

Central Line Insertion

Study Guide

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1. Introduction

1) Purpose of the training

The training has been created in response to:

- Learning from Serious Incidents and Patient Safety Incidents.
- A coroner notification to Medical Schools and GMC that adequate core knowledge and supervision should be obtained before junior doctors (or medical students) perform procedures on patients, particularly those relating to CVC insertion devices.

The Central Venous Catheter (CVC) is a catheter with a tip that lies within the proximal third of the superior vena cava, the right atrium or the inferior vena cava.



2) Target Audience

- There are multiple specialties which are involved in procedures using guidewire techniques for CVC insertion devices.

- This module is aimed at doctors in post-foundation level training, namely core and specialty training posts or equivalent.

- This module can be used by doctors in the Foundation Programme for learning; however, the procedure is not necessary for the Foundation Programme.

- The skill may be obtained in particular specialties, e.g. intensive care medicine at FY2 level, but the learner must be appropriately supervised.

- It is the responsibility of the doctor carrying out the procedure to ensure that they have the correct level of skill and supervision to undertake it.

3) Ethical Guidance

Guidance for supervisors

You must make sure that all staff you manage have appropriate supervision.

When you do not provide your patients' care yourself (for example, when you are off duty), or you delegate the care of a patient to a colleague, you must be satisfied that the person providing care has the appropriate qualifications, skills and experience to provide safe care for the patient.

Guidance for the learner

The learner must:

- Recognise the limits of their own professional competence and only practise within these.
- Only obtain consent for procedures which they are competent to perform, in accordance with GMC regulations.

4) National Safety Standards

In September 2015, NHS England published a set of National Safety Standards for Invasive Procedures (NatSSIPs) to be modified for local use to produce Local Safety Standards for Invasive Procedures (LocSSIPs), which Imperial College Healthcare NHS Trust has done for adult CVC insertions.

This is a mandatory change in the procedure of CVC insertion for all staff in all areas, and **must be performed with the help of an assistant (Wire Buddy)**. This assistant should be focused and free of other tasks during this high-risk and invasive procedure. Protection from common human factors, such as distraction from interruption or noise, are an important role of the assistant. They are also key to the verbal and visual confirmation of guidewire removal.

The LocSSIP checklist must be used step by step at the bedside, as the procedure is undertaken as a cognitive aid. The completed form must then be kept in the notes.

Select the **play buttons** below to watch demonstrations of the checklist in use at the start and end of the procedure. You can close the video by clicking on **X** at the top right of the video screen when the relevant section ends.



Click the 'Intro --- Sign out' image below to watch film demonstrations of the checklist in use at the start and end of the procedure.



5) Never Events

WHAT ARE NEVER EVENTS?



Never events are defined as Serious Incidents which are wholly preventable because guidance or safety recommendations are available at a national level and should be implemented by local healthcare providers.

Never events are incidents that require full investigation under the Serious Incident framework. A retained guidewire is a rare but serious complication of CVC insertion.

There have been a number of **guidewire-related Never Events** in recent years in ICHT, which is why this training is so important. We have also implemented the LocSSIP, which is a mandatory tool that must be used for each procedure performed.

If a Never Event occurs it is compulsory for the medical director to fully investigate the conditions under which it occurred, in order to minimise the chance of this happening again and to learn what can be done to improve safety.

CVC insertion is a **high-risk procedure**.

It is therefore everybody's responsibility to adhere to the guidance and engage in such safety processes.

After a Never Event, there will be meetings, reports and process reviews involving all staff.

You must only ever perform a procedure if you have the knowledge and skill to do so.

6) The LocSSIP at Imperial College Healthcare NHS Trust

Please see an example of the LocSSIP form

1 SIGN IN <i>To be completed by the individual conducting the procedure prior to scrubbing</i>	2 TIME OUT before needle to skin <i>To be read out loud by the assistant before needle to skin and as procedure progresses</i>	3 SIGN OUT <i>To be read out loud by the assistant before anyone leaves the procedural area</i>
<p>In an emergency only (eg Code Red) the items in red are the key critical safety ones to complete. At all other times, all items must be completed. This is an aide-memoire to be used during the procedure, not just for documentation afterwards.</p> <p>Check In:</p> <p><input type="checkbox"/> Confirm patient identity and site, procedure and consent</p> <p><input type="checkbox"/> Confirm no relevant allergies (eg chlorhexidine, latex)</p> <p>Appropriate staff available:</p> <p><input type="checkbox"/> Trained operator OR Operator plus Trainer</p> <p><input type="checkbox"/> Assistant present and WIRE BUDDY sticker issued</p> <p>Equipment check:</p> <p><input type="checkbox"/> Appropriate monitoring in place</p> <p><input type="checkbox"/> All procedural equipment available</p> <p>Clotting/platelets/anticoagulation reviewed:</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> Not available, plus emergency situation</p> <p>Need for platelet or FFP cover? <input type="checkbox"/> Yes <input type="checkbox"/> No</p>	<p>Setup confirmation:</p> <p><input type="checkbox"/> Skin cleaned (Chlorhexidine unless allergic) and draped</p> <div style="border: 1px solid black; background-color: #4a7ebb; color: white; padding: 5px; margin: 10px 0;">Before passing the dilator or line</div> <p style="color: red; font-size: 2em;">↓</p> <p>Confirm correct vessel placement of access needle / cannula or guidewire:</p> <p><input type="checkbox"/> Ultrasound <input type="checkbox"/> Blood gas</p> <p><input type="checkbox"/> Transducer <input type="checkbox"/> Other</p> <div style="border: 1px solid black; background-color: #4a7ebb; color: white; padding: 5px; margin: 10px 0;">FOCUS MOMENT after guidewire removal</div> <p style="color: red; font-size: 2em;">↓</p> <p><input type="checkbox"/> Guidewire(s) intact removal confirmed both verbally and visually by operator and wire given to Wire Buddy</p> <p><i>NB: if >1 pack used, check for multiple guidewires</i></p>	<p>Confirm:</p> <p><input type="checkbox"/> Guidewire(s) accounted for + disposed of appropriately</p> <p><input type="checkbox"/> Operator has disposed of all sharps safely</p> <p><input type="checkbox"/> Line secured appropriately including at hub</p> <p><input type="checkbox"/> All lumens aspirated and flushed, and connectors attached</p> <p><input type="checkbox"/> Documentation/pathway initiated</p> <p>How has intravenous placement been confirmed?</p> <p><input type="checkbox"/> Transduced <input type="checkbox"/> Ultrasound</p> <p><input type="checkbox"/> Blood gas <input type="checkbox"/> Other, specify:</p> <p>How will tip positioning be confirmed?</p> <p><input type="checkbox"/> Chest X-ray</p> <p><input type="checkbox"/> ECG TLS PICC placement</p> <p><input type="checkbox"/> N/A (e.g. femoral insertion)</p> <p>Line Insertion Documentation</p> <p><input type="checkbox"/> On Cerner, go to Obs & Assessments, find the "Lines and Devices" iView band and use the appropriate item from the available list; if in ICU, please use ICCA form instead</p> <p><input type="checkbox"/> Please ensure this procedure checklist is returned to the patient's paper notes folder so it can be scanned onto Cerner later</p>
<p>AFFIX BAR CODED PATIENT LABEL</p>	<p>Signature and printed name</p> <p>Operator: _____ Date: _____</p> <p>Wire Buddy: _____ Time: _____</p>	

