GUIDELINE	
Central Venous Access Devices (CVAD) and Midline Insertion and Management	
Scope (Staff):	Nursing and Medical staff
Scope (Area):	Perth Children's Hospital

This document should be read in conjunction with this DISCLAIMER

Contents

Aims

The aim of this guideline is to provide recommendations for insertion and management of CVADs and midlines with regards to:

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

Background

Central venous access devices are used for a wide range of intravenous therapies in the inpatient and home setting. CVADs and midlines are inserted in the Operating Theatres and at the bedside in the Paediatric Critical Care unit. 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. 2010.[2]
- Australian New Zealand Intensive Care Society (ANZICS). Central Line Insertion and Maintenance Guideline. 2012.[3]
- Infusion Therapy Society (INS) Standards of Practice.2016[4] and,
- Centre for Disease Control (CDC) Guidelines for the Prevention of Intravascular Catheter-Related Infections. 2011.[5]

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 stay and are extremely costly to the health system. Common complications for CVAD include: blockage, dislodgement and infection.[6] Importantly, central line associated blood stream infections (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.

Scope

This guideline should be used for the insertion and management of central venous access devices and medium-term 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 training program or has appropriate 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 apply, 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 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

Central Venous Access Devices (CVAD)

A CVAD is defined as an intravascular catheter that terminates in the great vessels at or near the heart (lower superior vena cava or inferior vena cava). This includes tunnelled or untunnelled central lines/central venous catheters (CVCs), surgically implanted CVADs (e.g. Infusaport), pulmonary artery (PA) catheters, PA catheter sheaths, dialysis/haemofiltration catheters and peripherally inserted central catheters (PICCs).

CVADs may be inserted centrally (central line, CVC, Infusaport, PA catheter/sheath, dialysis/haemofiltration catheter) or peripherally (PICC) in a patient. The location of the insertion site and the type of device inserted does not determine whether a line is a central venous access device – the location of the catheter tip in the lower superior vena cava or inferior vena cava determines whether a line is a CVAD.

Untunnelled CVADs are for short term use and emergency situations. The ongoing clinical need for these devices should be reviewed on a daily basis to minimise the risk of infection or complications, and untunnelled CVADs should be removed at the earliest possible time and are not suitable for outpatient settings. Examples of untunnelled CVADs include CVCs, and Vascaths for short term haemodialysis.

Tunnelled CVADs can remain in situ for months to years. The difference between tunnelled and untunnelled CVADs is that tunnelled CVAD catheters are tunnelled subcutaneously from the vein insertion site to the catheter exit site (usually in the anterior or anterolateral chest wall). Some tunnelled CVADs inserted 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. Examples of tunnelled CVADs include Hickman™ lines, Broviac™ lines and some longer term haemodialysis catheters.

Implanted CVADs (also known as Ports/ Infusaports) are long term CVADs that can remain in place for years. These CVAD 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. Ports are accessed with a non-coring needle that is inserted through the skin and into the port chamber for venous access.

Midline catheter - A midline catheter is a long peripheral intravascular device with the catheter tip terminating in a large peripheral vein. Midline catheters are not central venous access devices and only therapies suitable for peripheral administration can be given via this option. 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. Given the dwell time can be up to a few weeks, it has been included in this guideline for insertion recommendations in keeping with CVADs.

Abbreviations	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

Key Management Principles

1. 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]
2. The use of hand hygiene, maximal barrier precautions (sterile gown, cap, gloves and full body drape) and skin antisepsis with chlorhexidine-alcohol preparations[7] for all insertion of CVADs. [Level I] [3,4,8]
3. 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]
4. Perform hand hygiene prior to all CVAD and midline interventions [Level III][3]
5. 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 to cleanse skin during dressing changes and prior to inserting port needles [Level I] [4]
6. Correct flushing and administration techniques to maintain line patency and prevent line rupture by:
    - Using only 10mL 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]
7. Provide adequate patient/carer education and support to maintain optimum patient safety [Level V].

[NHMRC Levels of evidence]

Vascular Access Device Referral

- Refer to for the Vascular Access Device Selection Pathway in Appendix 2.[10]
- All referrals for CVAD and midline insertions are to be made by submitting an e Referral to Anaesthetic Department, subspecialty CVAD.
- All patients undergoing CVAD insertion require Staphylococcus aureus decolonisation at the time of referral, in accordance with the Guideline for Staphylococcus aureus Decolonisation (Paediatric), accessed via the CVAD Information Hub. For urgent insertion, decolonisation should occur as close to the time of insertion as able and for a total of five days.
- ***All requests for vascular access need to be discussed with and authorised by the primary Consultant Physician treating the patient prior to contacting the relevant teams for insertion.***
- Please note that under normal circumstances, CVAD insertion will not be performed after-hours but will be arranged according to clinical urgency for the next available time slot during normal working hours (e.g. next PICC list or on the Theatre Emergency list the following weekday).
- If a patient is admitted with a CVAD in situ, the conditions under which it was inserted should be reviewed by the admitting team and referral made to the CVAD team for ongoing support with management. This may include patients being admitted to the ward from the Emergency Department or another hospital institution, particularly if a resuscitation situation necessitated expedited central venous access.

