UHL *Intraosseous (IO) cannulation in Adults and Children(s)* Safety Standard Operating Procedure (LocSSIPs)

Change Description	Reason for Change
□ Change in format	□ Trust requirement

APPROVERS	POSITION	NAME
Person Responsible for Procedure:	Appropriately trained practitioner	
SOP Owner:	Emergency Medicine Consultant	Katie Meimeti
Sub-group Lead:	Emergency Medicine Consultant	Katie Meimeti

Introduction and Background:

1.1 INTRODUCTION

1.1.1 This document provides guidance for Healthcare Professionals on the use of emergency intraosseous (IO) cannulation in adult and pediatric patients in Leicester Royal Infirmary.

1.1.2 Intraosseous cannulation is the insertion of a needle into a bone to allow the delivery of medications in emergency situations. When Intravenous access has failed, is inadequate, unlikely to be achieved or would significantly delay time critical treatment, intraosseous cannulation should be used. IO access has been included in the Resuscitation Council UK (2021) Advanced Life Support guidelines and Advanced Paediatric Life Support for cases in which intravenous access is difficult or unavailable.

1.1.3 Primary Intraosseous sites for the EZ-IO include the proximal humerus, distal femur, proximal tibia and distal tibia. Insertion sites should be used only when landmarks can clearly be identified. The EZ- IO may remain in place for up to 24 hours.

1.2 SCOPE

1.2.1 This guideline is a LOCSSIP for IO cannulation in line with NATSSIP requirements. (UHL Policy on Safety Standards for Invasive Procedures).

1.2.2 This guideline applies to all clinical staff that inserts EZ-IO devices and/or cares for and maintains intraosseous cannulas for adult and pediatric patients within UHL.

1.2.3 Individual clinical staff who undertakes intraosseous insertion, use intraosseous cannula or remove intraosseous cannula must:

- Understand the UHL guideline on EZ-IO insertion. All staff has a responsibility for ensuring that the principles outlined within this document are applied.
- Receive training before practicing and attend a refresher as required.
- Take responsibility for arranging further practice to maintain and increase competency within the workplace.
- Practice in accordance with their own professional duties.
- Practice universal precautions.
- Practice an aseptic non-touch technique.
- Follow the UHL sharps injury procedure.
- Delegate to a more experienced practitioner if they are not competent to insert, use or remove intraosseous cannula.

2.1 STANDARDS FOR PRACTICE

All staff undertake intraosseous cannulation must have:

- Knowledge of this policy, the Vascular Access UHL policy and Infection Control policy.
- Understand their legal responsibilities.
- Have a knowledge of the anatomy and physiology of the various intraosseous cannulation sites.
- This procedure is only to be undertaken if trained to do so. Practitioners with current verified ATLS, APLS and ALS status, are considered as trained.
- If unsure of their competency in this procedure, hand over the responsibility to a more expert practitioner. The practitioner must ensure that the person delegated to perform the task is competent to do so.
- Only attempt intraosseous insertion twice in adults and once in pediatric patients
- If unsuccessful ask for a more experienced practitioner to make further attempts

2.2 INDICATIONS

2.2.1 EZ-IO devices should be considered where there is no or inadequate IV access and an immediate need for fluids and/or medication to treat or prevent cardiac arrest, peri-arrest or emergency situations.

2.2.2 Other situations where there is no or inadequate IV access and IV access is difficult or has failed and there is an immediate or urgent need for fluids and/or medication – any delay in establishing vascular access can be potentially life threatening.

Considered scenarios

1. Unsuccessful IV access
2. Shock
3. Sepsis
4. Refractory seizure activity
5. Peri arrest
6. Cardiac arrest
7. Major trauma

2.3 CONTRAINDICATIONS

- If a patient with capacity refuses consent.
- If the practitioner is put at risk (e.g., lack of patient compliance).
- Fracture in the targeted bone.
- Abnormalities / illness to the targeted bone (osteoporosis, osteogenesis imperfecta)
- Crush injuries to the targeted bone
- Ipsilateral vascular injuries
- Excessive tissue or absence of adequate anatomical landmarks.
- Infection at area of insertion site.
- Previous, significant orthopaedic procedure at site (e.g. prosthetic limb/joint).
- IO access in targeted bone within past 48 hours.

2.4 POSSIBLE COMPLICATIONS

The following are potential complications, and the patient should be observed for;

- Extravasation of fluid.
- Compartment syndrome- in infants, palpate the calf as well as visual inspection.
- Fracture of target bone.
- Infection.
- Pain on insertion.
- Skin necrosis.
- Embolism.
- Osteomyelitis

List management and scheduling:

Intraosseous Cannulation is used in emergency situations where any delay in establishing vascular access can be potentially life threatening, hence there is no booking list or scheduling required for this procedure.
The team who is looking after the patient will decide whether IO cannulation is required and will perform the procedure. The clinician who has performed the procedure is responsible to complete the **Invasive procedure safety checklist** (found in **appendix 2** of this document) and initiate the **Intraosseous access monitoring fo**rm (found in **Appendix 3** of this document). If the patient is moved to another area the receiving team is then responsible to continue the monitoring form and remove the intraosseous access, in line with the procedure guideline.

