



Arterial Line Insertion - Transducing and Monitoring - Clinical Practice Standard

Purpose

The purpose of this policy is to establish minimum practice standards for the care and management of Arterial Line Insertion -Transducing and Monitoring – Clinical Practice Standard, throughout the WA Country Health Service (WACHS).

Removing unwanted variation in clinical practice and following best practice guidelines has been found to reduce inappropriate care (overuse, misuse and underuse) thus improving health outcomes, reducing preventable harm and decreasing wastage.

Further information relating to specialty areas including Child and Adolescent Health Service (CAHS), Women and Newborn Health Services (WHNS) can be found via [HealthPoint](#) if not covered in this policy.

Scope

All medical, nursing, and midwifery staff employed within critical care areas such as theatre, ICU, ED and CCU where arterial monitoring of blood pressure occurs within WACHS.

All health care professionals are to work within their scope of practice appropriate to their level of training and responsibility.

Further information may be found via [HealthPoint](#) or the [Australian Health Practitioner Regulation Agency](#).

Considerations

Using pulse palpation as a landmark has been the traditional approach for the insertion of an arterial catheter. The site of the cannulation is usually selected, by palpating the pulse and the procedure is initiated. Ultrasound guidance is an alternative technique for insertion of arterial catheters. This technique is thought take less time and has a higher first time success rate.⁹

- The arterial line must be inserted by medical staff who are experienced in the procedure. If the radial artery is selected the operator may perform an “Allen” test to assess peripheral limb perfusion distal to the proposed arterial cannula site prior to insertion² or use ultrasound guidance
- Arterial cannulation sites must remain viable at all times
- All monitor alarms should be audible and set within 20% of patients actual Systolic and Mean Blood Pressure

- **No medication** should be administered **via the arterial lines** (Australian Commission on Safety and Quality in Health Care [ACSQHC] [National Standard for User-applied Labelling of Injectable Medicines, Fluids and Lines](#))
- Blood samples should only be taken when clinically indicated
- Personal protective equipment should be worn when handling arterial lines
- Strict aseptic technique should be followed during insertion, management and removal of arterial cannula. Refer to:
 - [WHO Five Moments of Hand Washing](#)
 - Australian Guidelines for the Prevention and Control of Infection in Healthcare³
 - WACHS Infection Prevention and Control Policy

General Information

Invasive haemodynamic monitoring is undertaken within critical care areas such as Theatre, ICU, ED and CCU. Arterial monitoring of blood pressure is one such monitoring technique.

An Arterial cannula may be inserted via the radial, brachial, femoral or dorsalis pedis arteries for the purpose of continuous monitoring of systemic arterial pressure and provide ready access for sampling of arterial blood. Indications for use may include:

- Haemodynamic instability
- To guide titration of vasoactive medications (e.g. Noradrenaline)
- Major surgical intervention
- Serial blood sampling¹

Staff are to comply with the specific requirements for hand hygiene, aseptic non-touch technique and personal protective equipment.

Refer to the WACHS Personal Protective Equipment (PPE) Procedure and Infection Prevention and Control Policy.

Possible Complications of the Procedure

The most common complication is infection, hence the importance of a sterile and minimal touch technique. Micro-organisms can migrate down the transducer line and rest at the insertion site causing swelling (phlebitis), redness or pus; thus causing trauma to the artery, possibly its collapse, and increasing the risk of sepsis.

Other complications include:

- Haematoma
- Thrombosis
- Haemorrhage
- Sepsis
- Vascular insufficiency
- Arterial spasm

- Embolism
- Aneurysm
- Ischemia
- Direct nerve damage
- Fistula formation
- Accidental drug injection

Clinical Communication

Clinical Handover

Information exchange is to adhere to the Department of Health Clinical Handover Policy using the iSoBAR framework.

Critical Information

Critical information, concerns or risks about a consumer are communicated in a timely manner to clinicians who can make decisions about the care.

Documentation

An individualised management plan is to be documented in the patient's health records as soon as practicable, in regard to this CPS.

