GUIDELINE

Central Venous Access Devices (CVAD) and Midline Insertion and Management

Scope (Staff):	Nursing and Medical staff
Scope (Area):	Perth Children's Hospital

Child Safe Organisation Statement of Commitment

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This document should be read in conjunction with this disclaimer

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Contents

Aim

The aim of this guideline is to provide recommendations for the insertion and management of central venous access devices (CVAD) and midlines with regards to:

- Appropriate CVAD selection for a patient's clinical situation.
- Facilitating completion of intravenous therapy with a single device with minimal complications (including central line-associated bloodstream infections (CLABSI), catheter blockages, and accidental dislodgement).
- Preservation of the patient's long term vasculature / vein health for future vascular access device insertions.

Risk

Sub-optimal CVAD insertion technique and line care, including non-compliance with infection prevention measures, can result in significant adverse patient outcomes. As well as causing unnecessary suffering for patients and their families, CVAD related complications can prolong hospital length of stay and are extremely costly to the health system. Common complications for CVAD include: blockage, dislodgement and infection.[6] Importantly, CLABSI and CVAD associated complications are largely preventable through the application of evidence-based practices. For a full list of complications, refer to the 'Guide to Complications' Appendix 1.

Background

CVADs are used for a wide range of intravenous therapies in the inpatient and home setting. CVADs are inserted in the Operating Theatres and at the bedside in both the Paediatric Critical Care and Neonatal units. Midlines are inserted in the Operating Theatres and at the bedside. Inherent in these devices can be significant complications during insertion, management and removal.

The insertion and maintenance recommendations included in this guideline are consistent with:

- National Safety and Quality Health Service (NSQHS) Standards in Preventing and Controlling Healthcare-Associated Infection: Invasive medical devices. 2017[1]
- National Health and Medical Research Council (NHMRC) and Australian Commission on Safety and Quality in Healthcare Australian Guidelines for the Prevention and Control of Infection in Healthcare. 2024[2]
- Infusion Therapy Society (INS) Standards of Practice. 2024 and,
- Centre for Disease Control (CDC) Guidelines for the Prevention of Intravascular Catheter-Related Infections. 2017.[5]

Scope

This guideline should be used for the insertion and management of CVAD and midline catheters in children of all ages.

This document does not provide instructions on how to insert a vascular access device, except those relating to aseptic technique. It is expected that the proceduralist has appropriate training in a specialist program or has adequate education and supervision during the procedure.

Permanent long term renal dialysis catheters are outside the scope of this document. Whilst the key principles of infection prevention and management remain the same, these devices (i.e., Permacath™) require specialist nursing care and are to be accessed by renal trained staff only. It is imperative the type of device is confirmed prior to accessing any CVAD. Renal nursing staff are required to refer to unit specific protocols for locking and de-clotting procedures.

Pulmonary artery (PA) catheters and PA catheter sheaths are outside the scope of this document and should be managed according to unit specific protocols.

Definitions

Device	**Acronym** (nationally accepted)	**Other common names** (i.e., brand name)
Peripherally inserted central catheter	PICC	
Non-tunnelled central catheter	CVC	Central line; femoral line; CVC
Non-cuffed tunnelled central catheter	t-CVC	Tunnelled PICC; tunnelled central line; tunnelled femoral line
Cuffed tunnelled central catheter	tc-CVC	Hickman™ Broviac™

Device	Acronym (nationally accepted)	Other common names (i.e., brand name)
Implanted central catheter	Port	Infusaport™ Port-a-cath™
Large bore non-cuffed central dialysis catheter	LB-CVC	Gamcath™ Vascath™ Apheresis catheters
Large bore cuffed tunnelled central dialysis catheter	tc-LB-CVC	Permacath™

Abbreviation	Definition
CVAD	Central Venous Access Device
VAD	Vascular Access Device
MI	Medical Imaging
PICC	Peripherally inserted central catheter
CVC	Central Venous Catheter
PCC	Paediatric Critical Care
OTPM	Operating Theatre Practice Manual
CPM	Clinical Practice Manual
TPN	Total Parenteral Nutrition
CLABSI	Central Line-Associated Blood Stream infection
CXR	Chest X-ray
II	Image Intensifier
AT	Aseptic Technique
TANTT	Theatre Aseptic Non-Touch Technique
SVC	Superior Vena Cava
IVC	Inferior Vena Cava
ChAMP	Children's Antimicrobial Management Program

Midline

A midline catheter is a long (5-12 cm) peripheral intravascular device with the catheter tip terminating in a large peripheral vein. Ideally, this should be placed in the upper arm in the basilic, brachial or cephalic vein with the catheter tip terminating well outside the axilla and axillary vein to avoid mechanical trauma to the vein at this junction. This catheter is available in single lumen paediatric sized devices.

Indications

- Midline catheters are not central venous access devices and only therapies suitable for peripheral administration can be given via this option (non-irritating / vesicant therapy).
- Dwell time typically 2-14 days; up to a maximum of 4 weeks.
- May be used in an outpatient setting.
- The small calibre, and longer length peripheral cannula makes this device unsuitable for blood draws and at high risk of blockage and vessel damage.

Considerations

- Gentle; non pulsatile flushing.
- Venous draws from other means (i.e., finger pricks and the use of microtainers).
- Dilution of infusate.

Inserted by:

- Department of Anaesthesiology
- PCC Department
- CVAD Nursing Team

Central Venous Access Device (CVAD)

A CVAD is a catheter or implanted port, usually made of silicone or polyurethane, where the catheter tip resides in the SVC or IVC depending on upper or lower extremity placement. Devices may be inserted peripherally or centrally, tunnelled or non-tunnelled and may be implanted by creating a subcutaneous pouch. Choice of device will depend on various factors including consideration of patient condition, estimated duration, indications, device and treatment risk factors, patient risk factors, vein characteristics, patient treatment plan, medication characteristics, care setting and abilities of providers.

Peripherally Inserted Central Catheter (PICC)

A PICC is a long (10- 40cm), thin central venous catheter inserted via peripheral veins, usually the basilic, brachial or cephalic veins of the upper arm, where the catheter tip resides in the distal third of the SVC. PICCs may also be tunnelled from the jugular veins where the catheter tip resides in the SVC, or from the femoral veins where the catheter tip resides in the IVC. This line is available in single and double lumen devices for paediatric populations dependent on the patient's measured vasculature.

Indications:

- For vesicant and peripherally non compatible solutions
- Dwell time greater than 7 days; up to weeks or months
- May be used in an outpatient setting.
- May be able to blood sample.

Considerations:

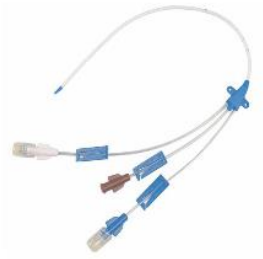
- Not usually inserted for blood sampling alone. Small calibre neonatal PICCs (1 and 2 French) are not able to be aspirated; do not bleed back or pulsatile flush; run fluids to keep vein open (TKVO).

Inserted by:

- Interventional Radiology / CVAD Nurse Practitioner
- PCC Department

Non-tunnelled

A non-tunnelled catheter is inserted via the internal jugular vein, less commonly the subclavian vein, and accessed percutaneously where the catheter tip resides in the SVC. Femoral vein access is again percutaneous where the catheter tip ideally resides in the IVC. These devices are commonly seen in the critical care area, typically have triple lumens and therefore are associated with an increased risk of infection.



Indications

- Critically unwell patients.
- Multiple incompatible infusates.

- Short term dwell limited to no longer than 7-14 days where possible.
- Not suitable for outpatient settings.

Considerations

- The ongoing clinical need for these devices should be reviewed on a daily basis to assess and treat for any malfunction to minimise the risk of infection or complications.
- These devices should be removed when no longer clinically indicated, or when triple lumen access is no longer required.
- Devices required beyond 7 days will need daily vigilant monitoring by the primary team with assessment for: the need to retain balanced against a risk assessment for replacement.

Inserted by,

- Department of Anaesthesiology,
- PCC Department.

Tunnelled

Tunnelled catheters are ‘tunnelled’ subcutaneously from the vein insertion site to the catheter exit site (usually in the anterior or anterolateral chest wall). Some tunnelled catheters have a cuff incorporated under the skin which has a dual function; to reduce accidental dislodgement and reduce the risk of infection ascending from the catheter exit site along the catheter tunnel contributing to CLABSI. The cuff takes approximately 4 to 6 weeks to provide securement. This line is available in single and double lumen devices for paediatric populations.

Indications

- Continuous vascular access required, may be for non-peripherally compatible therapy or as a vessel sparing strategy.
- Dwell time is months to years.
- Suitable for outpatient settings.

Considerations

- Additional securement is required until the cuff is adhered.
- Patients are susceptible to skin breakdown due to weekly dressings; regular site assessment is recommended.

Inserted by,

- Interventional Radiology,
- Department of General Surgery.

Implanted

Implanted central catheters have an injection port chamber which is tunnelled (like tunnelled CVADs) away from the vein insertion site and secured in a subcutaneous pocket, usually in the chest wall. Implanted central catheters are often referred to as 'Ports' and are accessed with a non-coring needle that is inserted through the skin and into the port chamber for venous access. These catheters are predominately single chamber ports, however, in older children they are available in a dual chamber.

Indications

- Intermittent ongoing vascular access required, may be for non-peripherally compatible therapy or as a vessel sparing strategy.
- Dwell time months to years (maximum 5 years).
- Suitable for outpatient settings.

Considerations

- Monthly port access for routine flush and maintenance care is required.

Inserted by,

- Interventional Radiology,
- Department of Surgery.

Dialysis

Dialysis catheters are specialised central catheters with two staggered large bore lumens; one to take blood and the other to return it. These devices are used for plasmapheresis, apheresis, plasma exchange or dialysis. They are inserted via the jugular vein, and either tunnelled and cuffed for long term access, or they are non-tunnelled and non-cuffed for short term access. In both instances the catheter tip resides in the SVC (although in a split-tip catheter system one lumen may be just inside the right atrium). They can also be inserted into the femoral vein, where the tip of the catheter resides in the IVC.

Inserted by,

- Tunnelled, and non-tunnelled: Interventional Radiology,
- Tunnelled: Department of Surgery,
- Non tunnelled: PCC Department.

Key Management Principles

- Hospital staff handling and accessing CVADs and midlines for delivery of treatment must be appropriately trained to do so by this hospital [Level IV].[4]

- The use of hand hygiene, maximal barrier precautions (sterile gown, sterile gloves, cap, and full body draping of patient) and skin antisepsis with chlorhexidine-alcohol preparations[7] (or alternative in the case of allergy) for all insertion of CVADs. [Level I] [3,4,8]
- Daily review of CVADs and midlines by medical and nursing staff, or at each outpatient appointment to:
    - Assess the need to retain the device. For patients no longer requiring treatment, consult with the primary medical treating team for the earliest appropriate removal of the device and document in the patient records [Level IV] [4]
    - Assess the CVAD insertion site to detect early signs of local infection, suture and dressing integrity, verification of catheter position, integrity of external components, and any CVAD associated skin impairment.
    - Assess the functionality of the device determined by the ability to aspirate blood and the ease of flushing for all catheter lumens [Level IV] [4]
    - Minimise access and manipulation through planning and grouping cares where possible [Level IV] [4]
- Perform hand hygiene prior to all CVAD and midline interventions [Level III][3]
- Aseptic technique when accessing and manipulating all CVAD and midlines, including:
    - Disinfecting line connections and needle free devices prior to accessing lines [Level II][2,4]
    - Chlorhexidine antisepsis (or alternative in the case of allergy) to cleanse skin during dressing changes and prior to inserting port needles [Level I][4]
- Correct flushing and administration techniques to maintain line patency and prevent line rupture by:
    - Using only 10 mL syringes or larger for administration / flushing procedures [Level IV].[4]
    - Using pulsatile flush technique and appropriate line locking techniques to maintain positive pressure and prevent retrograde blood reflux into the catheter upon removal of the syringe [Level IV]. [4,9]
- Provide adequate patient / carer education and support to maintain optimum patient safety [Level V].

[NHMRC Levels of evidence]

Referral

- All requests for vascular access need to be discussed with, and authorised by, the primary Consultant Physician treating the patient prior to contacting the CVAD team for insertion.

- For guidance on device selection, refer to the Vascular Access Device Selection Pathway in Appendix 2.[10,37]
- All referrals for vascular access device insertions are to be made by submitting an eReferral to CVAD Nursing for triage (via the Anaesthetic Department, subspecialty CVAD). Urgent referrals (i.e. for placement within 24-48 hours, place a phone call via Vocera C V A D, C N S or N P, if no answer leave a text message with patient details and return contact number and level of urgency).
- All patients undergoing CVAD insertion require Staphylococcus aureus decolonisation for the five days prior to insertion, in accordance with the Guideline for Staphylococcus aureus Decolonisation (Paediatric), which can also be accessed via the CVAD Information Hub. For urgent insertion, decolonisation should occur as close to the time of insertion as able for a total of five days.
- **Note**: CVAD insertion does not routinely occur after hours, however, alternate access can be discussed with the Duty Anaesthetist if required (including peripheral intravenous catheters, midlines and non-tunnelled central lines).