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 conscious 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

- To facilitate compliance with this guideline, all equipment requirements for this procedure should be co-located and mobilized 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 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 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 ≥0.5% chlorhexidine gluconate in 70% alcohol (unless contraindicated) and allowed to dry completely.[2,5,7,13] If chlorhexidine is contraindicated, use 10% povidone iodine in alcohol [1]. Soap and water cleaning may be required prior to chlorhexidine if the insertion site is particularly soiled.

5. Large drapes should be used to cover the whole patient other than the insertion site and 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 ≥0.5% chlorhexidine gluconate in 70% alcohol, 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) (i.e. 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]
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 ≥0.5% chlorhexidine gluconate in 70% alcohol.

Insertion Documentation

1. 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 chlorhexidine antisepsis. File this record in the patients' notes.
2. For all CVADs (including Midlines), the CVAD Data sheet (pink form) should be completed by the proceduralist and returned to the anaesthetic department 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 CVC or surgically implanted CVAD) until the correct catheter tip position is confirmed. In an emergency situation the 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'. In general, surgical CVADs will require postoperative x-rays upon return to ward and PICC lines and all radiologically inserted devices will not.
- Midlines do not routinely require an x-ray to confirm tip position.
- The ideal catheter tip position for any CVAD is either the inferior portion of the Superior Vena Cava (SVC) for upper body CVADs or Inferior Vena Cava with lower body CVADs. 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. Optimal positioning reduces catheter complications.
- 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. Please note that the 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.
- Ensure you 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 PICC lines inserted into the upper arm and certain arm movements. Vomiting and/or coughing episodes can 'flick' the PICC tip from the SVC up into the brachiocephalic 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 relevant team who performed the device insertion.
- 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 re-X-ray a CVAD with each subsequent admission, but 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 and should only be replaced if clinically indicated.[2,5,17]
- 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.
- 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 Consultant Surgeon 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 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 'To-Keep-Vein-Open (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.
- Asses 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 normal saline prior to use, determine the ease of flushing and any partial through to full obstruction (aka '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 1 Quick guide to complications and actions for the suggested management of CVAD associated skin impairment.
- Dressings and sutureless securement dressings 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]
- Sutureless securement devices (i.e. Statlock™, Griplok™ 3M PICC/CVC Securement Device™) reduce the risk of infection and dislodgement for PICC and midlines. For instructions on application and removal refer to Dressing Change Procedure (Appendix 5).
- The use of Chlorhexidine gluconate-impregnated (CHG) dressings (i.e. 3M Tegaderm CHG IV Securement Dressing, Biopatch disk™) is recommended to reduce the incidence of CRBSIs 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 (i.e. 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 CHG impregnated disks (Biopatch™). For instruction on application and removal refer to Dressing Change Procedure.
- Tissue adhesive (TA) (Histoacryl™, Dermabond™) may be applied to CVADs at the insertion site and/or the hub/stabilisation wings. Tissue adhesive 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 0.9% sodium chloride to remove debris.
    - 2% chlorhexidine gluconate (CHG) in 70% isopropyl alcohol is recommended for optimal skin antisepsis for needle insertion and dressing change procedures.[20, 5,22]
    - 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 CHG is sufficient: applying multiple layers and inadequate drying before applying dressings can increase the risk of skin irritation and chlorhexidine sensitivity.[25]
    - 10% Povidone iodine 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

- Prior to accessing the line, swab the needle free access bung with 2% chlorhexidine gluconate in 70% alcohol swab 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 0.9% saline first to determine 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 saline flush syringes where possible in preference to drawing up saline from ampoule with syringe and needle.
    - All sizes of the prefilled syringe (i.e. BD™ 3mL, 5mL, and 10mL) can be used with CVADs and midlines as they all have the same diameter as a 10mL syringe.
- Use a separate syringe for each flush.

Flushing technique [4,9,26]

- Use a **pulsatile technique** (aka ‘push-pause’ and ‘start-stop’) with every saline 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 (i.e. MaxPlus™): clamp *after* syringe disconnection.
    - Negative-displacement needleless connector (i.e. Smart sites, 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 (i.e. MaxZero™): 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

- 0.9% sodium chloride 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 infusions via a pump, consider the volume required to clear the administration set and additional add-on devices (e.g. 3-way taps, Y-connectors)
- 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 - 20mL (10mL fluid restricted)
On completion of lipid containing TPN	10 –20mL (10mL 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' ('KVO')

- 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.
- 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 medical officer is to prescribe a compatible fluid and the rate on a fluid order form. As a *general* guide: **3 - 5mL/hr** should be sufficient for most patients and devices.
- Consult with medical team if rate needs to be adjusted to prevent reflux of blood into the infusion line and ensure 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.
- 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] The heparin content is 100 units per mL, please see ChAMP guidelines:
    - TaurolockHep100® prophylactic lock for central venous access devices
    - TaurolockHep100® Monograph for 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 heparinised-saline or other lock solution.
- 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 heparinised saline, TaurolockHep 100®, Alteplase or any other de-clotting agent, contact the CVAD CNS/Anaesthetist 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 both CLABSI and occlusion. To promote consistent practice, the MaxZero™ is 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:

Solution	Change interval	Additional Information
Crystalloid solutions	7 days [28]	e.g. glucose/saline hydration fluids; non-lipid parenteral nutrition
Lipid solutions	24 hours [4,5,29]	Flush line with 10-20mL 0.9% sodium chloride every 24 hours when changing TPN / lipid lines.
Blood Products	Discard at end of infusion or at least every 12 hours	Flush line with 10-20mL 0.9% sodium chloride post infusion. Refer to Transfusion Protocols

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.
- 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 0.9% sodium chloride 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, 3mL discard is recommended with 5mL 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 5mL syringe may be used for aspirating blood if having difficulty with a 10mL 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 PIVC Insertion and Maintenance guideline using aseptic technique. 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).