At a minimum the plan must consider:

- Patient history and diagnosis for clinical conditions, medications, psychosocial and cultural factors that could influence observations
- Presence of comorbidities and treatment
- Frequency and specific observations
- Site requirements, patient education and consent
- Any restriction to intervention associated with advanced health directives (AHD) or similar
- Document in patients notes, wound management plan and on the nursing care plan the insertion date, site and type of dressing

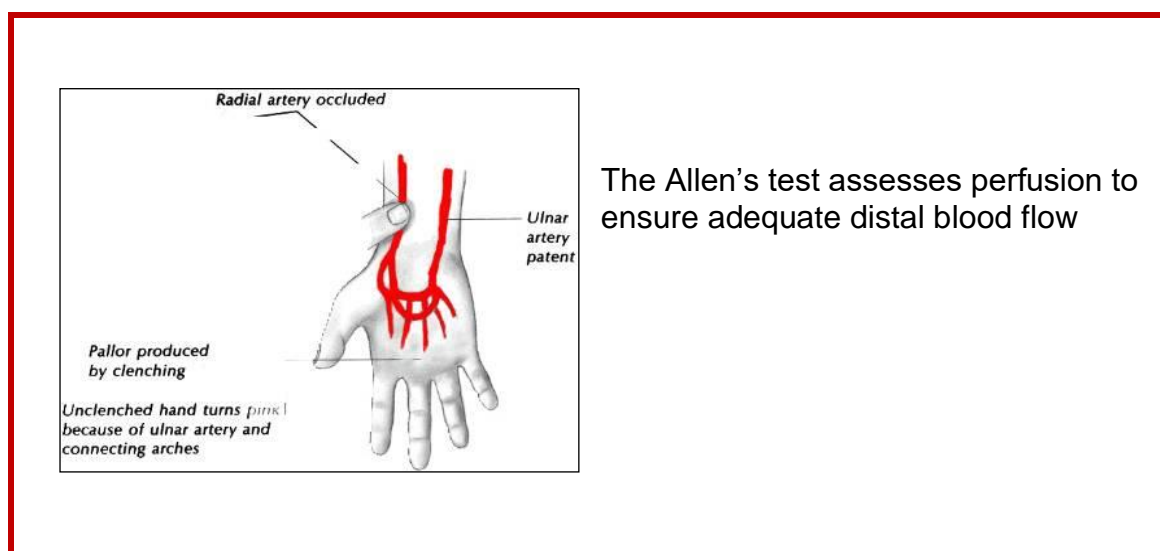
Refer to the WACHS Documentation Clinical Practice Standard.

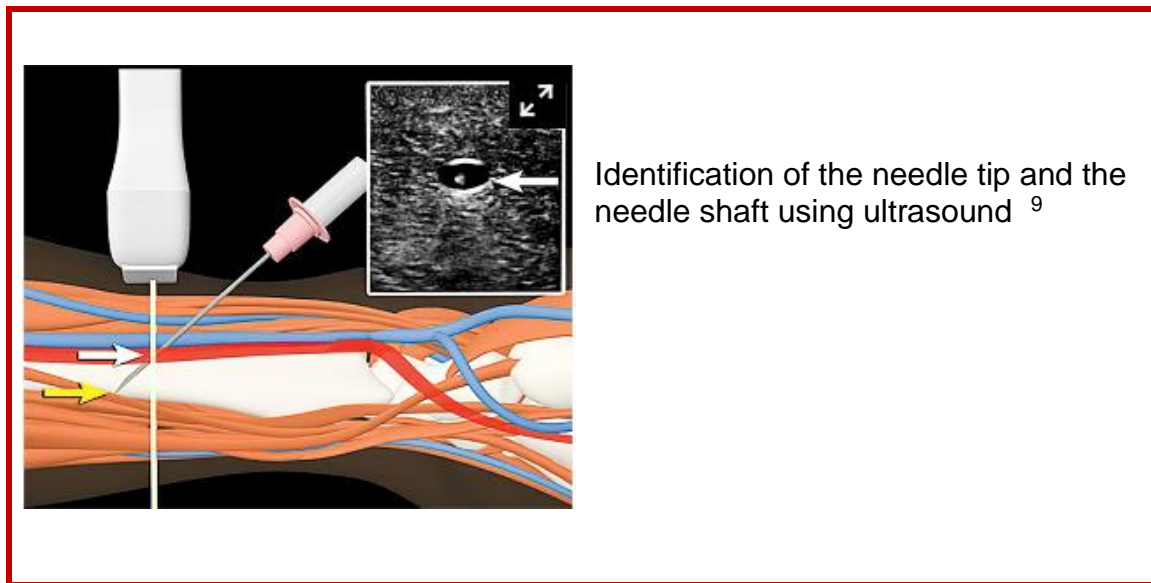
Patient Preparation and Education/Carer Information