Insertion of CVADs and Midlines

All clinicians must practice in accordance with the hospital insertion bundles, accessed via the CVAD Information Hub.

Personnel for Insertion

- Health care professionals performing CVAD insertion will be competent and have undergone training and education to perform this procedure or be supervised by an appropriately qualified clinician. This competency is often in accordance with a number of specialist training programs and specialist colleges. The proceduralist and / or supervisor should have a comprehensive understanding of the management of potential complications related to CVAD insertion.

Assistant

- A medical officer or registered nurse should be present to support or aide the proceduralist but does not physically take part in the insertion procedure.

If Sedation or General Anaesthesia Required:

- If procedural sedation or general anaesthesia is required for CVAD / Midline insertion, it is essential that this is performed and monitored by an appropriately qualified medical officer whose **sole** responsibility is providing monitored sedation or general anaesthesia.
- For patients having lines inserted with conscious sedation please refer to the relevant medication monograph and Procedural Sedation (non-anaesthetic personnel) guideline for patient observation and monitoring requirements. Theatre staff are to refer to the perioperative guideline 'Care of the Conscious Perioperative Patient'.

Preparation

- Ward-based midline insertion: To facilitate compliance with this guideline, all equipment requirements for this procedure should be co-located and mobilised to the patient's bedside (e.g., on a dedicated equipment trolley or pack).
- The CVAD and Midline Insertion Record (MR852.01) Procedural Assistant checklist should be commenced by the assistant as an additional measure to ensure compliance with infection prevention measures. Device manufacturer stickers identifying LOT and batch numbers should be applied to this form for product tracking processes.

Insertion Site

The choice of insertion site will depend upon a number of factors[11]:

- Patient size and age
- Relative risk of mechanical versus infectious complications
- Need for procedural sedation or general anaesthesia.
- Experience and competency of proceduralist

Aseptic Technique and Maximal Barrier Precautions

1. The proceduralist:[8]
   - Dons hat (covering all head and facial hair), mask and eye protection.
   - Removes all jewellery and watch from below the elbows, hands and arms.
   - Ensures sleeves are above elbows.
   - Performs a "surgical scrub" with chlorhexidine-based solution (or alternative in the case of allergy) in accordance with the 'Scrubbing, Gowning and Gloving' protocol (link found in the Aseptic Technique policy in the Infection Control Manual)
   - Dons sterile gown and gloves.
2. The assistant and supervisor don hat and mask and perform hand hygiene with soap and water or alcohol-based hand rub.
3. If the supervisor physically assists with the insertion, they must perform the same preparation as the proceduralist outlined above.
4. The insertion site should be:
   - Free of hair (clipping is preferred to shaving)[12]
   - Cleaned with chlorhexidine gluconate 2% in isopropyl alcohol 70% (unless contraindicated) and allowed to dry completely.[2,5,7,13] If chlorhexidine is contraindicated, use povidone iodine 10% in alcohol.[1] Soap and water cleaning may be required prior to antisepsis (chlorhexidine or alternative in the case of allergy) if the insertion site is visibly soiled.

5. Large drapes should be used to cover the whole patient and bed in addition to the insertion site to provide a secure sterile field for the entire insertion procedure. The use of a maximal sterile barrier is a key component in CLABSI prevention. A small sterile field is inadequate and may lead to contamination of the guide wire or catheter.
6. Other than in an emergency situation, the proceduralist, supervisor or assistant should stop the procedure if asepsis is breached.
7. When the line is secured, the site should be cleaned of blood with chlorhexidine gluconate 2% in isopropyl alcohol 70% (or alternative in the case of allergy), and then allowed to dry before a sterile occlusive dressing is applied. The dressing needs to cover the insertion site and all the CVAD, up to and including the hub.
8. Tissue adhesive (TA) (e.g., Dermabond™ or Histoacryl™) application is recommended at the insertion site for PICCs to decrease postoperative bleeding and prolong the time to first dressing change. Excessive application may contribute to skin impairment (i.e., skin tears, blisters, and build-up of tissue adhesive on the CVAD) and therefore application of 1 to 2 drops is recommended during insertion and not during maintenance of devices.[14,15] TA is not administered at the exit site of a tunnelled central line; rather, a single, dissolvable suture is placed.
9. Care must be taken not to contaminate the line(s) when connecting infusions or the pressure transducer lines. This can be achieved by:
    - Opening the transducer onto the sterile field to connect to a CVAD lumen and handing the other end to the assistant to connect to the flush bag.
    - Handling the ends of all administration sets with gauze soaked in chlorhexidine gluconate 2% in isopropyl alcohol 70% (or alternative in the case of allergy).

Insertion Documentation

- Central Venous Access Device Insertion Record (MR852.01) is to be completed in full and signed by the proceduralist for all devices. Assistants are expected to document compliance with hand hygiene, maximal barrier precautions and antisepsis (chlorhexidine or alternative in the case of allergy). File this record in the patients' notes.
- For all CVADs (including Midlines), the CVAD Data form (pink form) should be completed by the proceduralist or assistant and returned to the CVAD nursing team for auditing and quality assurance purposes.

Confirmation of CVAD Placement

- At time of insertion, the proceduralist must confirm the CVAD catheter tip position and check for rapid aspiration of blood. Further imaging with contrast injection may be necessary, particularly when unable to easily aspirate blood from the newly inserted CVAD.

- Do not use any CVAD (PICCs, tunnelled / untunnelled or implanted CVAD) until the correct catheter tip position is confirmed. In an emergency situation medical staff may indicate that the line may be used for emergency treatment while awaiting line confirmation. This is usually in the context of rapid aspiration of blood having been achieved.
- All CVADs require a confirmation X-ray after insertion and upon return to ward, unless documented on the CVAD and Midline Insertion Record that the device tip location was confirmed intra-operatively and is 'ready to use'. Typically, lines placed in PCC and jugular central lines placed for cardiac and other large surgical procedures, will need a portable Image Intensifier for confirming tip position after the surgical procedure (in PCC) or after insertion in the PCC unit.
    - Femoral central lines may be used without X-ray confirmation at the discretion of the proceduralist, based on uncomplicated insertion with no concerns regarding line placement, ultrasound used, transduced pressure confirming placement in venous system, free aspiration of blood from all lumens and no pulsatile blood flow observed. However, X-ray is recommended if there is any subsequent dysfunction with the line e.g., poor central venous pressure tracing, unable to aspirate or flush the line.
- Midlines do not routinely require an X-ray to confirm tip position.
- Optimal positioning reduces catheter complications. The ideal catheter tip position for any CVAD is either:
    - Upper body CVAD: inferior portion of the SVC. The correct position in the SVC is approximately 1-2 vertebral bodies below the carina to ensure the catheter tip is near the SVC / right atrium junction.
    - Lower body CVAD: IVC.
- Radiological confirmation of the position of a catheter tip is often performed during the insertion process via an image intensifier (II) or afterwards with a conventional X-ray. Images obtained with an image intensifier (II) confirming the tip position should be saved to avoid a repeat X-ray upon return to care of the requesting medical team.

  Note: Image intensifiers used in theatre often have poor resolution to view the catheter tip position and commonly, a 'real-time' image screen is obtained to view the tip 'flicking' in the correct location. If this is the case, please consult the CVAD Insertion Record to see correct location of the tip and 'ready to use' documented.
- Check the CVAD Insertion Record or Operation Record to confirm the CVAD tip position is in an appropriate location prior to accessing the device or ordering a repeat X-ray when the patient returns to the ward.
- When line patency cannot be established via blood aspiration within the first 48 hours post-operatively[16]:
    - The line MUST NOT be used until patency is confirmed.

  - Patency must be confirmed by a Consultant-led formal report of tip placement following a line-o-gram (unless medically contraindicated). Approval for use thereafter should be confirmed by the Consultant Surgeon and / or Radiologist.

- The CVAD tip has the potential to migrate or malposition during its dwell time. This risk is more so with PICCs inserted into the upper arm with extreme abduction or adduction. Vomiting and / or coughing episodes can 'flick' the PICC tip from the SVC up into the brachiocephalic, azygous or even jugular veins. Also, all CVADs are at risk of being accidentally dislodged (and the tip migrating), especially during dressing changes.
- Consequently, an ongoing level of vigilance and suspicion must be maintained when using a CVAD over time and if a device is not functioning well or causing patient symptoms (e.g., ringing in the ears, tingling or unusual sensations in the neck which may indicate tip malposition into the jugular veins), then a repeat X-ray may be necessary to re-confirm the tip position before deciding the next course of action. Options depend on the extent of tip malposition, therapy planned and duration of ongoing therapy, and include removal, replacement or continuing therapy with current CVAD. Please discuss management and options with the CVAD team.
- Patients being admitted with a CVAD in situ from another hospital or from the outpatient setting require careful consideration regarding their CVAD prior to accessing and using it for intravenous therapy. This will include at a minimum, obtaining the CVAD Insertion Record from the referring hospital or from a previous admission in the patient's hospital record to provide the CVAD details (type, size, length in situ etc.) and tip location at time of insertion.
- There are no current evidence-based recommendations regarding the need to repeat X-ray of a CVAD with each subsequent admission. The decision should be based upon clinical suspicion of potential migration (patient symptoms or issues handed over / documented suggesting malposition), type of therapy planned and consideration of repeated radiation exposure.

CVAD Replacement

- Routine replacement of CVADs is not recommended in paediatric patients and should only be replaced if clinically indicated.[2,5,17] Some examples where replacement of a CVAD should be considered and prioritised include (but not limited to) malfunctioning lumens (one or all), and CVAD sites that are compromised by contamination (i.e., vomitus, faeces, infected wounds). In the event of contamination and an unstable patient where elective replacement is not imminently possible, it is recommended that the primary treating team liaise with Infectious Diseases for consideration of antibiotic prophylaxis.
- Re-wiring a new CVAD over a guidewire into the same site as an existing CVAD may increase the risk of infection. Consequently, it should only be considered in the following circumstances[5]:
  - Risks of using another site outweigh the risk of infection with using the same site e.g., burn injuries with limited sites for CVAD insertion,

coagulopathies requiring CVAD replacement before coagulopathy can be corrected.

- The CVAD has been in situ for <72 hours AND there is no suspicion of CLABSI AND the line was inserted with strict aseptic technique.
- No other obvious venous access due to widespread venous scarring / obstruction.

- **Note:** Special care must be taken not to contaminate the new CVAD i.e., do not contaminate the sterile field, change sterile gloves after removing the old central line. The tip of the removed CVAD catheter should be sent for culture; if this is positive, the railroaded CVAD catheter should be removed, and a new site used.

Care and Management of CVADs

All clinicians must practice in accordance with the hospital maintenance bundles, accessed via the CVAD Information Hub

Personnel for Management

- It is recommended that Radiology, Anaesthesia, Intensive Care and Surgical Departments undertake unit specific education prior to accessing CVADs.
- Nursing staff involved in the management of patients with a CVAD must have the necessary knowledge and skills to competently provide care. Nursing staff are required to undertake theory and practical assessments detailed in the Vascular Access Education Framework. Nursing staff must not proceed to independent management of CVADs prior to successfully completing these assessment components.

Postoperative Care

- CVAD line tip position and patency must be established prior to accessing any newly inserted device. CVADs must be deemed 'ready for use' by either the proceduralist or primary medical team and clearly documented on either the CVAD Insertion Record (proceduralist) or in the patient's medical records (primary treating team).
- Midlines do not need confirmation prior to use.
- Commence routine postoperative observations or as otherwise indicated by the patient's clinical status. Refer to Postoperative and Procedural Care.
  - For inpatients, continue at least 4 hourly observations of Temperature, Pulse, and Respirations for 48 hours, then as indicated by clinical status and the treating medical team.
  - For day cases, please refer to 'Discharge Criteria following General Anaesthesia' and check the proceduralist pre-discharge instructions.

- If any difficulties encountered (i.e., inability to aspirate blood from the line, resistance on flushing, or changes in patient's cardio-respiratory status) within the first 48 hours of insertion or first use of recently inserted CVAD:
    - Do not use the line.
    - Immediately report to the treating physician / proceduralist for arrangement of a line-o-gram or other radiological investigation
    - Await formal report and written approval from the proceduralist before using the line.
- Unless needled in theatre for immediate treatment, implanted devices are not typically accessed until 5-7 days post insertion to allow the site to heal and swelling to subside. Urgency of treatment will be decided by the treating medical team. Refer to Infusaport Implanted CVAD (port) Needling & De-needling procedures in Appendix 3.
- A positive displacement needle-free access device is to be placed on each lumen / access port unless a dedicated continuous infusion is in progress.
- Assess the insertion site and exit sites for amount of blood / ooze:
    - A small amount of ooze or blood may be expected in the acute postoperative period.
    - Consider applying a pressure dressing over the site for acute postoperative ooze and review within 24 hours.
    - Contact the proceduralist / CVAD CNS for advice if the ooze / bleed is ongoing, excessive or obscuring adequate observation of the CVAD insertion / exit site.
    - A temporary gauze dressing may be indicated for excessive ooze until resolved. Gauze dressings must be changed within 48 hours of application[4,18,19] and replaced with a transparent dressing as early as possible.
    - Transparent dressings can stay in place for up to seven days if complication free. Use caution if dressing needs to be changed within 48 hours of insertion and discuss with proceduralist / CVAD CNS.