  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 Referral Form.

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 includes 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 2% chlorhexidine gluconate/70% alcohol
    - Plastic non-serrated clamps
    - Spare sterile bung
    - Posiflush® saline 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.

Related Policies, Procedures and Guidelines
Alteplase Monograph for Administration
Aseptic Technique (CAHS Infection Control Manual)
Aseptic Technique in the NICU
Hand Hygiene (CAHS Infection Control Manual)
Labelling of Injectable Infusions and Fluids
Oral Conscious Sedation
Perioperative Scrubbing, Gowning and Gloving protocol (Aseptic Technique)
Peripheral Intravenous Cannula (PIVC) Insertion and Maintenance
Sepsis Management (Emergency Department Guideline)
Sharps Management Policy (CAHS Infection Control Manual))
TaurolockHep100® prophylactic lock for central venous access devices
TaurolockHep® ChAMP Monograph for Administration
Transfusion Protocols
Guideline for Staphylococcus aureus Decolonisation (Paediatric)

Resources (please see the Central Venous Access Information Hub)
CVAD e-Referral Form & How to Refer and Book a CVAD
Staff Training / Education: CVAD Staff Training Package for Nursing Staff (access via the iLearn webpage) The Vascular Access Education Framework (PNE) Bundles of Care for Safe Insertion Bundles of Care for Safe Maintenance
Family Education: CVAD Family Education & Training Resources (Central Venous Access Information Hub) PCH CVAD Care Video for Families
Health Facts: Radiological Insertion of a CVAD PICC Insertion Information;

Resources (please see the Central Venous Access Information Hub)

Care of PICC;

Care of a Tunnelled Line

Care of an Implanted Device

Staphylococcus aureus decolonisation

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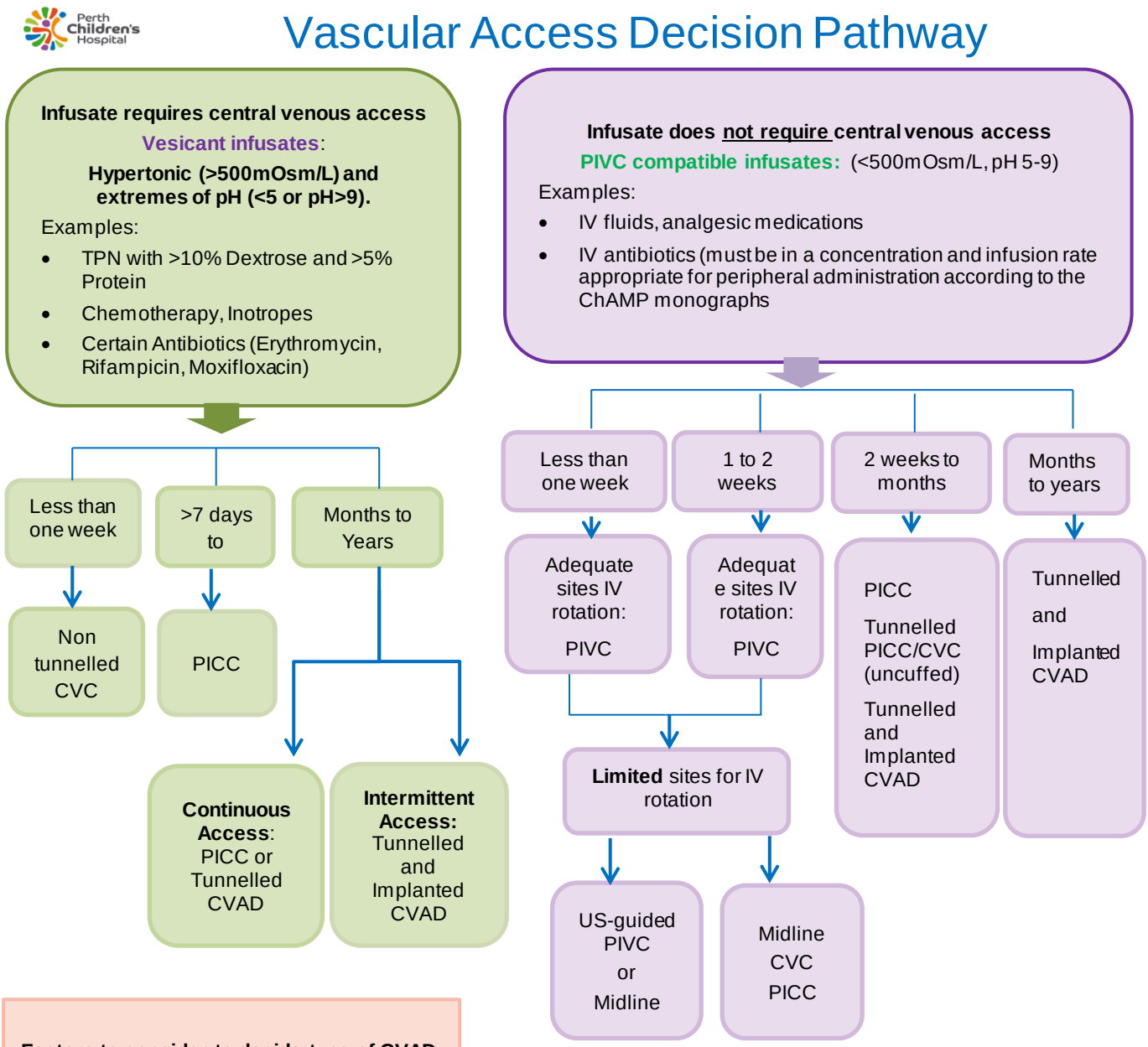
Appendix 1: Quick Guide to Complications and Actions