This LocSSIP applies to all CVAD (Central Venous Access Device), PICC & Midline insertions undertaken in ICHT. It does not include interventional or diagnostic procedures undertaken in the interventional radiology or cardiology suites, paediatric lines inserted under fluoroscopic guidance in theatre, nor neonatal long lines.

Must-do procedural steps:

1. To ensure compliance with best practice:
 - a. The Imperial CVC insertion procedural checklist (overleaf) **must** be used during the procedure (it is a cognitive aid, not just for documentation afterwards).
 - b. The operator **must** dispose of all sharps before leaving the procedural area.
2. To reduce the risk of arterial puncture and other sources of bleeding:
 - a. Unless clinical urgency precludes, blood results **must** be checked and relevant abnormalities corrected if indicated before the procedure begins.
 - b. Unless clinical urgency precludes, a sterile, ultrasound guided method **must** be used to visualise the vascular structures, needle, guidewire and catheter position.
3. To reduce the risk of unrecognised cardiac arrhythmias:
 - a. Continuous ECG monitoring **must** be undertaken during insertion of jugular or subclavian CVCs (not including midlines)
4. To eliminate the risk of guidewire retention (**A NEVER EVENT**):
 - a. When the needle, dilator or catheter is being inserted or manipulated, part of the guidewire (if present) **must** always be visible and held by the operator.
 - b. This is **always** a two-person procedure. The Wire Buddy should remain at the bedside during the procedure and provide a second pair of eyes on the guidewire.
 - c. Two-person confirmation of guidewire removal **must** take place and be recorded at the SIGN OUT.
5. To reduce the risk of catheter-related infections:
 - a. A catheter with the minimum number of lumens for the intended purpose **must** be used.
 - b. The insertion site **must** be cleaned (1st line is 2% chlorhexidine in 70% alcohol). Sterile drapes and a sterile ultrasound probe sheath **must** be used.
 - c. The operator **must** fully 'scrub' and **must** be wearing a gown and sterile gloves throughout the procedure.
 - d. Needle-free connectors **must** be placed on all catheter lumens other than where a single 3-way tap is required for transducing a line.
 - e. A semipermeable, transparent dressing **must** cover the catheter at the insertion site.
6. To minimise the risk of the VAD being accidentally dislodged:
 - a. The VAD **must** be secured to the patient using all available suture points, including the line hub itself. The two-piece clips do not prevent the line from being pulled out.
 - b. A PICC or Midline **must** be secured with a securement device in adults. This is not for use in paediatric patients.

2. CVC Insertion: Preparation

1) Indications

There are a variety of reasons to consider the use of a CVC. These can include:

	<p>Access to administer drugs</p> <ul style="list-style-type: none"> • Infusion of cytotoxic drugs • Long-term IV access • Difficult peripheral IV access • Trauma line
	<p>Access for extracorporeal blood circuits</p> <ul style="list-style-type: none"> • Renal replacement therapy • Plasma exchange
	<p>Monitoring</p> <ul style="list-style-type: none"> • Central venous pressures • Venous saturations • Targeted temperature management
	<p>Interventions</p> <ul style="list-style-type: none"> • Temporary transvenous pacing • Pulmonary artery catheter • Vascular intervention by radiology/vascular or cardiology

2) Contraindications

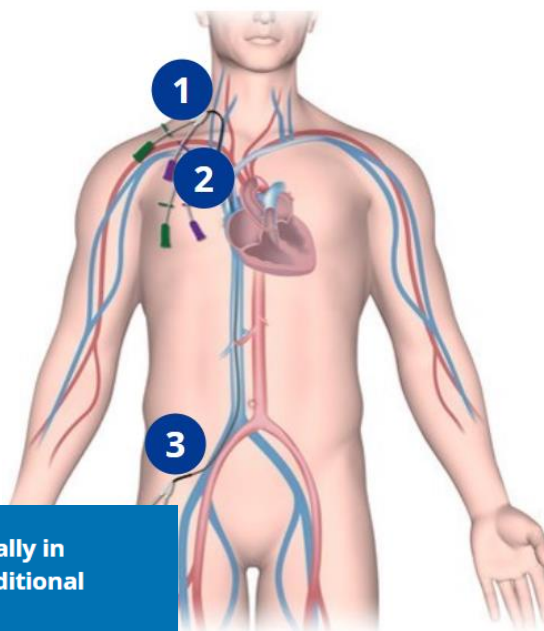
The following situations would contraindicate the use of a CVC:

	<p>Absolute</p> <ul style="list-style-type: none"> • Patient refusal • Thrombus in the target vein • Distorted local anatomy (trauma) • Local infection at the insertion site
	<p>Relative</p> <ul style="list-style-type: none"> • Coagulopathy (platelets <50, INR >2) • Bleeding in the proximal vessels • Uncooperative patient

3) Insertion Sites

The three most common insertion sites:

- 1** Internal jugular
- 2** Subclavian
- 3** Femoral veins



Note: PICCs are inserted more peripherally/distally, usually in the brachial or basilic veins in the arm. PICCs require additional training not covered by this module.