Daily Assessment

A daily review by bedside nursing and medical staff is required in order to:

- Determine the need to retain the device.
    - If the CVAD is currently in use for therapy, or therapy is planned to commence, no action is required.
    - If the CVAD is not in use for therapy, or only has TKVO infusions running, contact primary treating team for decision on need to retain.

  - Remove all devices promptly if able and document decision and outcome in patient's progress notes and on the CVAD and Midline Daily Assessment Record

- Undertake site assessment of the insertion and exit site to observe for signs of complications and the securement of the device / verification of catheter position.
  - Remove all coverings / bandages to enable a full skin inspection.
  - Complete site inspection at a minimum once per shift, or at each outpatient visit for intermittent therapy (includes devices that are not accessed or not currently in use) and hourly for continuous therapy.
  - Visualise the insertion / exit site. With clean hands palpate the surrounding skin for signs of infection, CVAD associated skin impairment, dislodgement, infiltration / extravasation, phlebitis, venous thrombosis or loss of integrity to dressing and / or securement. Refer to Appendix 1 for signs and symptoms and possible actions / management.
- Assess the patency / functionality of the device:
  - When accessing CVADs assess the ability to achieve blood aspiration appropriate to the calibre of the device (i.e., PICCs may be slower to aspirate, while implanted ports are expected to have brisk aspiration).
  - An inability to achieve blood aspiration may be a consequence of technique or withdrawal occlusion (fibrin sheath creating a one-way valve on end of device) or extravascular placement (access needle is not in connection with back of septum or catheter tip is no longer in vein).
  - When flushing CVADs with sodium chloride 0.9% prior to use, determine the ease of flushing and any partial through to full obstruction (also known as 'intraluminal occlusion'). Refer to Appendix 1 in conjunction with the Occlusion Management Summary (Appendix 4) for signs and symptoms and possible actions / management.
- Consolidate utilisation:
  - Access only when necessary to minimise manipulation and breaking of lines.
  - Group medication administration, line changes, blood sampling and routine flushing procedures.

Management Documentation

- Complete the CVAD and Midline Daily Assessment Record (MR852) once per shift or once per outpatient visit.
- Use the existing CVAD and Midline Daily Assessment Record for the life of the CVAD (space permitting) and bring forward to the current admission / outpatient appointment.

- For additional CVAD and Midline Daily Assessment Records for the same device, transcribe CVAD details and patient preferences (updated as required) to current records.
- Complete a separate CVAD and Midline Daily Assessment Record for each device.
- Document all CVAD removals on the CVAD Insertion Record (where available in medical records) and the CVAD and Midline Daily Assessment Record.

Dressings and Securement

- A sterile transparent, semi-permeable polyurethane dressing is to be used for all CVADs and midlines, unless there is a known sensitivity.[3,4] Liaise with CVAD CNS / Nurse Practitioner, Stomal and Wound Therapy if an alternative dressing needs to be sourced.
- For CVAD associated skin impairment (i.e., skin injury, exit site infection, non-infectious exudate and skin irritation/contact dermatitis) please refer to Appendix 16: CVAD Associated Skin impairment Algorithm
- Dressings and sutureless securement devices are to be changed every 7 days, sooner if loose, soiled or wet, except in those paediatric patients in which the risk for dislodging the catheter may outweigh the benefit of changing the dressing.[20-23]
- Subcutaneously anchored securement devices (e.g securAcath®) will be used on most patients to reduce risk for dislodgment, migration or malposition of PICC lines. These remain in place for the life of the line.[38,39]
- Sutureless securement devices (i.e., Statlock™, Griplok™ 3M PICC / CVC Securement Device™) can be used and also reduce the risk of infection and dislodgement for PICC and midlines.
- For instructions on removal of subcutaneously anchored securement devices (e.g SecurAcath®) and application and removal of sutureless securement devices refer to Dressing Change Procedure (Appendix 5).
- The use of chlorhexidine gluconate-impregnated dressings (e.g. 3M™ Tegaderm™ CHG IV Securement Dressing, Biopatch Disk™) is recommended to reduce the incidence of CLABSIs relative to all other dressing types in the intensive care unit setting for paediatric patients.[23] Their use is not recommended in patients with chlorhexidine allergy and premature neonates due to risk of serious adverse skin reactions.[5] For instruction on application and removal refer to the dressing change procedure (Appendix 5)
- Integrated securement dressings (e.g., SorbaView®) have a reinforced fabric ‘collar’ that aims to reduce movement of the external catheter extension, preserving dressing integrity. These products may come in two varieties: with **adhesive** centres for use with all VADs and **non-adhesive** centres for use with port access needles and with chlorhexidine gluconate impregnated disks (Biopatch™). For instruction on application and removal refer to Dressing Change Procedure (Appendix 5).

- Tissue adhesive (TA) (e.g., Histoacryl™, Dermabond™) may be applied to CVADs at the insertion site and / or the hub / stabilisation wings. TA usually takes up to 10 days to degrade. Any CVADs that require removing prior to its degradation or that are found to have excess build-up of TA will require adhesive remover wipes or paraffin for removal.[15]
- Sutures for short term non tunnelled CVADs are to be removed prior / with device removal only. For instructions, refer to Removing a PICC, tunnelled PICC, or non-tunnelled CVAD (Appendix 6).
- Tunnelled CVADs and implanted devices may be secured with absorbable sutures at the exit site. The sutures are anticipated to dissolve over 42 to 70 days depending on suture type.[24] In the instance that the sutures do not dissolve or appear inflamed contact the CVAD CNS / procedural team for advice. In the instance that non absorbable sutures have been used, clear instructions for removal will be given by the proceduralist.
- Skin antisepsis:
    - Clean the skin first with sterile sodium chloride 0.9% to remove debris.
    - chlorhexidine gluconate 2% in isopropyl alcohol 70% is recommended for optimal skin antisepsis for needle insertion and dressing change procedures.[20,5,22] (consider alternative in the case of allergy)
    - Prior to puncturing the skin for needle insertions, use friction and a back and forth motion for at least 30 seconds to cleanse the skin.
    - Use a circular motion to clean around the catheter insertion / exit site of indwelling devices during dressing change.
    - Allow skin to air dry completely before puncturing the skin or applying a dressing. Drying time can take up to two minutes. Do not attempt to speed up the drying process by wafting or blotting.
    - A single application of chlorhexidine gluconate 2% in isopropyl alcohol 70% (or alternative in the case of allergy) is sufficient; applying multiple layers and inadequate drying before applying dressings can increase the risk of skin irritation and chlorhexidine sensitivity.[25]
    - Povidone iodine 10% is an alternative for patients with chlorhexidine sensitivity.
    - Refer to Neonatal Guidelines for appropriate skin cleansing solutions for preterm infants (Aseptic Technique in the NICU).

Maintaining Patency

A registered nurse or paediatric IV medication competent enrolled nurse is permitted to administer a sodium chloride 0.9% flush without a medical prescription in the below circumstances:

- Prior to accessing the line, swab the needle free access bung using a chlorhexidine gluconate 2% in isopropyl alcohol 70% swab (or alternative in the case of allergy) with friction for 20 seconds and allow to dry for 30 seconds.
- Prior to access, assess functionality of the CVAD by attempting to aspirate the line and instilling sodium chloride 0.9% first to determine the tip is intravascular and patency of the device.
- Following access, flush and lock the device with volume sufficient to clear the device and add on devices of medication and prevent blood reflux into the catheter.
- During line locking procedures ensure that clamp position is rotated along the catheter to prevent catheter fracture, and that tunnelled devices (Broviac™) have clamps applied only over the protective clamping sleeve.
- Use pre-filled sodium chloride 0.9% flush syringes (e.g., BD PosiFlush™) where possible in preference to drawing up sodium chloride 0.9% from an ampoule with a syringe and needle.
    - All sizes of the pre-filled syringes (i.e., BD PosiFlush™ 3 mL, 5 mL and 10 mL) can be used with CVADs and midlines as they all have the same diameter as a 10 mL syringe.
- Use a separate syringe for each flush.
- A medical order for regular and PRN flushes is required for patients on fluid restriction and infants at risk of fluid overload.

Flushing Technique [4,9,26]

- Use a **pulsatile technique** (also known as ‘push-pause’ and ‘start-stop’) with every sodium chloride 0.9% flush. This creates fluid turbulence within the lumen preventing the build-up of precipitate and biofilm on the inner surface of the catheter. Biofilm is thought to contribute to the development of CLABSI.[9]
- Use a **positive pressure** technique with every flush and locking procedure. Positive pressure technique aims to prevent retrograde flow of blood into the catheter when disconnecting and prevents clot-related catheter blockages. Achieve this by the clamping and disconnection sequence described below for every access[4]:
    - Positive-displacement needleless connector (e.g., MaxPlus™): clamp *after* syringe disconnection.
    - Negative-displacement needleless connector (e.g., SmartSite™, three way taps and the catheter hub): maintain pressure on the syringe plunger while closing the clamp on the CVAD or extension set then disconnect the syringe.
    - Neutral-displacement needleless connector (e.g Microclave clear connector ™) is not dependent on flushing technique and can be clamped either before or after syringe disconnection.[6]

- Avoid “bottoming out” the plunger of syringes to prevent suction, which may cause reflux.

Flush Volumes

- Sodium chloride 0.9% is the preferred solution for flushing. However, always check compatibility with the medication / fluid being administered.
- Flush before, between and after every medication / infusion to prevent contact of incompatible fluids that can cause precipitation and line blockage.
- Following medication administration via an infusion pump, consider the volume required to clear the administration set and additional add-on devices (e.g., 3-way taps, Y-connectors). A PosiFlush™ is not approved for use with infusion pumps for this purpose.
- If discontinuing therapy, perform a manual positive pressure flush after clearing the administration line and administer lock solution if appropriate.

Flush volume guide

Indication	Minimum volume (*guide only*)
Between bolus medications / infusions	3 - 5 mL
After blood draw / blood products	10 – 20 mL (10 mL fluid restricted)
On completion of lipid containing TPN	10 –20 mL (10 mL fluid restricted)
Note: Larger volumes may be required to clear blood or lipid from catheters and bungs - change connectors if residual blood or lipid is visible.	

Continuous infusion ‘To Keep Vein Open’ (‘TKVO’)

- It may be appropriate for patients requiring multiple medications / infusions to maintain a continuous infusion to allow for concurrent administration and reduce manipulation of the CVAD.
- Small calibre neonatal PICC devices are easily blocked due to the small internal diameter and for this reason 2 French devices benefit from TKVO.
- There is no scientific evidence to recommend an optimal rate as multiple factors affect flow: fluid viscosity, venous resistance, temperature, catheter position in the vein, catheter diameter, presence of precipitate or clots and delivery device settings.[9]
- A health care practitioner is to prescribe a compatible fluid and the rate on a fluid order form. As a *general* guide: **3 - 5 mL/hr** should be sufficient for most patients and devices.

- Consult with the primary team if the rate needs to be adjusted to prevent reflux of blood into the infusion line and ensure the infusion pump is positioned at or slightly above the patients' heart.
- Maintain a fluid balance chart for all children requiring continuous infusions and consider total fluid intake for infants and children requiring fluid restriction.

Line Locking

There is limited scientific evidence available to guide practice for line locking. Local recommendations for line locking are dependent on the type of device in situ, the frequency of access and manufacturer instructions. Refer to the table in **CVAD Flushing and Locking Guide** (Appendix 7) for suggested volumes and frequency.

Options for locking solutions include:

Product	Strength	Availability
Heparin	**10 units/mL**	Ready prepared proprietary product commonly referred to as heparinised saline.
Heparin	**100 units/mL**	Baxter pre-made syringes are available. See Formulary One for imprest locations. Refer to Appendix 7.
TaurolockHep100®	taurolidine 1.35%, sodium citrate 4% and heparin 100 units/mL	Ready prepared manufacturers product.