Possible complication	Signs / Symptoms may include	Possible actions
Pneumothorax **Haemothorax** **Hydrothorax**	Respiratory and/or cardiovascular deterioration in the post-operative period [*unlikely following PICC insertions however, 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 Cytotoxic/Biotherapy Agents: Extravasation procedures*
• 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.

Possible complication	Signs / Symptoms may include	Possible actions
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.
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 Lesions (macules, papules, vesicles, bullae) Burning Itching Pain/discomfort	• Refer to existing, or initiate, wound management plan (consider photography with consent) • See the Management Guide for CVAD Related Dressing and Antiseptic Reactions available on CVAD Information Hub • 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



Factors to consider to decide type of CVAD for patients:

1. Infusate characteristics
2. Expected duration of treatment
3. Patient factors (Age/Weight/Comorbidities/preferences)
4. Indications: Difficult IV Access (DIVA) and requirement for blood draws
5. Procedural management considerations of child
6. Vein status/Venous health – any known abnormalities (thrombosis or stenosis)
7. Medical history/chronicity of disease/course – includes need for multiple CVADs in future
8. 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

PPE equipment (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)

0.9% sodium chloride sterile ampoules (x2)

3 way tap & needle-free bung/s

Drawing up needle(s)

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

Skin protection wipe (e.g. Cavillon®)

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

± Heparinised-saline/TaurolockHep100 ampoule

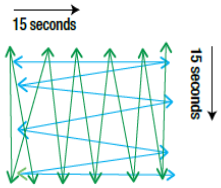
Procedure: Needling an Implanted Device

1. **Prepare Patient**
• Plan and implement age appropriate procedural pain/comfort measures:
  ○ Apply topical anaesthetic cream 45-60 minutes prior to needle insertion
  ○ Utilise 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
• 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.

Procedure: Needling an Implanted Device

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 0.9% sodium chloride
   - Clamp the line

3. **Cleanse the skin:**
   - Apply friction and use a back and forth direction using 2% CHG/70% alcohol swabstick:
     - use opposite sides of swab stick for each direction or a separate swab stick



   - Clean area of skin extending 1- 2cm 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 90º angle pushing firmly through the skin until tip touches bottom of portal chamber.
   - Do not rotate once in situ

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.