- Explain the procedure/s to the patient, family and/or carer
- Obtain verbal consent from patient/family and/or carer prior to commencement if possible
- Maintain patient privacy and privacy.
- Provide the opportunity for an accredited interpreter and/ or Aboriginal Liaison Officer where appropriate to the patient's language or communication requirements. (See WA Health Language Services Policy.)

Pre-Procedure Key Points

- Patient identification and procedure matching processes are undertaken
- Check patient medical chart/record for allergies, physician orders, site restriction and bleeding conditions
- Arteries typically cannulated for arterial monitoring are Radial and Femoral however Brachial and Dorsalis Pedis can also be utilised.
- The preferred site for arterial monitoring is the radial artery. The MO performing the procedure should do Allen's test to ensure adequate distal blood flow, or use ultrasound guidance to select an area with a large arterial diameter and minimal calcification
- Consideration should be given to vascular integrity prior to arterial cannula insertion due to a potential compromise to distal circulation.





- Position the patient in bed (if a radial artery is to be used, a rolled towel may be used to hyperextend wrist to allow easier visualisation of landmarks).
- Brachial insertion-elbow extension
- Femoral insertion-lay patient supine if possible

Equipment Required

- Equipment must be appropriate for the age and/or size of the patient
- Equipment must be serviced and calibrated in accordance with manufacturer's recommendations to ensure reliability and accuracy
- Specific sites may have pre prepared equipment packs and contents may vary, consider the following:
 - Sterile gloves
 - Sterile gauze
 - Sterile towels
 - Chlorhexidine Gluconate 2% and Ethanol 70% solution
 - 1% lignocaine without epinephrine in a 3-5ml syringe with a 25- to 27- gauge needle
 - Suture (2.0 to 4.0) and/or adhesive tape/strips
 - Sterile non absorbable dressing/transparent
 - Three-way stopcock
 - Pressure kit transducer kit
 - Pressure tubing
 - Arm/Wrist board of appropriate size for the patient as required

Procedure / Key Principles

Transducer Setup

- Assemble the pressure monitoring set
- Ensure all assembled equipment is ready for access and use prior to line insertion

Cannula Insertion

- Position the patient so that the hand is dorsiflexed at the wrist approximately 60 degree and palpate the artery
- Open arterial cannula insertion kit, and then don sterile gloves
- Create a sterile field around insertion site utilising appropriate drapes.
- Cleanse the skin with antiseptic solution/chlorhexidine
- Perform local anaesthesia
- Insert the cannula at a 30-45 degree angle
- Attachment to the monitor assembly
- Apply steri-strips or suture to keep cannula secure and apply transparent dressing⁴ or suture. Following placement of the Cannula by the medical staff, attach the 500ml bag Normal Saline flush bag which is inflated to 300mmHg
- Ensure transducer is attached to pressure cable and monitor, and that there is an identifiable arterial trace