- TaurolockHep100® may be used as an alternative locking solution for children at high risk of a CVAD related blood stream infection; including oncology and home parental nutrition (PN) populations.[27] Refer to ChAMP monograph:
  - TaurolockHep100® for the administration procedure
- The volumes suggested in CVAD Flushing and Locking Guide should be sufficient to fill the intraluminal volume of CVADs inserted at PCH including volume of the positive displacement bung.
- However, if the exact intraluminal volume is known administer 110% of the volume to ensure the catheter tip is in contact with the locking solution e.g., heparin in the appropriate strength in sodium chloride 0.9% / TaurolockHep100®.
- The volume of extension sets / 3-way taps, if present, must also be considered.
- Lock solutions are to be withdrawn from tunnelled and implanted devices prior to infusing flushes, medications or fluids.

- If unable to withdraw heparin, TauroLock™Hep100, alteplase or any other de-clotting agent, contact the CVAD CNS / After-hours CNS for advice on techniques for removal. In the instance that the solution cannot be withdrawn, liaise with ward pharmacist or ChAMP pharmacist and refer to the drug-specific protocols for instruction on the process and monitoring required in the event the lock solution is flushed into the circulation.

Administration Set and Needleless Access Devices

Needleless access device (NAD)

- There is inconclusive evidence for the use of one type of NAD / bung over another for optimum prevention of thrombotic CVAD occlusion. To promote consistent practice, the MaxZero™ and MaxPlus™ are used for all CVADs and midlines at PCH.
- NADs are to be distinguished from other valves in use in the hospital such as inline anti-reflux and back-check valves which are indicated for a different purpose.

NAD Change Intervals:

- **Weekly** when CVAD not in use with scheduled flush and dressing change or,
- When changing continuous infusion administration sets.
- Additionally, NAD should be changed:
  - If unable to clear of residual blood or lipid solutions
  - If the integrity of the bung is compromised
  - If removed from the patients CVAD - **do not reattach**,
  - Replace with a new sterile bung prior to drawing a sample for blood culture.

Administration Sets

- Administration lines are not to be disconnected and reattached to the patient at a later time e.g., for purpose of patient bathing, showering. Consider timing of scheduled line / infusion changes in collaboration with the patient / carer to allow for hygiene activities wherever possible.
- A new infusion and administration line are to be prepared once disconnected from the patients CVAD.
- Label all infusion administration lines in accordance with hospital policy Labelling of Injectable Medications and Fluids.

Administration Line Change Intervals

- CVAD lines are replaced at least every 7 days using aseptic technique.

- Fluid bags and infusions with additives prepared in the clinical area are changed every 24 hours.
- If using fresh blood or fresh blood products replace line(s) at the end of infusion or at least every 12 hours. Refer to Transfusion Protocols.
- If lipid emulsion is being infused, change lipid syringe / bag and line every 24 hours.

Blood Sampling [4]

- Carefully consider risks (i.e., small calibre devices, occlusion and infection) versus benefits (avoid venepuncture and associated risks, anxiety and distress) before deciding to use a CVAD for obtaining blood samples.
- It is not recommended to take blood from midlines and from small calibre neonatal PICC lines (1 and 2 French)
- Adhere to occupational safety measures to minimise exposure to blood borne pathogens. Use safety engineered devices where available e.g., needleless blood collection and transfer devices and dispose of equipment immediately after use into sharps waste containers. Refer to Blood Sampling procedure (Appendix 8) and CAHS Sharps Management Policy.
- Draw samples from a dedicated lumen not used for infusing the drug being monitored. Stop infusion for a minimum of 10 minutes and flush with sodium chloride 0.9% prior to discard.[4]
- Drug levels from single lumen devices and coagulation studies from heparinised devices are not recommended and in the absence of alternative methods, results must be interpreted with caution.
- Discard volumes:
    - Minimise by obtaining only the minimum discard volume and the minimum volume required for each test.
    - Typically, 3 mL discard is recommended with 5 mL for coagulation studies obtained from a CVAD exposed to heparin.
    - Do not re-infuse the discard volume due to risk of contamination and blood clot formation, unless clinically indicated and deemed appropriate for that patient by the treating clinician (e.g., Intensive and Neonatal Care).
    - A 5 mL syringe may be used for aspirating blood if having difficulty with a 10 mL syringe.[28,30] A smaller syringe will exert less negative pressure than a larger syringe and may prevent collapse of the vein around the catheter / fibrin tail.

Removal of CVADs

- **Midlines** can be removed by nursing staff as per Peripheral Intravenous Cannula (PIVC) Insertion and Maintenance Procedure using aseptic technique. Hospital in the Home (HiTH) patients can have their midlines removed in the

home setting by nursing staff providing the medical team have documented the line can be removed upon cessation of therapy without prior medical review.

- **PICC, tunnelled PICC and non-tunnelled CVAD** can be removed in the clinical area by medical or nursing staff following instruction by the primary medical team to do so. See Removal of a PICC, tunnelled PICC or non-tunnelled CVAD (Appendix 5). HiTH staff may remove PICCs in the home setting following instruction by the medical team and in accordance with Appendix 5.
- Removal must be documented by the clinician removing the CVAD on the CVAD Insertion / Removal Record (MR852.01) where accessible, or the CVAD and Midline Daily Assessment Record (MR852), and in the patient's medical records progress notes.
- **Tunnelled (cuffed) and implanted CVADs** will be removed in the Operating Theatre under General Anaesthetic. All referrals for CVAD removals are to be made by following the instructions How to refer and book a Central Venous Access Device (CVAD) and completing the CVAD e-Referral.

Patient Discharge

- Children are not discharged home with a non-tunnelled CVAD due to the increased risk of infection, dislodgement and air embolism.
- Refer to HiTH if the patient is to continue therapy at home via a CVAD or midline. The decision to continue therapy at home must be made on individual patient assessment in collaboration with the patient's medical team, the family and the HiTH team.
    - The HiTH team are to continue the CVAD and Midline Daily Assessment Record form (MR852) for patients requiring ongoing treatment.

Parent Education

- Parents / carers of patients with a CVAD or midline who are being discharged home with HiTH or going on leave must receive information and education on the type of device, general care and how to recognise problems and get help. This must commence well in advance of discharge and includes:
    - Relevant Health Facts for CVAD, who to contact and phone numbers for help, and Care of Central Lines at PCH Video (see useful resources below).
    - Discussion of general care to avoid dislodgement, infection and breakage of the CVAD.
    - How to recognise problems with the CVAD
    - Emergency management education in the event of accidental disconnection, breakage or dislodgement.
    - Provide an Emergency Kit containing:

- One pack of sterile gauze
- One large swab pad of chlorhexidine gluconate 2% in isopropyl alcohol 70% (or alternative in the case of allergy)
- Plastic non-serrated clamps
- Spare sterile bung
- 1 x 10 mL BD PosiFlush™ sodium chloride 0.9% pre-filled syringe

  - Document completion of the above on the Parent Education Checklist (MR845.00) and file in the patient's medical records.

Parent Competency

- Please access parent / carer education and training resources from the Central Venous Access Family Education intranet page.
- Parents / carers prior to undertaking any form of intravenous therapy and / or other CVAD care at home must complete a competency based structured education plan with knowledge and skills outlined in the Parent Education Guide for Nursing Staff and may only occur after consultation with the treating Consultant and the ward Clinical Nurse Manager. This must commence well in advance of discharge and includes all the above as per Parent Education **plus**:
  - Parent Education Checklist (MR845) completed for relevant skill set and filed in the patient medical records and
  - Family Training Workbook (topics relevant to the patient) printed and given to the parent/carer.
- On an annual basis refresher education should be conducted by nursing staff to ensure families have retained knowledge and skill for key management principles. Evidence of this should be documented in the progress notes.

References and related external legislation, policies, and guidelines

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Related CAHS Policies, Procedures, and Guidelines
Alteplase Monograph for Administration (Medication Management Manual)
Aseptic Technique (Infection Prevention and Control Manual)
Aseptic Technique in the NICU (Neonatology Policy Manual)
Hand Hygiene (Infection Prevention and Control Manual)
Labelling of Injectable Infusions and Fluids (Medication Management Manual)
Medication Administration (Medication Management Manual)
Perioperative Scrubbing, Gowning and Gloving protocol (Perioperative Practice Manual)

Peripheral Intravenous Cannula (PIVC) Insertion and Maintenance (Clinical Practice Manual)
Procedural Sedation (Clinical Practice Manual)
Sepsis recognition and management (Emergency Department Guideline)
Sharps Management Policy (Infection Prevention and Control Manual)
Staphylococcus aureus Decolonisation for Procedures (Infection Prevention and Control Manual)
TaurolockHep100® (ChAMP)
Transfusion Protocols (Transfusion Medicine Manual)

Useful resources
Bundles of Care for Safe Insertion (MyLearning)
Bundles of Care for Safe Maintenance (MyLearning)
Central Venous Access (Intranet Information Hub)
CVAD e-Referral Form & How to Refer and Book a CVAD (Intranet Information Hub)
CVAD Staff Training Package for Nursing Staff (access via the MyLearning)
The Vascular Access Education Framework (CAHS Nursing Education – Safety Skills Intranet Hub page)

Family / Carer Education
Central Venous Access - Care of a PICC (Health Facts sheet)
Central Venous Access - Care of an Implanted Device (Health Facts sheet)
Central Venous Access - Care of Tunnelled Lines (Health Facts sheet)
CVAD Family Education & Training Resources (Central Venous Access Information Hub – Family Education)
PCH CVAD Care Video for Families (Central Venous Access Information Hub – Family Education)
Peripherally Inserted Central Catheter (PICC) (Health Facts sheet)

Radiologic insertion of a Central Venous Access Device (Central Venous Access Information Hub – Family Education)
Staphylococcus aureus decolonisation (Health Facts sheet)

This document can be made available in alternative formats on request.

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Appendix 1: Quick Guide to Complications and Actions

Possible complication	Signs / Symptoms may include	Possible actions
Pneumothorax **Haemothorax** **Hydrothorax**	Respiratory and / or cardiovascular deterioration in the post-operative period [*may occur with central insertions*]	Stop using CVAD. Full set of observations. Notify medical team and proceduralist. Respiratory and cardiovascular management as indicated.
Infection	Fever and / or rigors when accessing the CVAD Inflammation, redness and / or exudate at the site.	Report to treating medical team for further investigation and treatment e.g. Blood Culture Collection from CVAD and Empiric antibiotics (see ChAMP guidelines). Wound swab collection if exudate present. Removal of the CVAD may be warranted following consultation with infectious diseases and / or clinical microbiology team. Send catheter tip for culture *(see Appendix 9)*
Displacement: • Outwards	Length of external catheter increased or dislodged access needle; difficulty flushing / aspirating; infusion pump alarms; pain, swelling, leaking; blistering or taut skin around the insertion site; change in skin colour (i.e., cold, blanching)	Do not use. Inform shift coordinator and seek medical advice. If limb affected, elevate and immobilise. Mark and measure the area of skin affected, commence a Wound Management Plan. *See Appendix 10: Infiltration / Extravasation; for cytotoxic agents also refer to Extravasation of Antineoplastic (Cytotoxic) Agents*