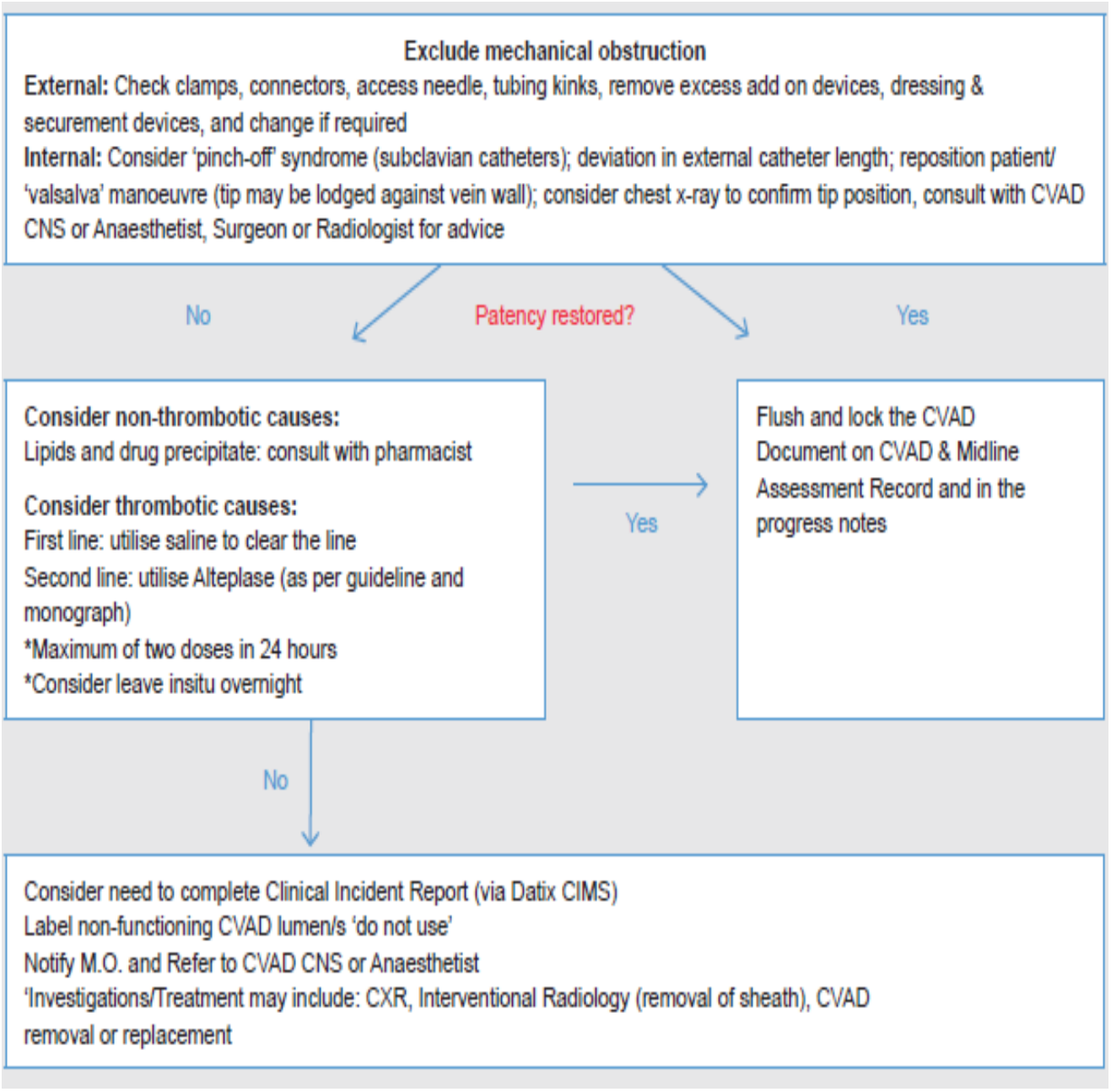
6. **Check line patency:**
   - Release clamp and/or turn the 3-way tap on to the syringe.
   - Aspirate the line using a 10mL syringe: withdraw heparin lock/TaurolockHep100 (2-3mL in most cases) and discard.
     - Obtain blood samples at this time if required.
   - Flush with 10-20mL 0.9% sodium chloride

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, lifting arm can facilitate aspiration,
   - If still unable to withdraw blood – seek senior nurse/CNS-CVAD or medical review

Procedure: Needling an Implanted Device
8. **Documentation** • Complete CVAD Daily Assessment Record 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 solutions using aseptic technique as per Peripheral & Central Intravenous Therapy Protocol • Cease infusion if in progress, clamp extension set and disconnect IV administration set using non touch technique. • Scrub the needle-free bung with 2% CHG/70% alcohol swab and allow to dry • Using pulsatile, positive pressure technique, flush port with 10-20mL 0.9% sodium chloride • Lock the line with heparinised-saline/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 chlorhexidine/alcohol swab 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.

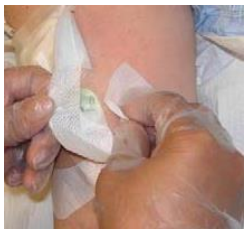
Equipment

- Dressing trolley / sterile dressing pack / waste bag
- PPE: apron; gloves (non-sterile and sterile)
- Skin cleansing swab stick/s and swab pad/s: 2% CHG/ 70% alcohol (consider povidone-iodine for patients with sensitivity)
- 0.9% sterile sodium chloride
- Gauze swabs ± sterile cotton tip applicators
- Skin protection wipe (i.e. Cavillon)
- Adhesive removal wipes or spray (i.e UniSolve, Niltac)
- Large transparent semi-permeable dressing (i.e. Tegaderm IV Advance)
- ± Sutureless securement device (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 • Note and record external length of catheter if applicable
4. Prepare Equipment: A large aseptic field is required for dressing changes. • Wash hands • Clean dressing trolley with detergent wipe and gather equipment. • Open dressing pack onto trolley and prepare equipment using non touch technique. • Repeat hand wash and put on apron & gloves

Dressing Change Procedure

5. Remove transparent dressing carefully and dispose into waste bag



- Adhesive remover wipes, spray or alcohol wipes can assist with dressing removal - never use scissors to remove the dressing.
- Inspect securement device (where applicable) 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.
- Chlorhexidine gluconate (CHG) impregnated dressings require sterile normal saline for easy removal
- Integrated securement dressings (i.e. SorbaView™) locate the v-notch on outer edge of closure piece and pull apart in opposite directions to break centre perforations.

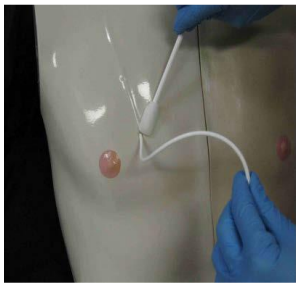
6. Repeat hand washing and put on sterile gloves.