4) Complications

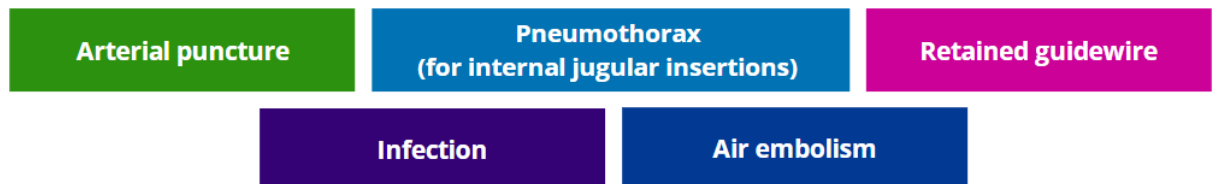
The following table details both immediate and delayed complications.

Immediate	Nature of complication
Cardiac	Arrhythmias; right ventricular perforation causing cardiac tamponade
Vascular	Arterial puncture; venous injury; bleeding; haematoma; air embolism
Pulmonary	Pneumothorax; pneumomediastinum; haemothorax; chylothorax
Device	Failure; entrapped/lost guidewires; knotted catheters; retrograde wire placement (wire deviating away from SVC depending on approach); microshock (leakage current sufficient to cause risk of VF)

Delayed complications	Where
Local infection	At site of catheter insertion
Systemic infection	Catheter related blood stream infection (CRBSI)
Thrombus	Local or embolised
Venous stenosis	At site of catheter insertion

5) Consent

When taking consent, it is important to discuss common or serious risks. The five main risks for discussion are:



Informed consent must be gained unless the patient is not competent to give consent. In some circumstances the CVC can be inserted in the patient's best interests.

The procedure, including risks and benefits, needs to be discussed.

Potential vessels should be assessed with surface anatomy and ultrasound checks before the procedure is undertaken.

Assessment is needed in relation to:

- Allergy status
- Coagulopathy
- Infection risk

6) CVC Procedure - Considerations

Within the Trust, CVCs should only be inserted in areas where:

- Staff are familiar with the procedure and managing patients with CVCs
- Adequate monitoring can be achieved
- Sterility can be maximised during insertion
- The risk of microshock can be minimised (e.g. in theatres and ICU)

The table below details the areas where CVC procedures should be conducted.

CXH	HH	SMH	QCCH
Theatres	Theatres	Theatres	Theatres
ED	Renal unit	ED	NICU
ICU	ICU	ICU	
Interventional radiology	Cardiac cath lab and Interventional radiology	Interventional radiology	
Acute medical unit	Acute medical unit	Acute medical unit	
Oncology	Haematology	PICU/NICU	

7) The Importance of Monitoring

CVC insertion is a high-risk intervention with the potential for significant complications and patient harm.

To minimise the risks, irrespective of the setting (physical location or urgency) in which CVC insertion is taking place, there are personnel and monitoring requirements which must be adhered to at all times:

Monitoring requirements for neck/subclavian access lines

- Continuous cardiac monitoring (ECG)
- Continuous pulse oximetry
- Transducer to confirm venous placement

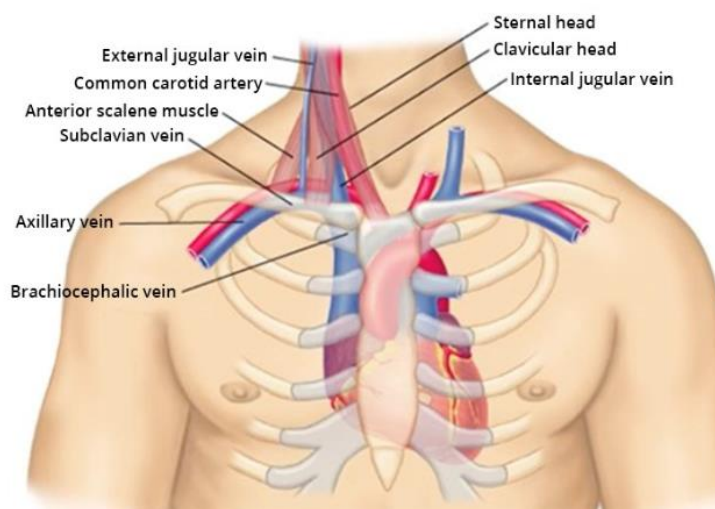
Personnel requirements

A second member of staff is a mandatory requirement to perform this procedure safely. Their role is to:

- Assist with the kit and using the checklist at the bedside
- Help to avoid distraction
- Confirm that the guidewire is removed by passing between the operator and assistant
- Comfort awake patients

8) CVC Insertion Sites

- **Internal jugular (IJ) veins:** most common and with a high success rate, as IJ veins are short, straight and large. They have a lower risk of complications, e.g. pneumothorax. Complications are dependent on technique and this may be more technically difficult in the hypovolaemic patient.
- **Subclavian veins:** more comfortable for the patient but with a potentially higher risk of pneumothorax.
- **Femoral veins:** good for emergencies but present an increased risk of infection. May be the only option in patients with pathology to the head and neck.