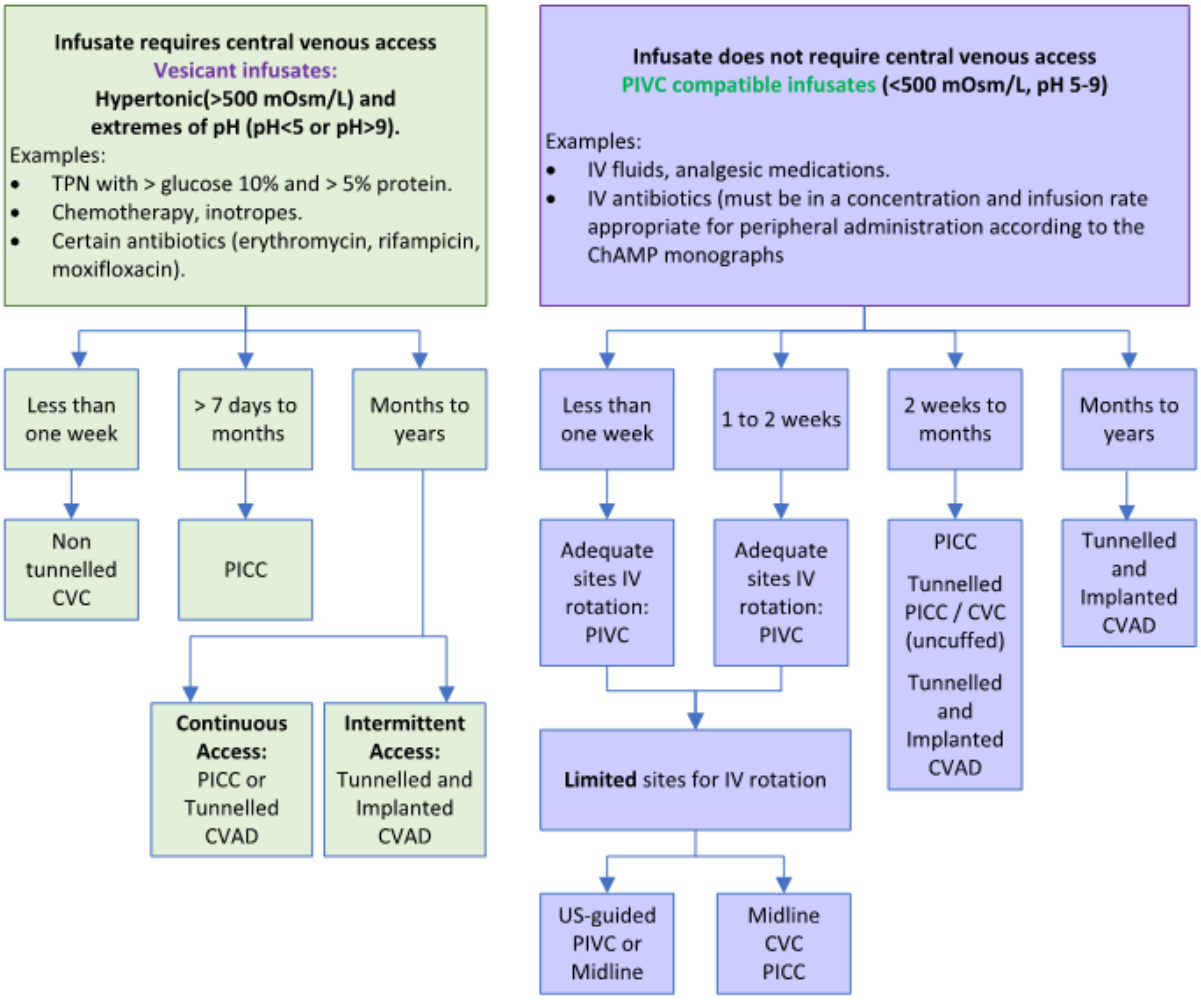
Possible complication	Signs / Symptoms may include	Possible actions
• Inwards - into atrium or ventricle (risk of Cardiac Tamponade – *see Appendix 11*)	External PICC / CVC length reduced. Palpitations, chest pain; respiratory distress; arrhythmias; hypotension	Seek urgent medical attention if clinically indicated or cardiac complication suspected - **Call 55 Code Blue Medical immediately.** Consider radiological imaging to assess tip position and confirm ongoing use of line.
Catheter damage:	CVAD external components are damaged or broken.	Stop using CVAD. Apply non-serrated clamps between the patient and fracture. Notify medical team. Some CVADs (i.e., Broviac™) can be repaired with the appropriate repair kit by trained staff. Other CVADs will usually need replacement. Any damaged line that requires removal or repair should be kept and sent to the manufacturer for investigation.
Mechanical Obstruction/ 'Pinch Off' syndrome	Frequent infusion pump alarms, positional obstruction can indicate 'pinch-off' for catheters in the subclavian vein.	Treatment depends on the cause e.g., malposition, thrombus, anatomical obstruction, fibrin sheath formation. Check all potential external sources. Re-position patient, Check for kinks in lines, clamps, securement devices, dressing and change if appropriate.

Possible complication	Signs / Symptoms may include	Possible actions
Intraluminal Occlusion	Partial obstruction: Resistance felt on flushing and/or inability to aspirate. Complete obstruction: Inability to flush and/or aspirate blood.	Consider need to use alteplase to clear thrombus occlusion *see* *Appendix 12.*
Venous Thrombosis	Oedema/swelling in the arm, neck, shoulder and/or leg at/or near to the catheter location.	Inform shift coordinator and seek medical advice. Comfort measures and analgesia Radiological Imaging: Ultrasound, Doppler. Consider referral to haematologist if DVT confirmed. ** Presence of a catheter related thrombus may not necessitate removal of CVAD please see *Appendix 13: CVAD-Related Venous Thrombosis*
Air Embolism	Sudden onset of chest pain, shortness of breath, Cyanosis Tachycardia Alteration in conscious state Abrupt fall in blood pressure	Clamp the catheter immediately. Lie child on their left side with head lower than their heart. Administer 100% oxygen - **Call 55 Code Blue Medical immediately.** *See* *Appendix 14*

Possible complication	Signs / Symptoms may include	Possible actions
CVAD associated skin impairment (i.e., local site infection, moisture-associated skin damage, contact dermatitis, and medical adhesive-related skin injuries (MARSIs)	Erythema; Induration; Exudate; Swelling. Skin tears. Lesion (macules, papules, vesicles, bullae). Burning. Itching Pain/discomfort	Refer to existing, or initiate, wound management plan (consider photography with consent) See Appendix 16: CVAD Associated Skin Impairment Algorithm. If senior nursing staff are uncertain about the underlying cause or management strategy escalate to CVAD Nursing or Stomal/Wound NP for review and advice (in hours) or Afterhours CNS.

Appendix 2: Vascular Access Device Selection Pathway

Vascular Access Decision Pathway



Factors to consider to decide type of CVAD for patients:

- Infusate characteristics.
- Expected duration of treatment.
- Patient factors (Age, weight, comorbidities, preferences).
- Indications: Difficult IV access (DIVA) and requirement for blood draws.
- Procedural management considerations of the child.
- Vein status / venous health – any known abnormalities (thrombosis or stenosis).
- Medical History / chronicity of disease / course – includes need for multiple CVAD's in the future.
- Inpatient or outpatient IV Therapy.

To minimise CLABSI, the following factors should be considered when selecting a CVAD:

- Number of catheter lumens should be kept to the minimum necessary for the management of the patient (CDC, 2016).
- Any solution containing lipid (e.g. TPN) should have a dedicated lumen.
- The likely duration or dwell time.

Appendix 3: Needling and De-Needling an Implanted Device

Key Points

- Only non-coring needles are to be used to access ports. The length of needle used will be determined by assessment of depth of port on palpation. Ideally the needle should rest as close to the skin as possible.
- Prior to inserting the needle, consider angle and position of the extension tubing for accessibility and patient comfort.
- A maximum of two attempts at access is acceptable before escalating to senior nursing staff.

Equipment

Personal Protective Equipment (PPE) i.e., apron, sterile gloves

Dressing trolley, large dressing pack

Rubbish bin +/- sharps container

Appropriate type and size of non-coring needle

10 mL Luer lock syringe (x3)

sodium chloride 0.9% sterile ampoules (x2)

3 way tap & needle-free bung(s)

Drawing up needle(s)

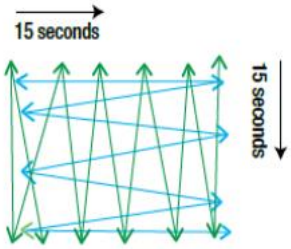
Skin cleansing swab stick / solution: chlorhexidine gluconate 2% in isopropyl alcohol 70% (consider alternative agent for patients with sensitivity to chlorhexidine)

Skin protection wipe (e.g., Cavilon®)

Transparent, semi-permeable, polyurethane dressing, large (e.g., SorbaView®)

± Prescribed locking solution (e.g., heparin in the appropriate strength in sodium chloride 0.9% / TaurolockHep100®) in a 10 mL syringe

Procedure: Needling an Implanted Device
1. **Prepare Patient** Plan and implement age appropriate procedural pain / comfort measures: • Apply topical local anaesthetic cream 45-60 minutes prior to needle insertion. • Utilise Keeping Kids in No Distress (KKIND) principles / play / distraction techniques throughout. • Position patient in a semi supine position if possible. • Identify infusaport site and palpate to identify the septum and outer perimeters.

Procedure: Needling an Implanted Device
• Assess site for signs of infection including redness, swelling, and tenderness. Do not continue with needle insertion if signs / symptoms present. Report to treating medical team and await further instruction.
2. **Prepare equipment** • Decontaminate dressing trolley, wash hands and gather equipment. • Put on PPE • Using sterile gloves and non-touch technique assemble non-coring needle (± extension set / 3-way tap if required) and attach needle-free bung(s) • Prime the entire set with sodium chloride 0.9% • Clamp the line
3. **Cleanse the skin**  • Apply friction and use a back and forth direction using a chlorhexidine gluconate 2% in isopropyl alcohol 70% swab stick (or alternative in the case of allergy): ○ Use opposite sides of swab stick for each direction or a separate swab stick. ○ Clean area of skin extending 1- 2 cm beyond the dressing area. ○ Allow skin to **air dry completely** (this can take up to 2 minutes). ○ Once skin is dry, place sterile towel below insertion site (to prevent contact of extension set / syringe with patient skin).
4. **Insert the non-coring needle** *(safety Lifeguard™ needle is preferred)* • Locate the base of the port with non- dominant hand. • Triangulate port between thumb and first two fingers to ensure stability during needle insertion. • Aiming for the centre of the port, insert needle at 90^{o} angle pushing firmly through the skin until tip touches bottom of portal chamber. • Do not rotate once in situ

Procedure: Needling an Implanted Device

5. **Dressing**

- Cover the site with a large sterile transparent semi-permeable dressing: consider patient sensitivity and individual patient needs.
- If sterile gauze is used to provide support and stability, ensure the insertion site remains visible.

6. **Check line patency**

- Release clamp and / or turn the 3-way tap on to the syringe.
- Aspirate the line using a 10 mL syringe: withdraw heparin lock / TaurolockHep100® (2-3 mL in most cases) and discard.
- Obtain blood samples at this time if required.
- Flush with 10-20 mL of sodium chloride 0.9%

7. **If unable to aspirate blood, consider the following**

- Ask patient to cough or take a deep breath (if age appropriate)
- Change patient position– lying down / sitting up or lifting arm can facilitate aspiration.
- If still unable to withdraw blood – seek senior nurse / CNS-CVAD or medical review

8. **Documentation**

- Complete CVAD Daily Assessment Record (MR852) with date / time of needle insertion
- Document difficulties in patient notes and include in clinical handover.

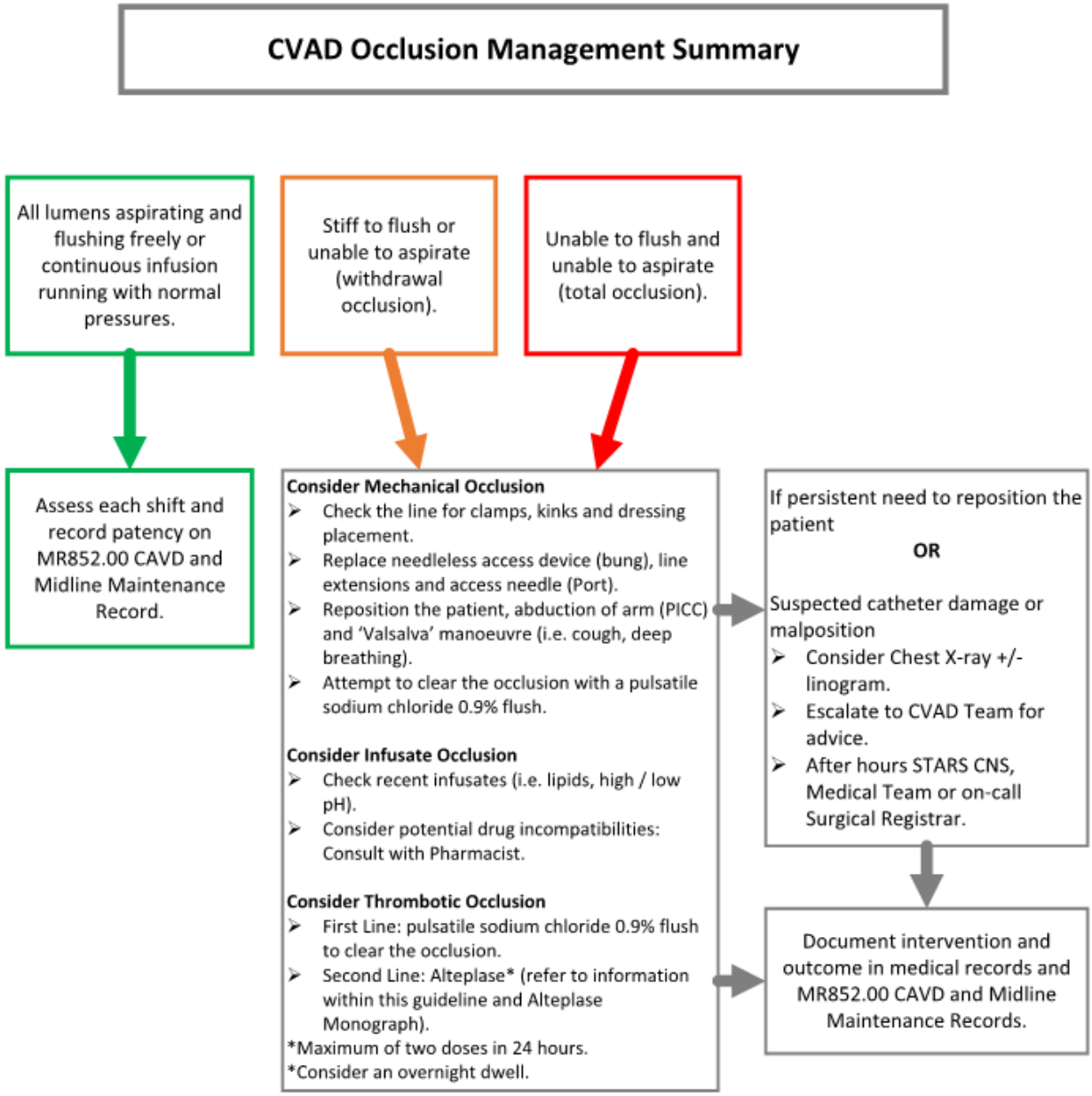
De-Needling an Implanted Device

1. **Flush the Port**

- Prepare equipment and flushing solution using aseptic technique.
- Cease infusion if in progress, clamp extension set and disconnect IV administration set using non touch technique.
- Scrub the needle-free bung with a chlorhexidine gluconate 2% in isopropyl alcohol 70% swab (or alternative in the case of allergy) and allow to dry.