Workforce – staffing requirements:

1. **All staff undertake intraosseous cannulation must have:**

- Knowledge of this policy, the Vascular Access UHL policy and Infection Control policy.
- Understand their legal responsibilities.
- Have a knowledge of the anatomy and physiology of the various intraosseous cannulation sites.
- This procedure is only to be undertaken if trained to do so. Practitioners with current verified ATLS, APLS and ALS status, are considered as trained, including doctors and nursing staff if they have a valid in date APLS/ ALS or ATLS certificate and are confident to perform the procedure**.**
- If unsure of their competency in this procedure, hand over the responsibility to a more expert practitioner. The practitioner must ensure that the person delegated to perform the task is competent to do so.
- Only attempt intraosseous insertion twice in adults and once in pediatric patients
- If unsuccessful ask for a more experienced practitioner to make further attempts

Patient preparation:

Please refer to 2.3 Contraindications

- ✓ **Consider using anesthetic for patients responsive to pain:**

Review manufacturer's lidocaine instructions for use prior to administration and observe recommended cautions/contraindications to using 2% preservative free and epinephrine free lidocaine intravenous lidocaine

1. Confirm lidocaine dose (1.5mg/kg maximum 120 mg in total)

2. Prime EZ-Connect extension set with lidocaine
Note that the priming volume of the EZ-Connect extension set is approximately 1.0ml

3. Slowly infuse lidocaine over 120 seconds.
a. Adults: Typical initial dose is 40mg
b. Infant/Child: Typical initial dose is 0.5mg/kg, not to exceed 40mg

4. Allow lidocaine to dwell in IO space 60 seconds

5. Flush with normal saline
a. Adults: 5–10ml
b. *i*nfant/Child: 2–5ml

6. Slowly administer an additional dose of lidocaine IO over 60 seconds.
Repeat PRN
a. Adults: Typical dose is 20mg
b. Infant/Child: Half the initial dose

7. Consider systemic pain control for patients not responding to IO lidocaine

- ✓ Consider stopping using the line in conscious patients that pain is not controlled

- ✓ ***Caution***
*The stylet and catheter are made from tungsten steel and therefore are **NOT** MRI compatible- Therefore, must not go into an MRI scanner.*

- ✓ **Please note**: proximal tibia and femoral access is the preference for children – adults preference is humerus
  - humerus placement in infants is tricky because anatomical landmarks are not developed clearly

Procedural Verification of Site Marking:

EQUIPMENT REQUIRED

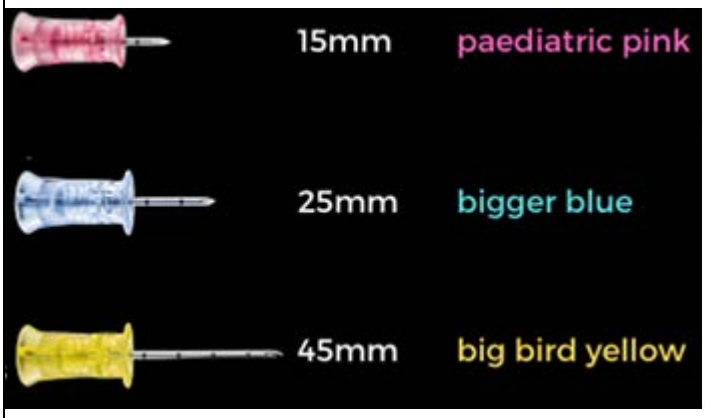
1. NEEDLES

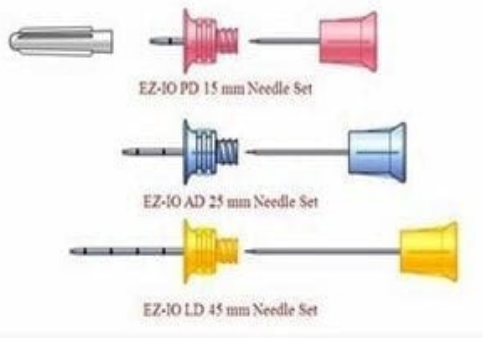
1.1 An EZ-IO power driver and suitably size EZ-IO needle based on patient size and weight. The weight range on EZ-IO needle sets is a guide only and not an absolute indication that the needle is appropriate for a particular weight. The most important check of correct needle length is once it is inserted through the skin and soft tissue and makes contact with the target bone, there must be a least one black mark on the needle still visible.