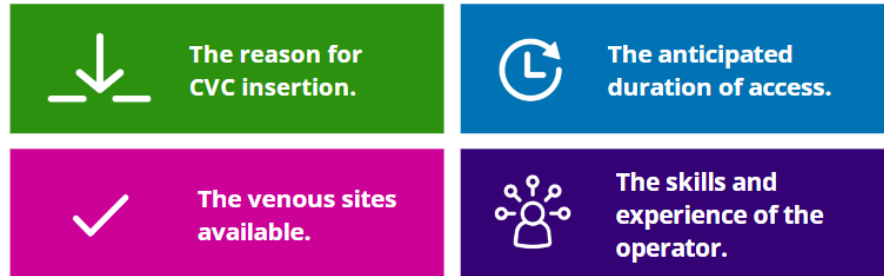


9) CVC Placement

Internal jugular vein	The internal jugular vein approach aims to result in the distal tip of the CVC sitting within the superior vena cava, above its junction with the right atrium and parallel to the vessel walls. This is at the level of the carina, as seen on the post-procedure chest X-ray.
Subclavian vein	The subclavian vein access to the superior vena cava should have the tip in similar positioning as the IJ. The risk of complications such as pneumothorax and uncontrolled bleeding associated with this route of access is greater and therefore only those trained and competent in subclavian vein cannulation should perform this procedure.
Femoral vein	The femoral vein access should see the tip of the line within the inferior vena cava. With the femoral approach, however, the risk of infection is higher, and if significant bleeding should occur, it may extend into the retroperitoneal space and be difficult or impossible to compress.
Basilic vein	Peripherally inserted central catheters (PICC) may be inserted via veins in the upper limb, most commonly the basilic vein . This is an advanced technique not covered by this module.

10) Route Choice

The choice of access route depends on multiple factors, including:



In general, however, the right internal jugular vein is the vein of choice for CVC insertion because of its relatively straight path to the superior vena cava and therefore its ease of cannulation.

The left internal jugular vein also offers access to the superior vena cava. However, the anatomical connection via the brachiocephalic vein makes it a less direct route of access to the SVC.

11) Equipment Packs

These are the contents of a CVC pack within the Trust:

- Needle and cannula for vessel puncture
- Guidewire
- Knife for skin incision
- Dilator
- Quad or quin lumen CVC with secure clips
- Suture and dressing
- Syringes
- Sharp safe
- Gauze and clamp
- Needle free connectors (with one-way valves)



3. Choice of CVC

After the indication for insertion has been reviewed, the patient's clotting and platelet count checked (if indicated) and the patient has consented, preparation for the procedure can commence. There are a number of different types of CVC available for use and the selection of the appropriate CVC for any given patient at any given time depends on a number of factors.

Length of the CVC	Type of CVC	Number of lumens required
<p>In adults, 12.5-16cm CVCs are generally sufficient for right internal jugular vein cannulation, while 16-20cm CVCs are required for the left internal jugular vein and for the femoral veins. However, the appropriate length CVC for any given patient needs to be assessed when looking at the patient prior to CVC insertion.</p>	<p>Different CVCs are required for renal replacement therapy versus, for example, the administration of vasopressor medications or TPN.</p>	<p>A number of different configurations are available throughout the Trust. You should select the smallest number of lumens necessary for the expected needs of the patient, to reduce infection risk.</p>

4. Ultrasound Considerations

1) Basic Principles

It is Trust policy that CVC insertion should be ultrasound-guided, unless the operator is skilled in emergency access without ultrasound guidance.

Real-time ultrasound guidance of CVC insertion provides the operator with a visualisation of the desired vein and the surrounding anatomical structures before and during insertion.

It also allows for confirmation of the venous placement of the guidewire prior to dilation and line insertion.



There are a number of advantages of ultrasound-guided techniques, including:

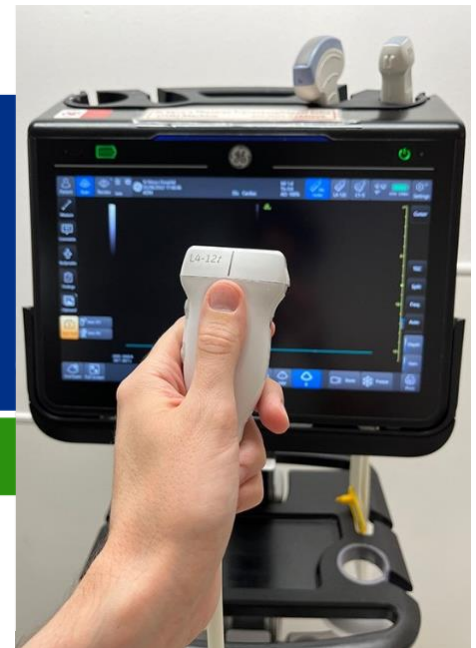
- Identification of the precise position of the target vein
- Detection of anatomical variants and/or thrombosis within the target vessel
- Avoidance of inadvertent arterial puncture
- Confirmation, prior to dilation, of the venous placement of the guidewire

2) Exceptions

There are a few specific situations in which the use of ultrasound is not mandated:

- The subclavian approach is traditionally a landmark technique which requires additional training and supervision to achieve competence. The more modern approach to subclavian venous cannulation, however, is guided by ultrasound but nevertheless still requires additional training and supervision. This is due to the greater risk of pneumothorax as well as incompressible bleeding in the event of inadvertent arterial puncture than with other approaches.
- Code red trauma or cardiac arrest due to major haemorrhage.

Outside of these specific situations, however, the Trust policy is to use ultrasound guidance.



3) Out-of-Plane Ultrasound Image of Guidewire Within Right Internal Jugular Vein



- For CVC insertion, the high frequency linear-array probe should be used as it allows for high resolution imaging of superficial structures.
- There are then two techniques for real-time ultrasound guidance during the procedure: long axis and short axis.
- There is currently no evidence to suggest that either approach is superior to the other, however, the short axis (out of plane) view may be more straightforward for those who do not have extensive ultrasound experience.

4) Taking a Systematic Approach to the Use of Ultrasound

Prior to prepping and draping the puncture site

Identification of the anatomy of the insertion site and localisation of the vein with ultrasound.

When visualising the vessel, apply light pressure with the probe against the skin to avoid compression of the vessel.

Differentiation between arteries and veins is most commonly possible by looking for pulsatility as well as compressibility.