De-Needling an Implanted Device
• Using pulsatile, positive pressure technique, flush port with 10-20 mL of sodium chloride 0.9%. • Lock the line with prescribed locking solution (e.g., heparin in the appropriate strength in sodium chloride 0.9% / TaurolockHep100®) as per prescription. • Clamp line / extension.
2. Remove or loosen the dressing. • If hands contaminated, repeat hand hygiene and don clean gloves
3. Stabilise the port by placing the first finger and thumb of the non-dominant hand firmly on either side of the port. **4. Disengage the needle safety guard as** per manufacturer instruction and with dominant hand, remove the needle in a straight upward direction. Refer to manufacturer instructions for specific safety device removal technique.[55]
5. Dispose of needle into sharps waste container immediately as per Sharps Management policy. **6. Apply pressure** with sterile gauze until haemostasis achieved. **7.** Inspect the site and **cleanse with a chlorhexidine gluconate 2% in isopropyl alcohol 70% swab** (or alternative in the case of allergy) and allow to dry before applying an occlusive dressing. **8. Leave dressing** in place for 24 hours and monitor closely for bleeding at site for at least 4 hours. **9.** Report to medical officer for review if infection is suspected.
10. Document removal of needle on CVAD Daily Assessment Record (MR852) and in the patients' notes.

Appendix 4: Occlusion Management Summary



Appendix 5: CVAD Dressing Change Procedure

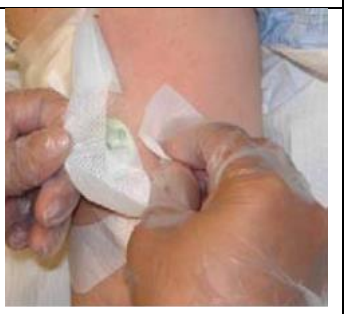
Key Points

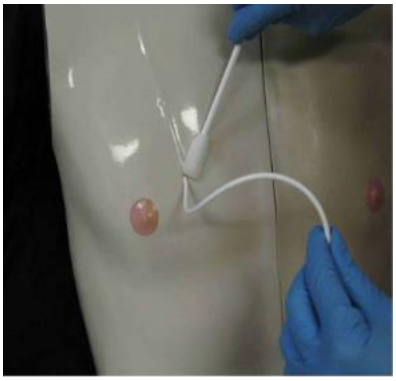
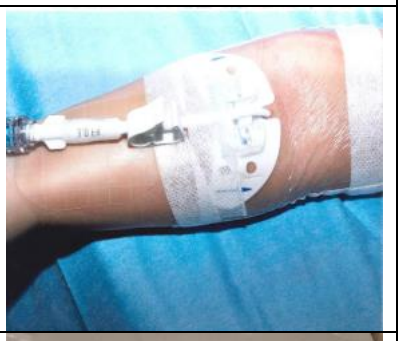
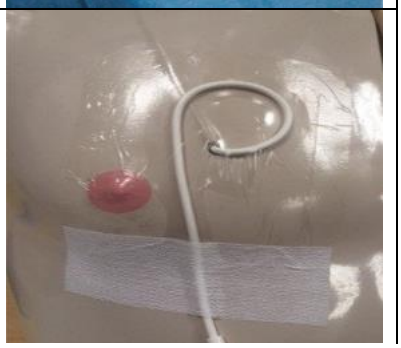
- Procedural management is critical to successful dressing change procedures in children.
- Ensure familiarity with the application and removal techniques of dressings prior to procedure.

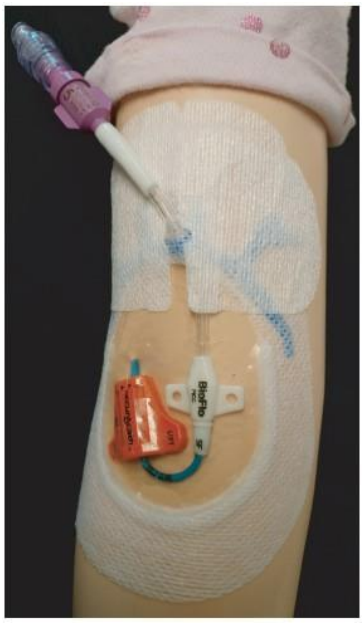
Equipment

- Dressing trolley / sterile dressing pack / waste bag
- PPE: apron; gloves (non-sterile and sterile)
- Skin cleansing swab stick(s) and swab pad(s): chlorhexidine gluconate 2% in isopropyl alcohol 70% (consider povidone-iodine for patients with chlorhexidine sensitivity)
- Sterile sodium chloride 0.9% ampoules
- Gauze swabs ± sterile cotton tip applicators
- Skin protection wipe (i.e., Cavilon™)
- Adhesive removal wipes or spray (e.g., Uni-Solve, Niltac™)
- Large transparent semi-permeable dressing (e.g., Tegaderm™ IV Advance)
- ± Sutureless securement device (e.g., StatLock™ for PICC; GripLok™)
- ± Sterile needle free bung

Dressing Change Procedure
1. Position patient for clear access to the CVAD insertion / exit site. 2. Wash hands 3. Assess the insertion / exit site: visualise and palpate for signs of infection / tenderness. 4. Note and record external length of catheter if applicable

Dressing Change Procedure
5. Prepare Equipment: A large aseptic field is required for dressing changes. 6. Wash hands 7. Clean dressing trolley with detergent wipe and gathers equipment. 8. Open dressing pack onto trolley and prepare equipment using non touch technique. 9. Repeat hand wash and put on apron & gloves
 10. Remove transparent dressing carefully and dispose into waste bag. 11. Adhesive remover wipes, spray or alcohol wipes can assist with dressing removal - never use scissors to remove the dressing. 12. If applicable inspect sutureless securement device and assess need to change. Remove with alcohol swabs if change is necessary. Assess risk / benefit of changing the device. Consider use of the tape strip to secure external catheter during change. Remove the tape strip prior to the clean dressing application. 13. Chlorhexidine gluconate impregnated dressings require sterile sodium chloride 0.9% for easy removal. 14. Integrated securement dressings (e.g., SorbaView™): locate the v-notch on outer edge of closure piece and pull apart in opposite directions to break centre perforations. 15. Repeat hand washing and put on sterile gloves.
16. Cleanse the skin: If visibly soiled clean the skin with sodium chloride 0.9% first and dry with sterile gauze. 17. Consider taking a wound swab collection if exudate present. 18. Hold and support the catheter close to the insertion / exit site in non-dominant hand with a sterile gauze swab.

Dressing Change Procedure
19. Following the cleanse with sterile sodium chloride 0.9%, cleanse the skin with a chlorhexidine gluconate 2% in isopropyl alcohol 70% swab stick (or povidone iodine for patients with chlorhexidine sensitivity). For preterm infants refer to Aseptic Technique in the NICU). 20. Using friction and a circular motion cleanse the skin from the insertion / exit site working outwards and extending beyond the area of the dressing. 21. **Allow the skin dry**. 
22. Clean the length of catheter from the insertion / exit site to end of hub with a separate chlorhexidine gluconate 2% in isopropyl alcohol 70% swab (or alternative in the case of allergy).
23. Apply skin protection to area beneath the dressing where appropriate, avoiding direct contact with insertion / exit site
24. Apply new securement device if applicable.
25. Apply transparent dressing, covering the insertion site and securement device if present. 
26. For tunnelled CVAD, loop catheter under the dressing and avoid obscuring the exit site. Anchor the catheter with adhesive tape; reinforce edges of dressing with adhesive dressing if required. 

Dressing Change Procedure
27. For CVAD with subcutaneous securement device (SecurAcath®), ensure hub of device is placed under the dressing to prevent pulling or kinking of the catheter. 
28. Document dressing change on the CVAD Daily Assessment Record (MR852) and schedule next dressing change date. 29. Remeasure PICC external length to ensure catheter has not moved during dressing change.

Appendix 6: Removing a PICC, Tunnelled PICC or Non-tunnelled CVAD

Key Points

- There is a risk of air embolus during the removal procedure. Ensure the catheter is removed during breath hold or expiration only. (See Appendix 14 for management of air embolus).
- Document removal on the CVAD Insertion and Removal Record (MR852.01) and / or CVAD Daily Assessment Record (MR852).

Equipment

- Dressing pack
- PPE: Apron / gloves; goggles (if risk of blood splash)
- Adhesive removal wipes or spray (e.g., Uni-Solve, Niltac™
- Skin cleansing swab stick(s) and swab pad(s): chlorhexidine gluconate 2% in isopropyl alcohol 70% (consider povidone-iodine for patients with chlorhexidine sensitivity)
- Sterile occlusive dressing: (e.g., Tegaderm™)
- ± stitch cutter (if catheter secured with sutures)
- ± sterile scissors (if catheter tip required)
- ± specimen container

Procedure: Removing a PICC, Tunnelled PICC or Non-tunnelled CVAD
1. Explain procedure to patient and family. 2. Implement comfort and distraction measures. 3. Position the patient supine flat or Trendelenburg position unless contraindicated. 4. For patient with a PICC ensure arm is outstretched and below the level of the heart.

Procedure: Removing a PICC, Tunnelled PICC or Non-tunnelled CVAD
5. Clamp the catheter (and administration sets if present). 6. Wash hands and prepare equipment using aseptic technique. 7. Don PPE 8. Loosen edges of dressing ± sutureless securement device with adhesive tape remover ± alcohol swabs and remove (do not use scissors on CVAD dressings) 9. If subcutaneous securement device (e.g SecurAcath®) present, detach device cover from base to enable CVAD removal and achieve haemostasis before removal of base following procedure outlined in Appendix 15 10. If sutures present lift away from the catheter with forceps and cut the suture away from the catheter. 11. Cleanse the skin with chlorhexidine gluconate 2% in isopropyl alcohol 70% swabs (or alternative in the case of allergy) and allow to dry.
12. If catheter tip required for culture, wash hands and don sterile gloves and/or use sterile forceps to remove the catheter. 13. Ask patient to perform Valsalva's manoeuvre if cooperative or ask patient to hold their breath during removal. 14. If child is crying / unable to follow instruction remove the catheter on expiration. 15. Hold sterile gauze over the insertion site and using gentle even pressure, slowly withdraw catheter. 16. If resistance is felt, pause, ask patient to turn head and try again. 17. If resistance is still encountered contact senior medical or nursing staff. 18. **Do not use force.**
19. Once catheter removed apply continual pressure over the exit site until haemostasis is achieved. 20. Apply occlusive dressing and leave in place for 24 hours. 21. Observe the site for bleeding for a minimum of 4 hours. 22. Check the catheter integrity following removal to ensure no remnants are left behind (refer to catheter length on insertion record).

Procedure: Removing a PICC, Tunnelled PICC or Non-tunnelled CVAD
If catheter tip is required for culture: 23. Catheter tip (last 2-3 cm) is only sent for microbiological culture if clinically indicated i.e., unexplained fever, significant erythema or exudate at the insertion site. 24. Once catheter removed from patient, ensure the tip does not become contaminated e.g., by hands, clothing, bedding. 25. Using sterile scissors cut the last 2-3 cm of the catheter and place directly into the specimen container. 26. Label specimen with patient details and send with pathology request form to Microbiology.
27. Document Removal on the CVAD Insertion and Removal Record (MR852.01) and / or CVAD Daily Assessment Record (MR852) and in the patient notes.

Appendix 7: CVAD Flushing and Locking Guide

Considerations

- Rationalise volumes of sodium chloride 0.9% for fluid restricted patients
- Rationalise heparin for patients with haemophilia - heparin **10 units/mL** in sodium chloride 0.9% (heparinised saline) is recommended.
- Maximise flushing following lipid infusions and blood sampling, a minimum of 10 mL sodium chloride 0.9% is recommended.
- Flush devices with sodium chloride 0.9% *prior* to instilling lock solution.
- Aspirate and discard locking solution prior to flushing CVAD.
- Heparin **100 units/mL** pre-made syringes are available. See Formulary One.