7. Cleanse the skin: If visibly soiled clean the skin with 0.9% sodium chloride first and dry with sterile gauze.

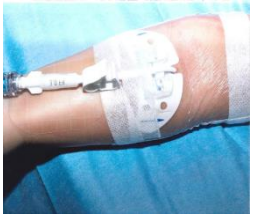
- Consider taking a wound swab collection if exudate present.

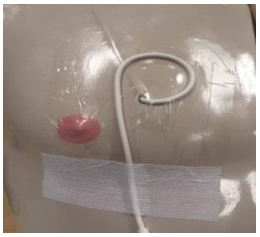
8. Hold and support the catheter close to the insertion/exit site in non-dominant hand with a sterile gauze swab.

9. Following cleanse with sterile normal saline, cleanse the skin with 2% CHG/70% alcohol swab stick (or povidone iodine for patients with sensitivity). For preterm infants refer to Aseptic Technique in the NICU)
10. Using friction and a circular motion cleanse the skin from the insertion/exit site working outwards and extending beyond the area of the dressing.
11. **Allow the skin dry**.



12. Clean the length of catheter from the insertion/exit site to end of hub with a separate chlorhexidine/alcohol swab.
13. Apply skin protection to area beneath the dressing where appropriate, avoiding direct contact with insertion/exit site
14. Apply new securement device if applicable.
15. Apply transparent dressing, covering the insertion site and securement device if present.



Dressing Change Procedure
16. 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. 
17. Document dressing change on the CVAD Daily Assessment Record MR852 and schedule next dressing change date. • 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 and/or CVAD Daily Assessment Record.

Equipment

Dressing pack

PPE: Apron/ gloves; goggles (if risk of blood splash)

Adhesive tape remover

Cleansing swabs or solution: 2% chlorhexidine gluconate in 70% isopropyl alcohol

Sterile occlusive dressing: (e.g. Tegaderm®)

± stitch cutter (if catheter secured with sutures)

± sterile scissors (if catheter tip required)

± specimen container

Procedure
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.
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) o If sutures present lift away from the catheter with forceps and cut the suture away from the catheter. 9. Cleanse the skin with 2% CHG/ 70% alcohol swabs and allow to dry.
10. If catheter tip required for culture, wash hands and don sterile gloves and/or use sterile forceps to remove the catheter. 11. Ask patient to perform Valsalva's manoeuvre if cooperative or ask patient to hold their breath during removal: o If child is crying/unable to follow instruction remove the catheter on expiration

Procedure
12. Hold sterile gauze over the insertion site and using gentle even pressure, slowly withdraw catheter 13. If resistance is felt, pause, ask patient to turn head and try again. ○ If resistance is still encountered contact senior medical or nursing staff. ○ **Do not use force**
14. Once catheter removed apply continual pressure over the exit site until haemostasis is achieved. 15. Apply occlusive dressing and leave in place for 24 hours. 16. Observe the site for bleeding for a minimum of 4 hours. 17. Check the catheter integrity following removal to ensure no remnants are left behind (refer to catheter length on insertion record)
If catheter tip is required for culture: 18. Catheter tip (last 2-3 centimetres) is only sent for microbiological culture if clinically indicated i.e. unexplained fever, significant erythema or exudate at the insertion site. ○ Once catheter removed from patient, ensure the tip does not become contaminated e.g. by hands, clothing, bedding ○ Using sterile scissors cut the last 2-3cm of the catheter and place directly into the specimen container. ○ Label specimen with patient details and send with pathology request form to Microbiology
• Document Removal on the CVAD Insertion and Removal Record MR852.01 and/or CVAD Daily Assessment Record and in the patient notes.

Appendix 7: CVAD Flushing and Locking Guide

Considerations:

- Rationalise volumes of 0.9% sodium chloride for fluid restricted patients
- Rationalise heparin for patients with haemophilia - sodium heparin **10 units/mL** is recommended.
- Maximise flushing following lipid infusions and blood sampling, a minimum of 10mL 0.9% sodium chloride is recommended.
- Flush devices with 0.9% sodium chloride *prior* to instilling lock solution.
- To make strength of sodium heparin **100units/mL**: Dilute 1mL of 5000units /5mL heparin with 9mL of 0.9% sodium chloride. Aspirate and discard prior to flushing CVAD
- TaurolockHep100® is recommended for patients at increased risk of CLABSI (Oncology; home Parenteral Nutrition). Refer to ChAMP guidelines and monograph.
- PICC in outpatient settings: Weekly flushes may be appropriate (balance risks vs. benefits); consider either sodium heparin **10 units/mL** or TaurolockHep100® (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 0.9% sodium chloride	Sodium heparin **10units/mL** **Daily**
PICC	1 mL	3-5 mL 0.9% sodium chloride	Sodium heparin **10units/mL** **Daily**
Non-tunnelled "CVC"	1 mL	3-5 mL 0.9% sodium chloride	Sodium heparin **10units/mL** **Daily**
Tunnelled "Broviac"	2 mL	5-10 mL 0.9% sodium chloride	Sodium Heparin **100units/mL** *or* TaurolockHep100® (heparin 100 units/mL) **Weekly**
Implanted	2 mL	10-20 mL 0.9% sodium chloride	Sodium Heparin **100units/mL** *or* TaurolockHep100® (heparin 100 units/mL) **Monthly**

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 (consult with pathology or the PathWest test directory where uncertain).