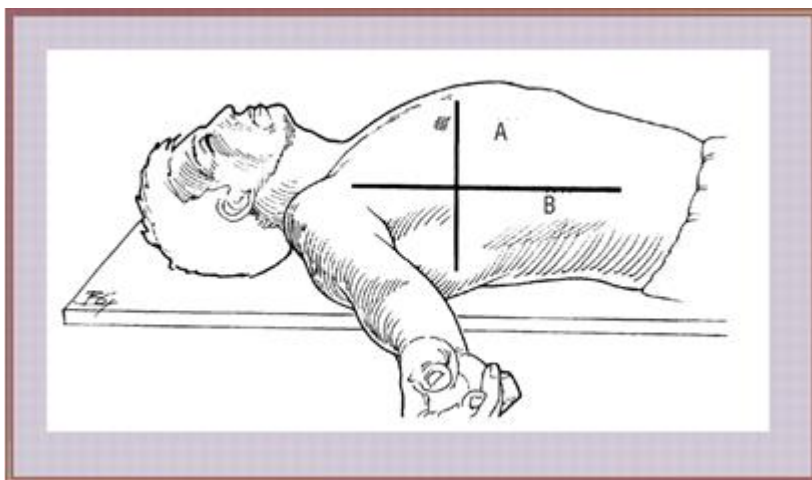
Zeroing the Arterial Line

This should take place:

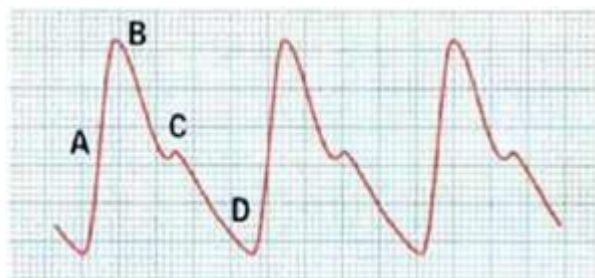
- Following insertion of a new Cannula
- Following line changes
- At the commencement of each shift
- Following re-positioning of the patient
- Upon suspected erroneous readings on the monitor
- Remove the cap on the three way tap and turn off toward the patient to open the transducer line to air



- Press the Zero button on monitor
- When the monitor reads zero and shows a flat trace line, close the three way tap and replace bung
- When transducer is secured to a transducer mount at the end of the patients bed the transducer must be zeroed at the level of the phlebostatic axis (anatomical landmark which represents the level of the right atrium, Found at the level of the 4th intercostal space, mid axillary line. See image below



Arterial Transduced Waveform



- 'A' represents the rapid ejection of blood from the ventricle known as the anacrotic limb. This correlates to the QRS on an ECG
- 'B' represents the systolic blood pressure
- 'C' represents the diacrotic notch which is when the aortic valve closes causing some retrograde blood flow. This correlates to the T wave on an ECG
- 'D' represents the diastolic blood pressure
- Once the arterial Cannula has been secured with a suture, apply the transducer dressing to Cannula over the insertion site

- All lines connected to the transducer and related to the arterial line should be labelled red as per National Standard for User-applied Labelling of Injectable Medicines, Fluids and Lines
- Ensure flush line is secure to patient with Velcro strap from transducer kit, and/or secure further with a bandage for patients moving.

Specific Observations

- The limb distal to the insertion site should remain in sight at all times, accidental disconnection of an arterial line can quickly result in catastrophic haemorrhage. The limb must also be checked at regular intervals for warmth, sensation, colour and pulses
- Clinical observations should be in line with prescribed parameters defined for each patient and at a minimum should include:
 - Recording of transduced pressure hourly
 - Manual non-invasive blood pressure at least 8 hourly to compare for arterial line reading accuracy
 - Regular neurovascular assessment of cannulated limb
 - 4 hourly Temperature recording
 - Pressure injury risk - gauze or pressure prevention dressing under transducer and minimum 2 hourly splint/pressure area care

Compliance Monitoring

Failure to comply with this policy document may constitute a breach of the WA Health Code of Conduct (Code). The Code is part of the [Integrity Policy Framework](#) issued pursuant to section 26 of the [Health Services Act 2016](#) (HSA) and is binding on all WACHS staff which for this purpose includes trainees, students, volunteers, researchers, contractors for service (including all visiting health professionals and agency staff) and persons delivering training or education within WACHS.

WACHS staff are reminded that compliance with all policies is mandatory.