  Preference is always to use pre-made syringes. Where unable to use pre-made syringes, make a strength of heparin **100 units/mL** as follows:

  Dilute 1 mL of heparin 5000 units/5 mL with 9 mL of sodium chloride 0.9%.
- TaurolockHep100® is recommended for patients at increased risk of CLABSI (Oncology; home Parenteral Nutrition).
- PICC in outpatient settings: Weekly flushes may be appropriate (balance risks versus benefits); consider either heparin **10 units/mL** or TaurolockHep100® (contains heparin 100 units/mL) for Oncology / home PN populations.

	Estimated volume (mL) per lumen*	≤ 24 hrs between access	>24 hrs between access
Midline	0.5 mL	3-5 mL sodium chloride 0.9%	Heparin **10 units/mL** **Daily**
PICC	1 mL	3-5 mL sodium chloride 0.9%	Heparin **10 units/mL** **Daily**
Non-tunnelled	1 mL	3-5 mL sodium chloride 0.9%	Heparin **10 units/mL** **Daily**
Tunnelled	2 mL	5-10 mL sodium chloride 0.9%	Heparin **100 units/mL** *or* TaurolockHep100® (contains heparin 100 units/mL) **Weekly**
Implanted	2 mL	10-20 mL sodium chloride 0.9%	Heparin **100 units/mL** *or* TaurolockHep100® (contains heparin 100 units/mL) **Monthly**

* If the exact intraluminal volume is known, administer 110% of the volume to ensure the catheter tip is in contact with the locking solution

Appendix 8: CVAD Blood Sampling Procedure

Key Points

- Poor technique with blood sampling may lead to thrombotic occlusion and increase risk of blockage and infection.
- Small calibre devices are at an increased risk of occlusion.
- Minimise risk of occlusion and blood loss for the patient by considering rationalising discard volumes, 3-5 mL is sufficient in most cases. Consider additional measures such as minimising samples and the use of Micro-containers where possible

Equipment

- Cleaned blue tray or dressing trolley
- 10 mL sterile syringe (x2)
- ± Luer lock vacuum blood collection device (e.g., BD Vacutainer®)
- Blood collection tubes / bottles
- Chlorhexidine gluconate 2% in isopropyl alcohol 70% swabs (consider povidone-iodine for patients with chlorhexidine sensitivity)
- Sodium chloride 0.9% 10 mL ampoules
- PPE (apron, gloves, ± goggles if risk of blood splash)
- ± Prescribed locking solution (e.g., heparin in the appropriate strength in sodium chloride 0.9% / TaurolockHep100®) in a 10 mL syringe
- Drawing up needle
- ± Sterile needle-free bung

Blood Sampling Procedure
1. Confirm patient identification with the blood specimen request form. 2. Check volume of blood required for requested specimen/s. 3. Perform hand hygiene and prepare equipment using aseptic technique 4. Don personal protective equipment. 5. Cease infusions if in progress and clamp line (if appropriate to do so) 6. Vigorously scrub the needle-free access device with a chlorhexidine gluconate 2% in isopropyl alcohol 70% swab (or alternative in the case of allergy) for 20 seconds and allow to air dry.

Blood Sampling Procedure

Syringe method:

- Holding the end of the CVAD lumen with a new swab or sterile gauze, attach a sterile 10 mL Luer lock syringe to hub or needle-free device and unclamp line.

- Slowly retract plunger to withdraw blood (3-5 mL in most cases) and discard syringe into sharps waste container unless line cultures are required.

- If having difficulty obtaining an aspirate try changing the patient's position, ask patient to cough, move arm up/ down. If blood still not flowing, try using a 5 mL syringe (a smaller syringe will exert less *negative* pressure and may prevent catheter collapsing on aspiration).
- Attach new syringe and gently withdraw required volume of blood.
- Remove syringe and swab the needle-free device with alcohol swab and allow to dry.
- Flush the catheter with at least 10 mL of sodium chloride 0.9% using pulsatile, positive pressure technique.
- Lock the line with prescribed locking solution (e.g., heparin in the appropriate strength in sodium chloride 0.9% / TaurolockHep100®) or resume infusions.
- Transfer blood to appropriate collection bottles / tubes preferably using a blood transfer device if appropriate.
- Label blood specimen(s) with patient details and write which lumen used.
- Send to laboratory in biohazard specimen bag with blood request form.

CVAD Blood Collection Device: (Vacutainer® Luer-Lok Access Device)

- Can only be used on CVADs with adequate and brisk blood flow.

- Attach Luer-lock blood collection device to new needle-free bung and rotate clockwise to lock in place.
- Insert discard blood collection tube (brown top) first in the centre of the holder and allow blood to flow into the tube (3-5 mL is sufficient discard in most cases).
- Remove discard tube and dispose into sharps waste container.
- Insert blood sample tube(s) in turn and allow blood to flow into the bottle until the minimum volume required for the test is reached.
- Remove sample tube(s) and gently invert 8-10 times.
- On completion of sampling remove the collection device by turning anti-clockwise, dispose directly into sharps waste container.
- Swab needle-free device with alcohol wipe and allow to dry.

Blood Sampling Procedure
• Flush CVAD with 10 mL sodium chloride 0.9% using a pulsatile technique. • Lock with prescribed locking solution (e.g., heparin in the appropriate strength in sodium chloride 0.9% / TaurolockHep100®) if required or continue infusion. • Label tubes accordingly and send to Laboratory in biohazard specimen bag with request form.

Appendix 9: CVAD and Midline Related Infection

Key Points

- Inadequate care of the patients CVAD significantly increases the risk of CVAD-related infections, including superficial skin or insertion site infections, deep tissue infections and invasive infections including CLABSI. Early recognition, diagnosis and prompt management are critical.
- Patients who have a permanent CVAD may present with an infected CVAD. In this context, decision making around line use and line removal should be considered.
- In the acute setting when the patient first presents with symptoms of a CVAD infection, sepsis or septic shock, antibiotics should be given as soon as possible (within 1 hour) and in most cases the CVAD can be used for intravenous access. Refer to the Sepsis Recognition and Management Guideline.
- If the patient is experiencing septic showers with rigors, fevers and tachycardia when the CVAD is used, alternative intravenous access should be secured if possible and as soon as possible.

Routes of Contamination[28]

- Migration of skin organisms from the insertion site along the catheter tract.
- Direct contamination of catheter hub by contact with hands or with contaminated devices.
- Contamination of fluids and / or medications during preparation.
- Spread from another focus of infection via the bloodstream.

Signs and Symptoms

- Redness, swelling, tenderness at site of insertion or along the insertion path.
- Drainage / ooze at insertion / exit site
- Fever
- Rigor on flushing or manipulation of the CVAD.

Actions

If a CVAD infection is suspected, the following actions must be taken:

- Urgent medical review
- Blood culture from the CVAD and if possible, from another site
- Swab insertion / exit site if exudate is present (request should state: ‘CVAD site infection - microscopy, culture and sensitivities’)
- Following review, the following actions should be carefully considered:
  - Empiric antibiotics (see ChAMP Guidelines)
  - If possible, removal of a short term CVAD

- In the setting of an implantable CVAD, an urgent review is recommended by the proceduralist / CVAD team.
- It is recommended to consult the Infectious Diseases team for clinical advice about suspected, possible or proven CVAD infections to facilitate antimicrobial treatment and to advise on need to remove the CVAD.

Appendix 10: CVAD and Midline Infiltration / Extravasation

Definition: ***'Extravasation'*** is the accidental leakage of drug or fluid out of the vein into the tissues with the potential to cause tissue injury and necrosis. The degree of tissue damage is dependent upon the properties of the drug or fluid, the concentration and volume infiltrated.

Key Points

- The position and patency of the CVAD must be ascertained prior to infusing vesicant drugs or fluids. Sluggish or no blood return could indicate a problem. Vesicant drugs and fluids are not recommended for administration via a midline.
- Refer to protocol for extravasation of antineoplastic (cytotoxic) agents.
- Recognising the early signs and symptoms of infiltration/extravasation is essential to minimise tissue damage.

Potential Causes [4,33]

- Inadequately secured catheter and malposition of catheter tip
- Dislodgement of Infusaport needle
- Fibrin sheath causing fluids to track to the insertion / exit site and accumulating in the subcutaneous tissue.
- Fracture or damage to the catheter from excessive intraluminal pressure e.g., administering medications with a small gauge syringe.

Signs and Symptoms (also refer to the PIVAS tool)

- Leakage of fluid from insertion / exit site.
- Erythema and / or swelling at insertion / exit site.
- Pain and burning sensation at site and during infusion.
- Blistering or taut skin around insertion / exit site
- Change in skin temperature and colour: cold / blanching or hot / tender.

Actions

- Cease infusion(s) / injection immediately and disconnect from CVAD (keep bag / syringe and administration set to assess amount of drug / fluid infused).
- **Do not flush.**
- If limb affected, elevate and immobilise.
- Mark and measure the area of skin affected.
- Attempt to aspirate any residual drug from the CVAD.

- Refer to treating medical team urgently – a referral to the plastic surgeon may be warranted.
- Leave Infusaport needle in situ until further treatment confirmed.
- Liaise with pharmacist and treating medical team for appropriate treatment e.g., heat / cold compress, antidote. Refer also to Extravasation of Antineoplastic (Cytotoxic) Agents and the Oncology/Haematology Unit for management advice.
- Document incident and all actions taken in the patients notes.
- Complete a Clinical Incident report via Datix CIMS.
- Consider medical imaging of affected area.
- Liaise with Stomal and Wound Therapy Nurse Practitioner for ongoing wound management.

Appendix 11: Pericardial Effusion and Cardiac Tamponade

Key Points

- A rare but significant complication; increased risk in infants with PICC / CVC.[36]
- Early recognition is critical in preventing adverse patient outcome.

Potential Causes

- Trauma at insertion.
- Migration of the catheter tip into the right atrium or ventricle with the risk of rupturing the heart wall or causing erosion from vesicant or irritant infusions.[44,54]
- Consider catheter migration into the heart if sudden onset of clinical symptoms.

Signs and Symptoms

- Reduced external catheter length (more common with PICC) associated with:
  - acute respiratory distress, chest tightness, tachycardia, hypotension, and a change in level of consciousness

Actions

- Cease infusion immediately and clamp catheter.
- Initiate life support measures as clinically indicated.
- Seek emergency medical attention: **CALL 55 CODE BLUE Medical**

Appendix 12: Alteplase Administration Procedure

Refer also to Alteplase monograph.

In hours: contact ward pharmacist for supply of alteplase syringe.
Out of hours: Syringes can be obtained from the 3C unit. It is stored frozen and once thawed should be used immediately.

Key Points

- Never use excessive force to instil alteplase into a blocked CVAD.
- Optimal volume of de-clotting agent to administer into a blocked CVAD is 110% of the intraluminal catheter volume to ensure contact with the catheter tip.
- Withdraw alteplase from catheter prior to flushing and resuming use.

Dose

- Alteplase 2 mg in 2 mL is supplied frozen from pharmacy and is pre-prepared in a 10 mL syringe.
- Maximum dose per instillation: 2 mg
- Maximum total dose in 24 hours: 4 mg (or no more than 2 doses)

Prescribing

An authorised health care practitioner must prescribe the alteplase dose in milligram (mg) on the once only section of the WA Paediatric Hospital Medication Chart.

- If the exact catheter volume is known / recorded (refer to CVAD insertion record), prescribe the dose in mg equal to the catheter volume plus 10% (up to a maximum of 2 mg) and to the nearest *measurable* dose.
- If known catheter volume is greater than 2 mL prescribe a 2 mg dose diluted in sodium chloride 0.9%:

  e.g. Known tunnelled CVAD volume = 2.4 mL

  Prescribed dose = 2 mg in 2.6 mL sodium chloride 0.9%

- If exact catheter volume cannot be determined the following guide can be used:

Childs weight:	PICC / Non-tunnelled	Tunnelled / Port
< 10 kg	1 mg in 1 mL	1 mg in 2 mL
> 10 kg	1 mg in 1 mL	2 mg in 2 mL

Multiple lumen CVAD

- If multiple lumens are blocked, each lumen can be treated simultaneously with the same dose providing the *total cumulative dose* instilled in 24 hours does not exceed 4 mg.
    - No more than two instillations per lumen should be attempted in 24 hours.
    - Consider treating 1-2 lumens at a time if clinical situation allows.
- Contact ward pharmacist in hours or on-call pharmacist out of hours for additional information and / or advice.