Equipment

Cleaned blue tray or dressing trolley

10mL sterile syringe

± Luer lock vacuum blood collection device (e.g. BD Vacutainer)

Blood collection tubes/bottles

2% chlorhexidine (CHG)/70% isopropyl alcohol swabs

10mL 0.9% sodium chloride

Personal protective equipment (apron, gloves, ± goggles if risk of blood splash)

± Heparinised saline, 10mL sterile syringe, drawing up needle

± Sterile needle-free bung

Blood Sampling Procedure
Confirm patient identification with the blood specimen request form. Check volume of blood required for requested specimen/s. Perform hand hygiene and prepare equipment using aseptic technique Don personal protective equipment. Cease infusions if in progress and clamp line (if appropriate to do so) Vigorously scrub the needle-free access device with 2% CHG/70% alcohol swab for 20 seconds and allow to air dry.
Syringe method: 1. Holding the end of the CVAD lumen with a new swab or sterile gauze, attach sterile 10mL luer lock syringe to hub or needle-free device and unclamp line.

Blood Sampling Procedure

2. Slowly retract plunger to withdraw blood (3-5mL 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 5mL syringe (a smaller syringe will exert less *negative* pressure and may prevent catheter collapsing on aspiration).
3. Attach new syringe and gently withdraw required volume of blood.
4. Remove syringe and swab the needle-free device with alcohol swab and allow to dry.
5. Flush the catheter with at least 10mL 0.9% sodium chloride using pulsatile, positive pressure technique.

6. Lock the line with heparinised-saline or resume infusions.
7. Transfer blood to appropriate collection bottles/tubes preferably using a blood transfer device if appropriate
8. Label blood specimen/s with patient details and write which lumen used.
9. Send to laboratory in biohazard specimen bag with blood request form.

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

1. Can only be used on CVADs with adequate and brisk blood flow.
2. Attach luer-lock blood collection device to new needle-free bung and rotate clockwise to lock in place.

3. Insert discard blood collection tube (brown top) first in the centre of the holder – allow blood to flow into the tube (3-5mL is sufficient discard in most cases).
4. Remove discard tube and dispose into sharps waste container.
5. 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.
6. Remove sample tube/s and gently invert 8-10 times
7. On completion of sampling remove the collection device by turning anti-clockwise, dispose directly into sharps waste container.
8. Swab needle-free device with alcohol wipe and allow to dry
9. Flush CVAD with 10mL 0.9% sodium chloride using a pulsatile technique.
10. Lock with heparinised-saline if required or continue infusion.
11. 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 central-line associated blood stream infection (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, anti-biotics 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 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, 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 pharmacy protocol for management of non-cytotoxic extravasation (*in development)*
- Recognising the early signs and symptoms of infiltration/extravasation is essential to minimise tissue damage.

Potential causes [4,33] [4]

- 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
- excessive intraluminal pressure e.g. administering medications with a small gauge syringe

Signs/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

1. Cease infusion(s)/injection immediately and disconnect from CVAD (keep bag/syringe and administration set to assess amount of drug/fluid infused).
2. **Do not flush**
3. If limb affected, elevate and immobilise
4. Mark and measure the area of skin affected
5. Attempt to aspirate any residual drug from the CVAD
6. Refer to treating medical team urgently – a referral to the plastic surgeon may be warranted
7. Leave Infusaport needle in situ until further treatment confirmed

8. Liaise with pharmacist and treating medical team for appropriate treatment e.g. heat/cold compress, antidote. Refer also to Extravasation of Cytotoxic/Biotherapy Agents and the Oncology/Haematology Unit for management advice.
9. Document incident and all actions taken in the patients notes
10. Complete a Clinical Incident report via Datix CIMS
11. Consider medical imaging of affected area.
12. Liaise with CNC Stomal and Wound Therapy 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/ symptoms:

- Reduced external catheter length (more common with PICC) associated with:
    - acute respiratory distress,
    - chest tightness,
    - tachycardia,
    - hypotension,
    - 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: Syringe can be obtained from the 3C unit. It is stored frozen and once thawed should be used immediately. Record patient details on the alteplase log for Auditing and Quality Assurances purposes.

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 2mg in 2mL is supplied frozen from pharmacy in a pre-prepared 10mL syringe.
- Maximum dose per instillation: 2mg
- Maximum total dose in 24 hours: 4mg

Prescribing

- A medical officer is to prescribe the Alteplase dose in milligram (mg) on the once only section of the pNIMC.

1. 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 2mg) and to the nearest *measurable* dose.
2. If known catheter volume is greater than 2mL prescribe 2mg dose diluted in 0.9% Sodium Chloride:

   e.g. Known Broviac volume = 2.4mL
   Prescribed dose = 2mg in 2.6mL 0.9% Sodium Chloride.