Records Management

[Health Record Management Policy](#)

Relevant Legislation

- *Acts Amendment (Consent to Medical Treatment) Act 2008*
- *Carers Recognition Act 2004*
- *Civil Liability Act 2002*
- *Disability Services Act 1993*
- *Equal Opportunity Act 1984, Equal Opportunity Regulations 1986*
- *Guardianship and Administration Act 1990*
- *Health Practitioner Regulation National Law (WA) Act 2010*
- *Mental Health Act 1996*
- *Occupational Safety and Health (OSH) Act, 1984 (Amended 2011)*
- *OSH Regulations, 1996*
- *Poisons Act 1964*
- *Poisons Regulations 1965*
- *Poisons Amendment Regulations 2010*
- *Public Sector Management Act, 1994*

Relevant Standards

- [National Safety and Quality Health Service Standards](#)
 - Action 3.5 The risk of infected patients, the workforce and visitors is minimised by the routine application of basic infection prevention and control strategies
- Australian Commission on Safety and Quality in Health Care (ACSQHC) [National Standard for User-applied Labelling of Injectable Medicines, Fluids and Lines](#)
- National Health and Medical Research Council (NHMRC) [Australian Guidelines for the Prevention and Control of Infection in Healthcare](#)

Related WA Health System Policies

- MP0095 [Clinical Handover Policy](#)
- MP0122/19 [Clinical Incident Management Policy](#)
- OD0651/16 [Clinical and Related Waste Management Policy](#)
- MP0084/18 [Credentialing and Defining Scope of Clinical Practice Policy](#)
- MP0131/20 [High Risk Medication Policy](#)
- MP0104/19 [Medication Review Policy](#)
- MP0086/18 [Recognising and Responding to Acute Deterioration Policy](#)
- OD0657/16 [WA Health Consent to Treatment Policy](#)
- MP0053/17 [WA Clinical Alert \(Med Alert\) Policy](#)
- MP0051/17 [WA Health System Language Services Policy](#)

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Relevant WACHS documents

[Clinical Escalation of Acute Physiological Deterioration including Medical Emergency Response Policy](#)

[Clinical Observation and Assessments Clinical Practice Standard \(physiological, neurovascular, neurological and fluid balance\)](#)

[Documentation Clinical Practice Standard](#)

[Infection Prevention and Control Policy](#)

[Inter-hospital Clinical Handover Form Procedure](#)

[MR1 WACHS Emergency Department Notes](#)

[MR140A Adult Observation Chart](#)

[MR140B Maternity Observation Chart](#)

[MR144 WACHS Fluid Balance Worksheet](#)

[MR170A WA Hospital Medication Chart](#)

[MR184 WACHS Inter-hospital Clinical Handover Form](#)

[Personal Protective Equipment \(PPE\) Procedure](#)

Policy Framework

[Clinical Governance, Safety and Quality Policy Framework](#)

Acknowledgement

Acknowledgment is made of the previous SMHS / WACHS site endorsed work used to compile the Arterial Line Insertion – Transducing and Monitoring Clinical Practice Standard 18 March 2015.

References

1. Beer K, Cherry T, Joy H, Hemmings K, Simpson S. Nursing practice standard for the management of arterial catheter (brachial, femoral, radial and dorsalis pedis artery). *Management of arterial catheters (brachial, femoral and radial)*. Perth: Royal Perth Hospital; 2010:
2. Critical Care Clinical Governance Lead. Guidelines for the management of arterial lines: TCP 211. Sussex: Brighton and Sussex University Hospitals NHS TRust; 2009.
3. Australian Commission for Safety and Quality in Health Care, National Health and Medical Research Council. Australian guidelines for the prevention and control of infection in healthcare Canberra, ACT: NHMRC; 2010: <https://www.nhmrc.gov.au/about-us/publications/australian-guidelines-prevention-and-control-infection-healthcare-2019> . Accessed 3 April 2020.
4. Joanna Briggs Institute. Arterial Line: Insertion (recommended practices). Adelaide: Joanna Briggs Institute; 2012:

5. Joanna Briggs Institute. Arterial Line: Management (recommended practices). Adelaide: Joanna Briggs Institute; 2009:
6. Blackburn J, Walton B,.Journall of Anaesthesia Practice. Riskd associated with arterial lines: Time for a National Safety Standard; November 10, 2016: accessed 17/05/2019:
7. Fiona Stanley Fremantle Hospitals Group, Transducer Monitoring Management (with a Continious Flush Device). Accessed 24/05/2019:
- 8: Fremantle Hospital and Allied Health Service Nursing Practice. Arterial Catheters Management Procedure: 2015:
- 9: Ailon J., Mourad O., Chien V.,Saun T., and P Shelly. Ultrasound -Guided Insertion of a Radial Arterial Catheter: The New England Jouranal of Medicine; Oct 2019:

Definitions

Carer	A person who provides personal care, support and assistance to another individual who needs it because they have a disability, a medical condition (including a terminal or chronic illness) or a mental illness, or are frail and/or aged
Patient	A person who is receiving care in a health service organisation

Appendices

Appendix 1: [Troubleshooting Transducer Monitoring Management](#)

Appendix 2: [Transducer Line Changes](#)

Appendix 3: [Blood Gas Sample Collection](#)

Appendix 4: [Safe Set™ Closed Blood Sampling System](#)

Appendix 5: [Removal of Arterial Line](#)

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Appendix 1: Troubleshooting Transducer Monitoring Management⁷

PROBLEM	TROUBLESHOOTING
No waveform	<ul style="list-style-type: none"> • Check patient • Ensure stopcocks are not turned off to patient • Check zero reference and calibration equipment • Check for loose connection in the pressure-monitoring line • Ensure that the connecting tubing is not kinked or compressed • It is possible that the catheter is occluded or has moved out of the artery. If this is suspected, try to aspirate blood from the line
Waveform drifting	<ul style="list-style-type: none"> • Temperature change of IV solution (new flush bag hung) or environmental temperature change • Re-zeroing the system
Unable to flush line with continuous flush device	<ul style="list-style-type: none"> • Check stopcocks and tubing for kinks • Check that the pressure bag is inflated to the appropriate level (300mmhg) • Reposition catheter to move it away from vessel walls or remove catheter kink • Aspirate with a syringe (do not apply excessive force to aspirate)
Reading too high	<ul style="list-style-type: none"> • Check zero and calibration • Check to see if transducer is still located at the phlebostatic axis level • Check stopcocks and make sure they are open to the patient • Check flow rate of the automatic flush device (flow too fast (the standard flush delivers 3microdrops/min
Reading too low	<ul style="list-style-type: none"> • Check to see if transducer is still located at the phlebostatic axis level • Check for loose connection in the pressure-monitoring line and leaks • Check for air bubbles • Re-zero and calibration
Artefact	<ul style="list-style-type: none"> • Check for electrical interference • Check for kinks in the tubing • Check for blood in the system • Suspect possible occlusion at the catheter tip (thrombus) • Check stopcocks, tubing & catheter patency • If attempts to troubleshoot are unsuccessful, inform shift coordinator/MO and escalate review

Appendix 2: Transducer Line Changes

Equipment:

- Gloves [Non sterile]
- Safety glasses
- Infusion pressure bag
- Sodium Chloride 0.9% 500mls
- Arterial transducer set
- Dressing pack
- Cleaning solution
- Clear dressing e.g. Opsite™ 3000

Procedure

- Don safety equipment and silence monitor alarms. Explain procedure to patient as necessary
- Spike the 500mL bag of sodium chloride 0.9% with the pressure transducer line, The line should be fully primed and then inflate the pressure bag to 300 mmHg
- With assistance, remove dressing from arterial line site; observe for excessive bleeding, inflammation or infection
- Clean area with antiseptic solution and dry.
- Ask colleague to occlude the artery proximal to the insertion site. Note: If occlusion is effective waveform will be flattened
- Whilst the artery remains occluded unscrew flush line and remove. Replace immediately with clean line
- Ensure colleague supports new line and cannula to avoid dislodgement
- Ensure transducer is attached to pressure cable and monitor, and that there is an identifiable arterial trace
- Apply clear dressing to cannula over the insertion site
- Ensure flush line is secure to patient with velcro strap from transducer kit
- Document in the patient notes, Wound Management Plan and on the Nursing Care Plan the line change and dressing type. Dressings should be changed every seven days, or sooner if visibly soiled.⁵
- Observe the limb, distal to the insertion site for warmth, sensation, colour and pulses if applicable.
- Transducer line to be changed every 72 hours and prn. This is to include all lines from insertion site to and including continuous flush device.¹

