or to a locking cap/needleless connector.
Locking Solution:	Final solution instilled into the CVAD to prevent an intraluminal occlusion.
Lumen:	The opening to the interior space of a tubular structure, such as a central vascular access catheter.
Occlusion:	Obstruction of a vascular access device lumen, preventing or limiting the ability to flush and/or administer solutions through a lumen or withdraw blood. 1) **Complete occlusion:** Inability to administer solutions or withdraw blood from the central vascular access device (CVAD) lumen. 2) **Partial occlusion:** Decreased ability to administer solution and/or withdraw blood from the CVAD lumen. 3) **Withdrawal occlusion:** Ability to infuse solutions with decreased ability or inability to obtain blood return. 4) **Mechanical occlusion:** Occlusion of a CVAD involving a component of the infusion system. An external occlusion may include a filter, a needle-free connector, a malpositioned or blocked non-coring needle, or a closed clamp. An internal occlusion results from pinch-off syndrome or from a kinked or malpositioned CVAD. 5) **Thrombotic occlusion:** CVAD occlusion resulting from fibrin buildup (i.e., fibrin sheath or fibrin tail) or a blood clot within the catheter lumen or vessel.
Occlusive Dressing:	A non-permeable dressing sealing surrounding tissue from air, fluids and harmful contaminants.
Push-Pause Flushing Method:	A pulsatile flushing technique using a push-pause method involving repetitive injection of short (e.g., 1 mL) pushes followed by a brief pause for the purpose of creating turbulence within the lumen of the vascular access device.
Needleless Connector:	A device that allows the connection of the male luer tip of a syringe or administration set directly to the needleless connector of a vascular access device without the use of needles.

Securement Device:	Stabilization to maintain a secure hold of the CVAD and prevent it from moving in and out of the insertion site. The two options include an adhesive device with a skin protectant solution or sutures.
Transparent Semi-Permeable Dressing (TMS):	A transparent film protecting against fluid contaminants and bacteria while enabling wound visualization.

Central Vascular Access Device (CVAD) also known as a central line or Central Venous Catheters (CVC): indwelling devices inserted into a vein with the tip residing in the superior or inferior vena cava.		
Type of Central Venous Access Device	**Documented as/Example**	**Locations/Features**
Non-Tunneled Central Venous Catheter	Known as a Percutaneous and Non Cuffed CVC Line	• Percutaneous insertion of catheter into the internal jugular, subclavian, or femoral veins. • Associated with high risk of catheter-related infections due to skin exit point of catheter in close proximity to the entry point of the vein used. • Temporary or short-term devices. • Available with single, double, triple, or quadruple lumen.
Peripherally Inserted Central Catheter (PICC)	Know as PICC Line	• Inserted into peripheral vein (e.g., basilic, brachial, cephalic, saphenous, temporal scalp) and advanced to the superior or inferior vena cava. • Less risk of complications such as pneumothorax on insertion than other CVADs due to peripheral vein access on upper arm (compared to accessing of jugular or subclavian vein). • For short to intermediate duration of therapy. • Available with single, double, or triple lumen.
Tunneled Central Venous Catheter	Hickman	• Catheters are "tunneled" through a subcutaneous tract after accessing vein on insertion (i.e., subclavian or jugular) and before exiting the skin. • Cuffs are on the catheter to adhere to the subcutaneous tissue within 10–14 days. They function to stabilize the catheter under the skin. • For long-term access and long duration of therapy. • Available with single, double or triple lumen.
Tunneled Central Venous Catheter - Other	Hemodialysis Central Venous Line Apheresis	• Inserted of catheter into the internal jugular, subclavian, or femoral veins. • Hemodialysis catheters are often for relatively short-term use because of an acute need for dialysis or because chronic dialysis is just starting. • Catheters have two lumens, one is a red (arterial) to draw blood from the vein and out of your body into the dialysis pathway and the other is a blue (venous) allowing cleaned blood to return to the body. • Apheresis catheters are for short use in patients who will be receiving a stem cell transplant as part of their cancer treatment.
Implanted Vascular Access Device	Port-A-Cath	• Tunneled CVADs with proximal end terminating in a subcutaneous pocket with a self-sealing reservoir implanted under the skin. • Ideal for long-term, intermittent infusion. • Must be accessed with a non-coring needle inserted into the port septum. • Available with single or double port.

A non-valved CVAD is a catheter that is open at the tip and at the lumen hub, with a clamp on the external portion of the catheter to stop blood from coming into the catheter and out of the hub.
A valved CVAD is a catheter with an integrated valve that can be located at the catheter tip (distal) or in the catheter hub (proximal). The valve will open with infusion and flushing into the catheter and also when pressure is exerted for aspiration, such as for blood sampling or when checking for blood return. The valve is neutral or remains closed when no pressure is applied and will prevent blood from coming into the catheter.

15.0 Related Documents

16.0 Key Words

Infusion therapy, CVAD, central line, Port-A-Cath, PICC line, tunneled, non-tunneled, apheresis line

17.0 Reviewed by/Consultation with

Infection, Prevention and Control

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