Confirmation of vein patency: compressing the vein with gentle pressure confirms patency; visualisation of clot within the vessel may indicate that the vein is not patent and a different vessel can then be chosen.



Click [here](#) to watch the film clip

Here the vein can be seen in the centre of the screen, and the artery on the left. When the ultrasound probe is used to gently compress the tissue, the lower-pressure vein is occluded and the artery remains visible and pulsating.

After prepping and draping the vessel puncture site

Real-time ultrasound guidance for vein puncture should be carried out under aseptic conditions.

Use a sterile ultrasound probe cover and single-use sterile gel to reduce the risk of catheter-associated bacteraemia related to the use of non-sterile gel.

The position of the operator should be such that they have the insertion site, the needle and the ultrasound screen in the line of sight during needle insertion.

The ultrasound probe should be held with the non-dominant hand while advancing the needle with the dominant hand.

At all points, the needle must be seen on the ultrasound screen. If it is not, the needle must be held still and the position and/or orientation of the ultrasound probe changed until the needle comes back into view.

Confirmation of needle position

Before insertion of the guidewire, the needle tip should ideally be seen centrally within the vein, even if blood is freely aspirating through the syringe.

Confirmation of wire position within the vein

After insertion of the guidewire and removal of the needle and prior to dilation, the position of the guidewire within the vein must be visualised in both an out-of-plane and in-plane orientation.

Where appropriate, the visualisation should be confirmed with the Wire Buddy or supervising clinician.

If there is any uncertainty about the position of the wire or the vessel within which it sits, a more experienced operator should be called to assist, or where that is not possible, the wire should be removed and the procedure started again.

- Vessel puncture USS

VESSEL PUNCTURE

The vein is visible in the middle of the image and is clearly compressible, and the pulsatile artery is on the left side of the screen. As the needle is passed down through the tissue towards the vein, the tissue can be seen deforming and tenting as the needle pushes through. At the end, the needle can be seen in the vein.



Click [here](#) to watch the film clip

FOLLOWING WIRE DOWN INTO THE VEIN

Here with the probe held near the skin entry point, the wire can be seen as a bright echogenic dot at the top of the screen. As the probe is moved down the neck, the wire can be traced as it passes down through the tissue into the blood vessel, which is then manually compressed to confirm that it is in fact the vein. The wire can be clearly seen in the lumen of the vein at the end of the video.



Click [here](#) to watch the film clip

5. Insertion Technique

1) Gallipot Use

There have been several incidents in the past where people have decanted solutions into open gallipots and injected them into patients, only to find that they had mixed things up and injected a different substance to the one they were expecting. On occasion these errors have led to serious harm, including limb amputations or paralysis.



NHS Improvement said in 2017:

“Due to the risk posed by unidentifiable solutions in ‘open systems’ we consider their use for injectable medicines to be an indefensible practice”.

This is a clear statement and Trust policy supports this.



You **must** draw up any solution that you are going to inject into the patient directly from the ampoule each time.

Your assistant - or Wire Buddy - will help you with this.

The central line insertion film:



You can click [here](#) to watch the full 29 minute film ‘Central Line Insertion’. The content will be recapped on the following pages, and you will be able to watch individual segments of this film with each section.

2) Procedure Recap – Preparation

SIGN IN

Confirmation of consent and use of the LocSSIP checklist at the bedside during the procedure.

Click [here](#) to watch the film clip 'Sign in'

PERSONNEL (Demonstration of sign-in using LocSSIP)

A dedicated assistant familiar with the process of CVC insertion must be present for the duration of the procedure.

Click [here](#) to watch the film clip 'Personnel: Using LocSSIP'

POSITIONING OF THE PATIENT

If accessing the internal jugular veins, patients should be positioned in the 15-30 degree head-down (Trendelenberg) position - this increases the diameter of the vein as well as reducing the risk of venous air embolism.

Click [here](#) to watch the film clip 'Positioning of the patient'

ULTRASOUND

This must be used for the insertion of invasive devices. Ultrasound probe covers and single use sachet of sterile ultrasound gel must be used. Before performing the procedure it is necessary to scan the vessel, using the appropriate transducer probe, to ensure that the vessel is clear of thrombosis, stenosis or obstruction. Scan the vessel from top to bottom.

Click [here](#) to watch the film clip 'Ultrasound'

PERSONAL PROTECTIVE EQUIPMENT AND HAND HYGIENE

Sterile gown and sterile gloves must be worn. Eye and face protection is indicated with facemasks and a visor or goggles. Hands must be decontaminated using an antiseptic skin cleanser prior to CVC insertion. Hats are commonly used for the procedure, although there is no evidence to support their use for this procedure (Loveday et al 2014 & O'Grady et al 2011).

Click [here](#) to watch the film clip 'PPE and Hand Hygiene'

PREPARATION OF EQUIPMENT

A large trolley should be used on which the sterile field is prepared. Prepare the local anaesthetic and put it to one side (not to be confused with saline). Flush the lumens of the CVC and the needle-free connectors with 0.9% sodium chloride, to reduce the risk of venous air embolism.

Click [here](#) to watch the film clip 'Preparation of Equipment'

ADMINISTER LOCAL ANAESTHETIC

Local anaesthetic, e.g. 1% lidocaine, should be applied to the area of intended puncture, especially if the patient is awake. (The step of actually injecting the patient's skin is skipped in this video.)

Click [here](#) to watch the film clip 'Administer Local Anaesthetic'

SKIN PREPARATION

Decontaminate the skin site with 2% Chlorhexidine in 70% isopropyl alcohol (Chloraprep 3ml) using a criss-cross technique for 30 seconds and allow to air dry prior to the insertion of the CVC. Use a single patient application of alcoholic povidone iodine application for patients with a history of Chlorhexidine sensitivity. Allow the antiseptic to dry before inserting the CVC.

Click [here](#) to watch the film clip 'Skin Preparation'

PLACE STERILE DRAPE OVER THE PATIENT

Ensure that the drape is appropriately positioned.