Appendix 3: Arterial Blood Gas (ABG) Sample Collection

ABG samples left at room temperature need to be analysed within 10-15 mins of collection, and require collection anaerobically and anticoagulated with immediate expulsion of any air bubbles.⁸

Equipment

- Gloves
- Safety glasses/goggles
- 2mL syringe
- Arterial blood gas (ABG) syringe
- Sterile gauze swabs
- Alcohol swabs

Procedure

- Don safety equipment, silence monitor alarms and explain procedure to patient as necessary
- Ensuring the three way tap is turned-off to the patient remove cap from three way tap
- Place on sterile gauze swab.
- Clean the exposed port on three way tap with alcohol swab
- Place 2mL syringe on exposed port. Rotate three way tap to enable blood to be drawn from patient



- Following aspiration of 2mL blood, rotate the three way tap 45 degrees. Remove 2mL syringe and dispose of in 'waste for incineration' bin when convenient



- Attach ABG syringe to exposed port. Rotate the three way tap in order to draw blood from the patient



- Remove ABG syringe, expel any air, replace the cap on the tip of the syringe and agitate sample.
- Following the aspiration of blood, turn three way tap to allow flush to come through the side port. With a sterile gauze swab under the side port, flush until clear



- Rotate the three way tap to enable the line to be flushed to the patient. Flush several times for no longer than two seconds at a time until line is clear of blood, clean side port with alcohol swab and replace cap
- Turn three way tap to original position in order to obtain arterial trace
Ensure the arterial trace is identifiable



Appendix 4: Safe Set™ Closed Blood Sampling System



Setup and Priming

- Remove kit from sterile package and secure all connections
- For priming use gravity or pump pressure only
- Activate flow of IV fluid and squeeze the flush device to prime
- Clear the monitoring system of air through the zeroing stopcock of the transducer
- Change the white vented cap to a non-vented cap
- Release the locking mechanism on the SafeSet™ in-line reservoir by depressing the ridged area of the plunger clip
- Pull the in-line reservoir plunger back to minimum 2 mls
- Hold the SafeSet™ in-line reservoir in the upright position with the tip pointed up
- Activate the flush device. Check for adequate removal of any air bubbles at the tip of the SafeSet™ reservoir, allowing fluid to go past the 1-way stopcock distal to the SafeSet™ reservoir
- Close the SafeSet™ reservoir until it is in the locked position. Continue to flush until all air is cleared from the system
- Attach the male luer to the patient's Cannula being certain not to introduce air into the system during the connection procedure
- [Level & Zero](#)

Appendix 5: Removal of Arterial Line

It is not recommended that arterial cannulas are routinely replaced, however when no longer required it should be promptly removed.⁵

Equipment

- Gloves Safety glasses/goggles
- Dressing pack
- Sterile gauze swabs
- Stitch cutter
- Antiseptic solution
- Adhesive tape
- Specimen container
- Sterile scissors

Procedure

- Assess the patient's coagulation status including recent coagulation results if available
- Re-confirm the arterial is no longer required
- Ensure the patient is comfortable and the arterial line is easily accessible. Explain the procedure as necessary
- Don safety equipment and silence the alarms
- Turn three way tap off to patient, deflate pressure bag
- Remove dressing from arterial cannula site
- Clean site with antiseptic solution
- Cut suture if present
- Whilst applying firm pressure to the entry site with sterile gauze swab, remove arterial Cannula and place on second sterile gauze swab
- **Maintain firm pressure for five minutes, or until bleeding stops**
- Apply a third sterile gauze swab as a dressing
- Ensure insertion site remains visible at all times and monitor for haematoma or signs of bleeding
- Document removal on Nursing Care Plan and Wound Management Plan
- If required aseptically preserve Cannula tip by cutting with sterile scissors and placing in specimen container and send to microbiology

Post Procedure

- Continue to observe site frequently, for bleeding and for distal circulation
- Patient to remain immobilised for at least 30 mins following arterial line removal to prevent active bleeding from insertion site.