Administration

Equipment

- WA Paediatric Hospital Medication Chart
- Alteplase syringe - thawed.
- Blue tray – decontaminated with detergent wipe or alcohol 70%
- 10 mL sterile syringe(s)
- 10 mL sodium chloride 0.9% ampoule
- ± Prescribed locking solution (e.g., heparin in the appropriate strength in sodium chloride 0.9% / TaurolockHep100®) in a 10 mL syringe
- Chlorhexidine gluconate 2% isopropyl alcohol 70% swabs (consider povidone-iodine for patients with chlorhexidine sensitivity)
- Disposable gloves
- White medication label(s)
- ± 3-way tap
- Sterile needle-free bung

Procedure: Administering Alteplase
• Explain procedure to patient / carer. • Adhere to the six rights of safe medication administration. • Remove alteplase from freezer to thaw to (or near) room temperature. • Wash hands and prepare equipment using aseptic technique. • If required, dilute thawed alteplase with sodium chloride 0.9% to required volume.

Procedure: Administering Alteplase
• Vigorously scrub the CVAD hub with chlorhexidine gluconate 2% in isopropyl 70% swab (or alternative in the case of allergy) for 20 seconds and allow to dry. • Confirm occlusion by attaching a 10 mL sodium chloride 0.9% syringe and attempting withdrawal. • If blood flashback obtained, flush with 5-10 mL of sodium chloride 0.9%, remove syringe, clamp line and resume use.
If occlusion confirmed continue as follows: • **Partial occlusion:** Ability to flush but sluggish or no blood return. • Ensure CVAD is clamped (unless valved CVAD) • Using aseptic technique, remove bung, cleanse the hub, allow to dry. • Attach alteplase syringe to catheter hub. • Unclamp CVAD and slowly instill alteplase into catheter – do not use force. • Clamp CVAD and remove syringe. • Attach new sterile bung / cap. • Label with 'Alteplase - DO NOT USE' • Leave for 60-120 minutes (optimum time is 120 minutes).[31]
• **Complete Occlusion:** Inability to infuse or withdraw blood. • Use negative pressure / 3-way tap technique.[32] • Ensure CVAD is clamped. • Using aseptic technique remove the bung, cleanse the catheter hub and connect 3-way tap with tap in OFF position to the CVAD. 
• Attach a sterile 10 mL Luer lock syringe to one of the ports and the alteplase syringe to the other port as shown. • Turn tap so it is ON to the aspirating syringe, OFF to the alteplase syringe. • Unclamp CVAD and gently pull back on the plunger of the empty syringe to the 3–5 mL mark to create a vacuum in the catheter then turn tap OFF to syringe. • Clamp CVAD.

Procedure: Administering Alteplase
• Remove aspirating syringe, expel air and reattach to tap - use new syringe if tip becomes contaminated. • Unclamp CVAD and turn tap so it is ON to alteplase syringe and CVAD. • Allow alteplase to flow into the catheter.
• Once instilled, or partially instilled, clamp CVAD and turn tap OFF to alteplase syringe. • The total volume may not be instilled with first attempt; repeat these steps until dose is complete. This may take several attempts. • Consider leaving tap / syringes attached (if safe to do so) and reattempting at 5 minute intervals. • Contact medical team if instillation unsuccessful after 3 reattempts. • On completion of instillation, clamp CVAD, remove 3-way tap, cleanse the hub and allow to dry before attaching a new sterile bung. • Label treated lumen(s) with 'Alteplase – 'DO NOT USE.'
At the end of dwell time: • 'Scrub the hub' and allow to dry. • Using aseptic technique, attach sterile 10 mL syringe and attempt to withdraw alteplase – do not use excessive force when aspirating. • A 5 mL syringe can be used for aspiration if unsuccessful with 10 mL syringe. • If blood aspirate obtained, withdraw at least 3-5 mL and discard (to ensure complete removal of blood clot and alteplase). • Check if discard is required for microbial culture with treating medical team / Infectious Diseases team. • Flush with 10-20 mL of sodium chloride 0.9% using pulsatile technique. • Change bung. • Resume CVAD use or lock with prescribed locking solution (e.g., heparin in the appropriate strength in sodium chloride 0.9% / TaurolockHep100®)
If patency not restored: • Leave for a further 60-120 minutes or overnight. • A second dose may be considered after consultation with medical team. • Document interventions and outcomes in patient notes and CVAD Daily Assessment record (MR852). • Consider other causes of catheter occlusion.

Procedure: Administering Alteplase
• Refer to CVAD CNS / Afterhours CNS if unable to restore patency.

Appendix 13: CVAD - Related Venous Thrombosis

Key Points

- Reduced functioning of the CVAD can be an early sign of thrombus formation. Early recognition and prompt management can prevent adverse patient outcomes including infection and venous thromboembolism. Refer to clinical practice guideline Primary Prophylaxis of Venous Thromboembolism (VTE)
- Refer to Haematologist if VTE suspected or confirmed for management.
- The decision to remove a CVAD due to thrombosis is made after consultation with the Haematologist, Radiology and the treating medical team.

Potential cause of venous thrombosis

Thrombosis occurs when a blood clot develops in the vein around the catheter causing stenosis and obstruction of blood flow.

Risk Factors[4,33,34]

- Trauma and irritation of the vein leading to thrombi formation and narrowing or occlusion of the venous lumen.
- Patients with an underlying haematological diagnosis
- Migration of catheter tip[34,35]
- Larger diameter catheters and multiple lumens
- Long term CVAD

Signs and Symptoms

- Pain
- Distended veins
- Swelling in neck (upper body catheters) or leg (femoral catheters)
- Reduced perfusion to extremities on affected side.

Actions

- Seek prompt medical attention.
- Radiological imaging confirmation e.g., Ultrasound, Doppler may be required.
- Long term anticoagulation therapy may be required after consultation with Haematologist.
- The decision to remove the CVAD should be individualised. The presence of a venous thrombosis is not an absolute indication to remove a well-functioning CVAD in certain circumstances and may be associated with further complications.
- Complete a Clinical Incident Report via Datix CIMS

Appendix 14: CVAD-Related Air Embolism

Key Points

- Air embolism is a medical emergency – call **55 Code Blue Medical** if suspected.
- Prevent air embolism by ensuring all CVAD connections are secure, manipulation is minimised, and safety precautions are implemented during line changes and CVC / PICC removal procedures.
- Early recognition of signs and symptoms of air embolism is vital to prevent adverse patient outcomes.

Potential Causes of Air Embolism

- Caused by an inadvertent bolus of air entering the vascular system.
- Situations where this can occur include:[4]
  - Insertion and removal
  - Accidental disconnection between catheter and connections
  - Unclamped line during bung / administration set changes.
  - Air in IV administration sets
  - Catheter fracture

Signs and Symptoms

- Sudden onset of respiratory distress.
- Chest / shoulder pain.
- Change in neurological status / loss of consciousness / agitation.
- Palpitations; hypotension

Procedure: Accidental Disconnection of an Infusion Line from a CVAD
• Immediately clamp the catheter as close as possible to the insertion / exit site and stop any infusions. Where practical observe hand hygiene and use aseptic technique. **If bleeding back has occurred** and there is no visible damage to the catheter. • Clean end of catheter hub with 2% chlorhexidine gluconate in isopropyl alcohol 70% swab (or alternative in the case of allergy) and allow to dry. • Flush the line with 10 mL of sodium chloride 0.9% using pulsatile positive pressure technique and place a new needle-free device on lumen. • Prepare a new infusion and administration set using aseptic technique.

Procedure: Accidental Disconnection of an Infusion Line from a CVAD
• Document event on CVAD and Midline Daily Assessment Record (MR852) and in the patients' notes. • Monitor patient for signs of infection: 4 hourly temperature, pulse, and respiratory rate monitoring for 48 hours.
If bleeding back has *not* occurred: *there is a risk of air embolism.* • Clamp line immediately close to insertion / exit site as possible • Call for immediate assistance. • Remove pillows, place bed flat and turn patient on left side. • Clean catheter at point of disconnection with chlorhexidine 2% in isopropyl alcohol 70% swab (or alternative in the case of allergy) and allow to dry. • Attach a sterile 10 mL syringe and aspirate line until blood has been drawn. • Observe child for changes in neurological, haemodynamic, and respiratory status. Consider a medical review, MET call, CODE BLUE as indicated by the patient's clinical condition. • Await further instructions for management. • If the infusion is to be recommenced, prepare new infusion and administration set using aseptic technique.
If catheter damage observed e.g., hole or break. • Clamp CVAD immediately between damaged portion and the point of catheter exit/entry. • Cover the hole / break with sterile gauze or alcohol swab. • Call for immediate assistance and place patient in position stated above. • Do not attempt to flush or aspirate and await medical instruction. • Complete a Clinical Incident Report via Datix CIMS

Appendix 15: Use and removal of Subcutaneous Anchor Devices

securAcath®

The Only Subcutaneous Catheter Securement Device
For The Life Of The Line

Placement

Care & Maintenance

- Gently lift the catheter and SecurAcath device to clean around the catheter insertion site – 360° cleaning site
- Do not twist or rotate the SecurAcath from original position
- Use saline soaked gauze to remove blood from SecurAcath
- Include suture wings / hub of the catheter under the dressing
- Clean site and dress as per hospital policy

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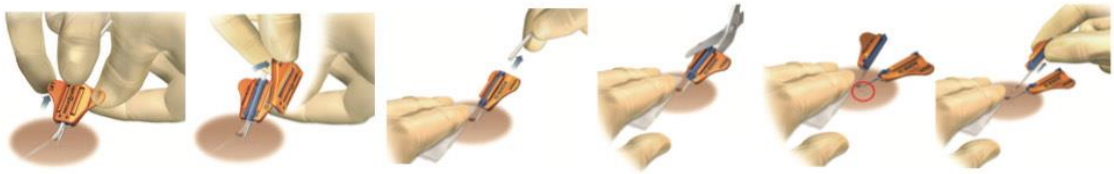
Removal

Fold Option: Can be used with or without catheter in place

Split Option: Catheter must be removed prior to using this method



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Appendix 16: CVAD Associated Skin impairment Algorithm

Immediate Allergic Reaction

I.e. Urticaria, angioedema, cough, anaphylaxis

Treat and report allergic reaction (refer to PCH Anaphylaxis guideline and Allergy and Adverse Drug Reaction Management policy)

Urgent referral to **Immunology**

Figure 1: Reaction to chlorhexidine with alcohol

Try 2% chlorhexidine without alcohol

↓

No improvement?

Try Povidone Iodine

↓

No improvement?

Try sterile sodium chloride 0.9%

Document solution used on MR852.

Localised Cutaneous Reactions

I.e. skin colour change, red, dry, irritated, raised skin lesions (macules, papules, vesicles, bullae), itching & burning.

Refer to **Dermatology** for consideration of patch testing if:

Severe, history of significant reaction, or multiple events with likely ongoing need.

If positive: Report as allergy

Skin Injury

I.e. stripping, skin tears and blisters

Weeping/ Oozing

(Non-Infectious)

Assess colour, amount, consistency, odour and location of exudate.

Exit site infection.

Redness (erythema), induration (hard) and/or tenderness within 2cm of the catheter exit site; possibly with other signs of infection, such as fever, purulent discharge at exit site, associated blood-stream infections.

Skin Irritation/Contact Dermatitis

Rule out infiltration, extravasation, thrombophlebitis & other skin conditions (e.g eczema)

Identify and avoid suspected irritant:

- Change type/concentration of cleansing solution (**see Fig 1**)
- Ensure solution and barrier film (e.g. Cavilon™) are allowed to dry fully before dressing application
- If no resolution, change brand/type of dressing. (see CVAD Basic Dressing Selection Guide)
- NB: Prescribed topical agents: lotions only under dressings, creams to be applied away from dressings.

Consider non-alcoholic antiseptic and barrier film.

Foam dressing (e.g. Mepilex® Lite) over injured area.

Assess irritated skin every 24 hours, monitor for signs of infection.

Control bleeding: pressure at site

Apply barrier film and absorbent foam dressing (e.g. Mepilex® Lite)

Consider alginate dressing and/or Haemostatic agent beneath dressing (Redress in 24 hours)

Acute Onset

- Culture site and blood cultures
- Silver impregnated dressing (such as Mepilex® Ag) whilst awaiting cultures.
- If S.aureus confirmed continue silver impregnated dressing
- If no growth, apply foam dressing (e.g. Mepilex® Lite)

Chronic/Persistent

If skin injury related to exudate and irritation, consider non-alcoholic antiseptic and foam dressing (e.g. Mepilex® Lite).

- Educate Parents/caregivers and staff on proper dressing selection, atraumatic application, removal and site care.
- Identify patients at risk and take precautions with site care (manage treatable causes: dehydration/malnutrition etc.)
- Wound Management Plan

References:

1. Broadhurst D., Moureau N., Ullman A.J. et al. Management of Central Venous Access Device-Associated Skin Impairment: An Evidence-Based Algorithm. *J Wound Ostomy Continence Nurs.* 2017 May; 44 (3): 211-220.
2. Nickel, B., Gorski, L., Kleidon, T., et al. Infusion Therapy Standards of Practice, 9th Edition. *Journal of infusion nursing. 2024 Jan; 47*(1S Suppl 1), S255.