Click [here](#) to watch the film clip 'Sterile Drape'

RESCAN THE PATIENT'S NECK IN A STERILE MANNER

Ensure that the transducer probe is at the centre of the jugular vein, which should be at the centre of the screen.

Click here to watch the [film](#) clip 'Rescan'

Procedure Recap – Needle and Guidewire Insertion

REAL-TIME ULTRASOUND-GUIDED NEEDLE PUNCTURE

This can be using either an out-of-plane or in-plane approach. A 5ml syringe should be placed on the back of the needle or cannula and once the skin has been punctured, gentle aspiration of the syringe should be performed whilst visualising the needle tip entering the target vein. A needle-mounted cannula such as an Abbocath can be used; just as when inserting a peripheral cannula, after getting the flashback and aspirating blood, the needle should be slightly advanced and the cannula then slid off into the vein and the needle withdrawn.

Click [here](#) to watch the film clip 'Realtime Ultrasound'

GUIDEWIRE INSERTION - 1

Once vein puncture has been confirmed both via the aspiration of blood through the syringe or the cannula and through visualising the needle tip in the centre of the vein on ultrasound, the guidewire should be advanced through the needle or cannula. The guidewire should thread freely and there should be no resistance to its passage.

Click [here](#) to watch the film clip 'Guidewire Insertion 1'

GUIDEWIRE INSERTION - 2

Should any resistance be encountered, retract the guidewire and ensure that the needle or cannula has not migrated out of the vein, then attempt to insert the guidewire again. Whilst inserting the guidewire (for either the internal jugular or subclavian routes), the assistant or Wire Buddy should monitor the ECG and inform the operator immediately should any ectopics or arrhythmias occur, which would suggest that the guidewire has entered the right atrium and should be withdrawn.

CONFIRMATION OF VENOUS PLACEMENT OF THE GUIDEWIRE

This must be carried out using ultrasound, as described previously.

Once the guidewire has been inserted, **the needle or cannula should be removed over the guidewire**, keeping one hand on the guidewire at all times. This ensures that sufficient length remains outside of the skin, so as not to lose the wire.

Click [here](#) to watch the film clip 'Confirmation of Placement of the Guidewire'

OTHER WAYS OF CONFIRMING THE NEEDLE IS WITHIN THE JUGULAR VEIN

There are other ways to confirm that the needle is within the internal jugular. Check the video for further details on these methods.

Click [here](#) to watch the film clip 'Other ways of Confirmation'

Procedure Recap – Use of Dilator and CVC Insertion

2-3MM SKIN INCISION

Once venous placement of the guidewire has been confirmed, a small 2-3mm skin incision should be made over the guidewire with a scalpel in order to facilitate insertion of the dilator.

Click [here](#) to watch the film clip ‘Skin Incision’

DILATOR SHOULD BE INTRODUCED OVER THE GUIDEWIRE

Always holding on to the guidewire, the dilator should be introduced over the guidewire, through the skin incision. It should not require excessive force, and often a twisting or screwing motion with some skin counter-traction can help aid passage of the dilator. Do not let go of the guidewire whilst dilating.

Click [here](#) to watch the film clip ‘Dilator Introduction’

REMOVE THE DILATOR AND INSERT THE CVC

Once dilated, remove the dilator and cover the skin incision site with gauze while placing the distal tip of the CVC onto the guidewire. Pull the guidewire back sufficiently, such that you can hold it at all times whilst gently inserting the CVC over the guidewire to the desired length. You must ensure at all times that you have the guidewire in your hands and should verbalise this to your assistant or Wire Buddy.

Click [here](#) to watch the film clip ‘Remove Dilator’

VISUALLY CONFIRM THAT THEY HAVE SEEN THE GUIDEWIRE REMOVED

Once the CVC has been inserted, the guidewire should be removed and its removal verbalised with your assistant or Wire Buddy. They must visually confirm that they have seen the guidewire removed and the LocSSIP used to verify the process.

Click [here](#) to watch the film clip ‘Visual Confirmation’

ASPIRATE AND FLUSH THE LUMENS

All lumens should now be aspirated and flushed with 0.9% sodium chloride to ensure their patency.

Click [here](#) to watch the film clip ‘Aspirate and Flush the Lumens’

POINTS OF FIXATION

The CVC should now be sutured in place with at least two points of fixation through the loops on the side of the hub of the CVC itself, plus two more points of fixation if you use the additional clips (as shown in the video).

Click [here](#) to watch the film clip ‘Points of Fixation’

CLEAN AND DRESS THE SITE

Where available, apply a chlorhexidine-impregnated sponge or gel around the insertion site. Cover the insertion site and anchor sutures with a semi-permeable transparent dressing.

Click [here](#) to watch the film clip 'Clean and Dress the Site'

Procedure Recap – Before using the CVC

CONFIRMING VENOUS PLACEMENT

You must confirm venous placement of the CVC by either performing blood gas testing or transducing the pressure waveform (or both).

CHEST X-RAY

A chest X-ray is required for all internal jugular or subclavian line insertions. However, provided that the waveform is venous and a venous gas has been obtained, the line can be used prior to the chest X-ray, if required in an emergency. This should be clearly documented in the patient's notes. The tip should be in the superior vena cava (SVC). You do not need to perform a chest X-ray for femoral central lines. For more information on checking the chest X-ray post-procedure, select [here](#).

EXCEPTION

The CVC can be used prior to the X-ray in an emergency, provided that the waveform is venous and a venous gas has been obtained.