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

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

Multiple lumen CVAD:

- If multiple lumens blocked, each lumen can be treated simultaneously with same dose providing the *total cumulative dose* instilled in 24 hours does not exceed 4mg.
  - 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

Prescription chart

Alteplase syringe - thawed

Blue tray – decontaminated with detergent wipe or 70% alcohol

10mL sterile syringe/s

10mL 0.9% sodium chloride syringe

± Heparinised-saline (of appropriate strength in 10mL syringe)

2% chlorhexidine gluconate (CHG)/70% isopropyl alcohol swabs

Disposable gloves

White medication label/s

± 3-way tap

Sterile needle-free bung

Procedure: Administering Alteplase
1. Explain procedure to patient/carer. 2. Adhere to the 6 rights of medication administration. 3. Remove alteplase from fridge to thaw to (or near) room temperature. 4. Wash hands and prepare equipment using aseptic technique. ○ If required, dilute thawed alteplase with 0.9% sodium chloride to required volume
5. Vigorously scrub the CVAD hub with 2% CHG/70% alcohol swab for 20 seconds and allow to dry. 6. Confirm occlusion by attaching 10mL saline syringe and attempting withdrawal. If blood flashback obtained, flush with 5-10mL saline, remove syringe, clamp line and resume use.
7. If occlusion confirmed continue as follows: **Partial occlusion** confirmed: *Ability to flush but sluggish or no blood return.* 7.1 Ensure CVAD is clamped (unless valved CVAD) 7.2 Using aseptic technique, remove bung, cleanse the hub, allow to dry. 7.3 Attach alteplase syringe to catheter hub 7.4 Unclamp CVAD and slowly instill alteplase into catheter – **do not use force** 7.5 Clamp CVAD and remove syringe. 7.6 Attach new sterile bung/cap. 7.7 Label with 'Alteplase - DO NOT USE' 7.8 Leave for 60-120 minutes (optimum time is 120 minutes)[31]

Procedure: Administering Alteplase

8. **Complete Occlusion**: *Inability to infuse or withdraw blood.*

   Use negative pressure /3-way tap technique[32]

   1) Ensure CVAD is clamped
   2) Using aseptic technique remove the bung, cleanse the catheter hub and connect 3-way tap with tap in OFF position to the CVAD.
   3) Attach a sterile 10mL luer lock syringe to one of the ports and the alteplase syringe to the other port as shown.

   4) Turn tap so it is ON to the aspirating syringe, OFF to the alteplase syringe.
   5) Unclamp CVAD and gently pull back on the plunger of the empty syringe to the 3–5ml mark to create a vacuum in the catheter then turn tap OFF to syringe.
   6) Clamp CVAD.
   7) Remove aspirating syringe, expel air and reattach to tap - use new syringe if tip becomes contaminated.
   8) Unclamp CVAD and turn tap so it is ON to alteplase syringe and CVAD.
   9) Allow alteplase to flow into the catheter.
   10) 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 steps 8.4-8.9 until dose is complete. This may take several attempts.
      - Consider leaving tap/syringes attached (if safe to do so) and reattempting at 5minute intervals.
      - Contact medical team if instillation unsuccessful after 3 reattempts.
   11) On completion of instillation, clamp CVAD, remove 3-way tap, cleanse the hub and allow to dry before attaching a new sterile bung.
   12) Label treated lumen/s with 'Alteplase – 'DO NOT USE.'

9. **At the end of dwell time:**

- 'Scrub the hub' and allow to dry.
- Using aseptic technique, attach sterile 10mL syringe and attempt to withdraw alteplase – do not use excessive force when aspirating.
  - A 5mL syringe can be used *for aspiration* if unsuccessful with 10mL syringe
- If blood aspirate obtained, withdraw at least 3-5mL 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 10-20mL 0.9% sodium chloride using pulsatile technique.

Procedure: Administering Alteplase
• Change bung. • Resume CVAD use or lock with Heparinised-saline or other prescribed locking agent.
10. **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 • Refer to CVAD CNS/Duty Anaesthetist 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 a haematologist if VTE is suspected or confirmed for ongoing 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/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 e.g. Ultrasound, Doppler may be required to confirm diagnosis
- Long term anticoagulation therapy may be required after consultation with haematologist.
- The decision to remove the CVAD should be individualized and 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 Clinical Incident Report via Datix CIMS

APPENDIX 14: CVAD-Related Air Embolism

Key Points

- Air embolism is a medical emergency – call 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/ 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
1. 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. 2. **If bleeding back has occurred** and there is no visible damage to the catheter; • Clean end of catheter hub with 2% CHG/70% isopropyl alcohol swab and allow to dry. • Flush the line with 10mL 0.9% sodium chloride using pulsatile positive pressure technique and place a new needle-free device on lumen. • Prepare a new infusion and administration set using aseptic technique. • Document event on CVAD management record and in the patients' notes. • Monitor patient for signs of infection: 4 hourly TPR for 48 hours

Procedure: Accidental Disconnection of an Infusion Line from a CVAD
3. **If bleeding back has *not* occurred: *<u>there is a risk of air embolism</u>*** • 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 2% CHG/ 70% alcohol swab and allow to dry. • Attach sterile 10mL 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.
4. **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