FINAL STEPS

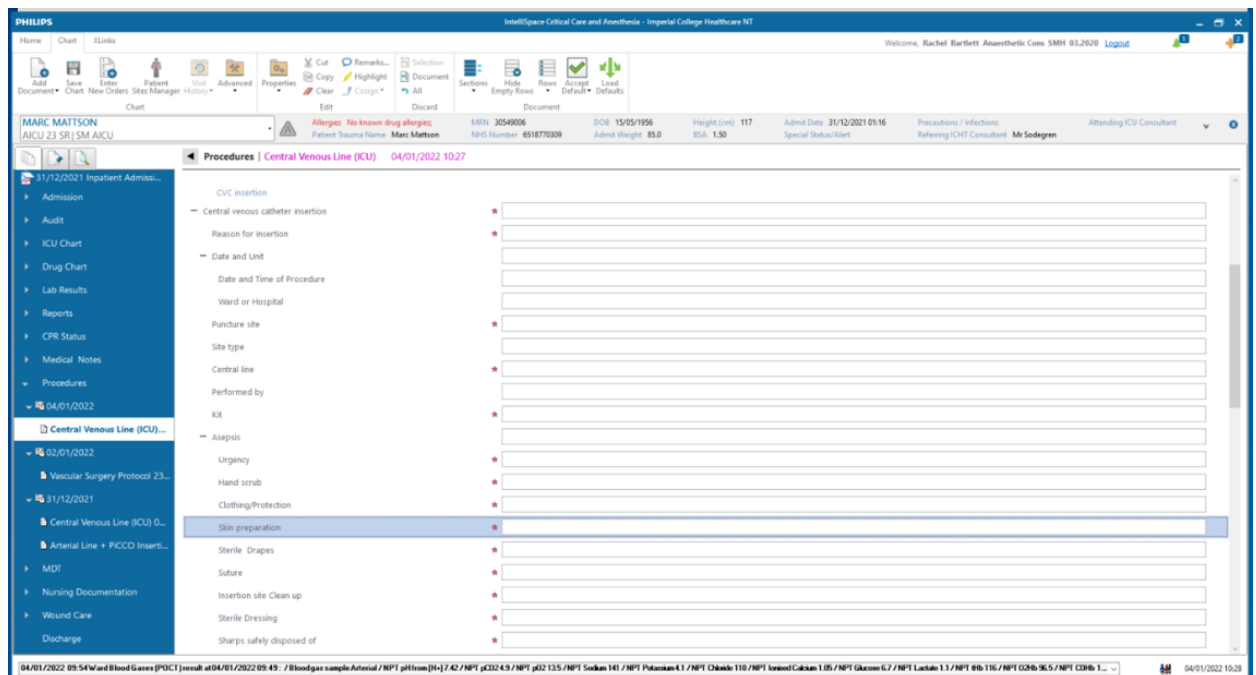
Select the PLAY button to view the final element of the video (from 25:45) – the checking process and the Wire Buddy stepping through the sign-out element of the LocSSIP.

Click [here](#) to watch the film clip 'Final Steps'

Procedure Recap – Documentation

The documentation requirements are:

- Document the procedure, including the indication and consent (if applicable), on the patient's electronic notes.
- This depends on your area of work. For example, for ICU patients, it will be on ICCA, and for most other patients it should be on Cerner. There is a structured Cerner item under *Obs & Assessments > Vascular Access Devices* that allows documentation of CVC insertion.
- On the paper checklist, document the name of your assistant or Wire Buddy, and mark to confirm that you both visualised the guidewire being removed.
- Make sure the paper checklist is signed and returned to the patient's paper notes after the procedure. This will be scanned automatically on discharge



The screenshot displays the Philips IntelliSpace Critical Care and Anesthesia software interface. The patient information at the top includes: MARC MATTHEWSON, AICU 23 SRJ SM AICU, Allergies: No known drug allergies, Patient Trauma Name: Marc Matthewson, MRN: 30549005, NHS Number: 618770309, DOB: 15/05/1956, Admit Weight: 85.0, Height (cm): 117, Admit Date: 31/12/2021 01:16, and Referring ICHT Consultant: Mr Sedegen. The main window shows a structured procedure form titled 'Procedures | Central Venous Line (ICU) 04/01/2022 10:27'. The form includes the following sections and fields:

- CVC insertion**
 - Central venous catheter insertion
 - Reason for insertion
 - Date and Unit**
 - Date and Time of Procedure
 - Ward or Hospital
 - Puncture site
 - Site type
 - Central line
 - Performed by
 - KIR
 - Aspesis**
 - Urgency
 - Hand scrub
 - Clothing/Protection
 - Skin preparation**
 - Sterile Drapes
 - Suture
 - Insertion site Clean up
 - Sterile Dressing
 - Sharps safely disposed of

The interface also shows a left-hand navigation menu with options like Admission, Audit, ICU Chart, Drug Chart, Lab Results, Reports, CPR Status, Medical Notes, Procedures, and Discharge. The bottom status bar displays various lab test results and the date/time: 04/01/2022 10:21.

After the procedure is completed:



You should document how the venous placement was confirmed (e.g. blood gas, pressure waveform transduced).

A chest X-ray is required for all internal jugular or subclavian CVC insertions, to confirm that the line tip is correctly positioned and that there is no pneumothorax. This should be clearly documented in the patient's notes. The tip should be in the superior vena cava (SVC). You do not need to perform a chest X-ray for femoral central lines.

The CVC can be used prior to the X-ray in an emergency, provided that the waveform is venous and a venous gas has been obtained, and that this has been documented clearly.

The patient will need to be cared for in an environment where the staff are trained to manage central lines.

6. Care on the Wards

In a general ward setting, activities involving the CVC might include CVP monitoring, blood taking and the administration of IV medication or Parental Nutrition.

There is a risk of air embolism or blood loss if clamps and ports are not closed when not in use. All lumens must have a needle-free connector attached at all times. You should:

<p>Be trained to ensure that you are familiar with the correct technique to close all ports and clamps appropriately. There must never be an open lumen.</p>	<p>Flush lines thoroughly where they have been accessed for any of the reasons above.</p>	<p>Utilise an Aseptic Non-Touch Technique (ANTT).</p>

FLUSHING NEEDLE-FREE CONNECTORS

0.9% saline is used for flushing the lines with a 10ml syringe before and after each drug administered.

When flushing and administering your medication, adopt the push/pause technique.

This method creates a turbulent flow of the infusions inside the cannula and vein to minimise or prevent the mixing of incompatible medications or solutions.

By preventing the accumulation of medication precipitate inside the lumen, you reduce the risks of issues such as a potential blood clot or reflux.



All areas where patients are cared for with a CVC should have nursing staff trained in drug administration via this route.

When taking blood samples via a CVC, make sure you draw off and discard 5-10ml of blood first to avoid erroneous results. Always use the Vacutainer system to take blood, to ensure the correct volume is collected. Do not use a syringe to add blood to the bottles separately. **ANTT and flushing are important here.**

7. Monitoring Central Venous Pressure

Central venous pressure (CVP) is a direct measurement of the pressure in the superior vena cava. The pressure is monitored with an electrical transducer which is attached to the distal port (closest to the heart) of a CVC.

It is recorded at the end of expiration in a supine position.

Normal mean CVP values in a spontaneously breathing non-ventilated patient are **0-6 mmHg**.

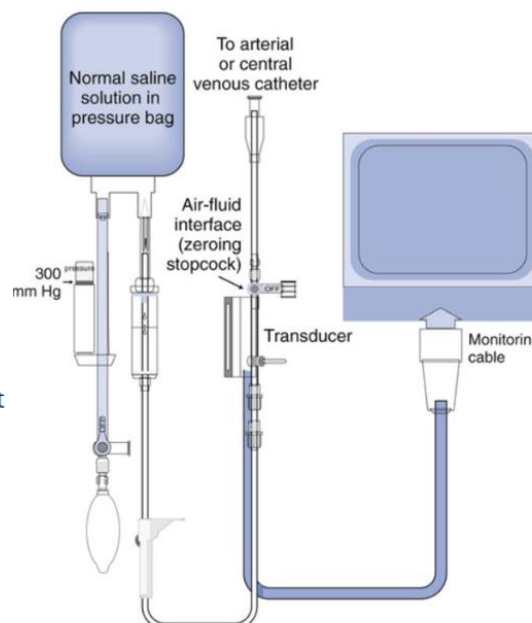
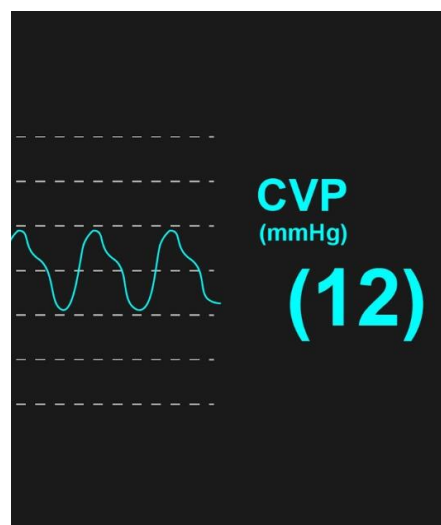
Positive pressure ventilation increases the CVP during inspiration as the intrathoracic pressure rises.

The CVC is linked to a strain gauge **transducer** via saline-filled tubing from a pressurised bag.

This maintains a constant column of incompressible saline between the tip of the CVC in the vein and the strain gauge, with a slow and constant flush (3ml/h) to prevent clot formation.

The strain gauge is composed of a diaphragm which is moved by the CVP wave transmitted through the incompressible saline.

These small movements are measured as changes in current and resistance in a Wheatstone bridge. These are then electrically converted into a signal which is amplified and displayed on the monitor with an accompanying waveform and the mean CVP in mmHg.



The aim is to measure the CVP at the mid-point of the right atrium, so the transducer should be at the level of the fifth intercostal space in the mid-axillary line. The transducer needs to be 'zeroed' to atmospheric pressure at this level.



The risks of this system include the potential for malfunction, air embolism, wrong fluid administration and infection.

8. Removing CVC Lines

Procedure Recap

Indications for the removal of a CVC include:

- Once **there is no need for drugs** that can only be given via the central venous route (i.e. original indication no longer applies)
- There is **no indication for CVP measurement**
- Catheter-related **blood stream** infection
- Catheter at the **end of its safe indwelling duration** (7 days generally)
- **Persistent catheter occlusion**
- **Damaged catheter**



Removing CVC Lines - Procedure Recap

STEP 1

Prior to removal, check coagulation. If the patient has a significant coagulopathy or thrombocytopenia, consider correction or delaying removal of the line. Also consider timing around anticoagulant medications.

STEP 2

Check alternative intravenous access is in place.

STEP 3

Ensure that the patient is laid on the bed supine, the bed should be flat, checking the position of the bed from the side angle. Do not remove the line while they are sitting upright, due to the risk of air embolism.

STEP 4

Wash your hands and don appropriate PPE.

STEP 5

Remove the dressing from the catheter site.

STEP 6

Clean the site with Chloraprep or suitable alternative, using ANTT to cut the sutures.

Removing CVC Lines - Procedure Recap

STEP 7

Ask the patient to perform the Valsalva manoeuvre and/or hold their breath during catheter removal. Alternatively, you could time catheter removal to coincide with the end of inspiration or the beginning of expiration.

STEP 8

Use one hand to cover the insertion site with sterile gauze swabs. With the other hand, firmly but gently remove the catheter. Apply gentle pressure as the catheter is being removed. If resistance is felt, stop and contact a senior.

STEP 9

Once the catheter is removed, press firmly with sterile gauze swabs until haemostasis is achieved (which should take approximately five minutes).

STEP 10

Apply an air-occlusive dressing which should remain in place for at least 48 hours.

STEP 11

Document removal in the electronic records.

9. Recording Competence and Supervision

	✓	We recommend that you keep a careful logbook of all the CVC lines that you are involved with, and those you directly place yourself.	
	✓	All lines need to be directly supervised by a consultant or senior registrar until you are deemed independent. You should request detailed feedback on your technique and record this as a DOPS on your e-portfolio.	
	✓	Trainees who have performed less than five CVC insertions should be supervised by someone at a registrar or consultant grade only.	
	✓	Please recognise that this is a high-risk procedure . If you undertake this independently, you are responsible for engaging in patient safety governance processes, to ensure that the maximum safety profile can be achieved.	

This is the end of the module.

To complete the assessment please return to the pre-assessment system.