All reusable equipment (the EZ-IO power driver) must be reprocessed in line with manufacturer's instructions.

1.2 Needles are:

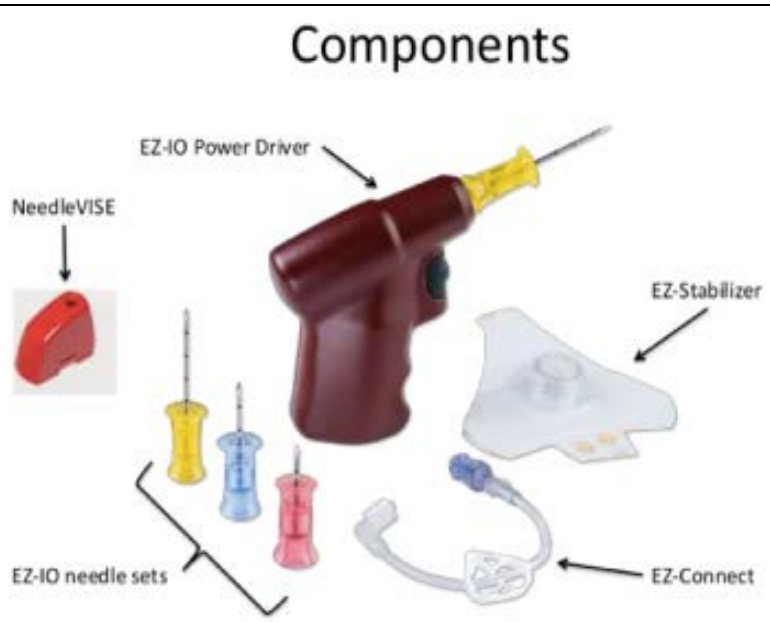
- Pink: 15mm, 3-39kg (typically used in infants and small children).
- Blue: 25mm, 3 kg or over (typically used in children and adults).
- Yellow: 45mm, 40kg or over (typically used in larger adults and for humeral insertion).





2. EQUIPMENT COMPONENTS:

- EZ-Connect (extension set with needle free connector).
- 0.9% Sodium Chloride flush.
- Two empty 10ml syringes (if attempting a sample collection).
- Consider preservative free 2% lidocaine for patients responding to pain.
- Non-sterile non latex gloves.
- 2% Chlorhexidine in 70% Isoprolol wipe. (e.g.skin wipe).
- EZ IO stabilizer dressing.
- Cannulation tray.
- Sharps bin.



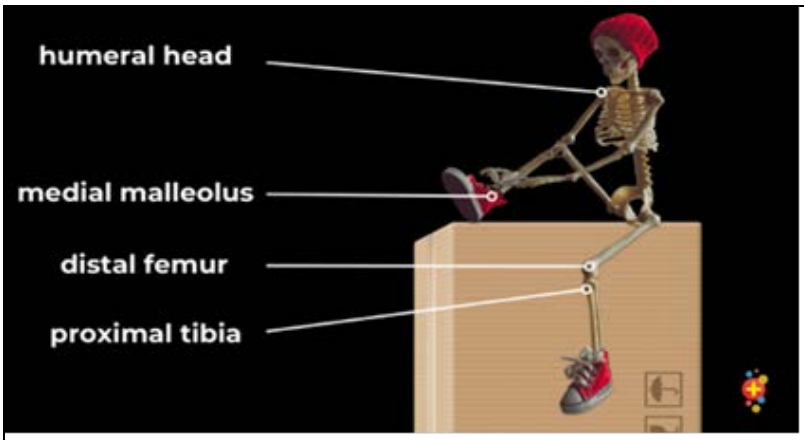
***** TECHNICAL NOTES**

Guidance from a leading manufacturer of battery-powered IO injectors states that “a green light indicates it is suitable for use, a flashing red light indicates there is only 10% of battery life remaining. Purchase and replace [the injector] when the red LED begins blinking”

3. EZ-IO PROCEDURE

3.1 PREPARATION

- Wear personal protective equipment.
- Obtain suitable assistance as required.
- Identify the patient: Check name, date of birth and hospital number.
- Ascertain the need for IO cannulation and if possible, obtain consent as per UHL policy.
- Choose an appropriate sterile needle set and assemble equipment including appropriate receptacle for sharps.
- Draw up 10mls Sodium Chloride 0.9% solution into syringe.
- Connect the syringe to the EZ-Connect lumen and prime with normal saline solution- leave the syringe attached to EZ-Connect.



3.2 ASSESSMENT

Locate target site on selected limb and assess viability for needle insertion.

- Proximal Tibia- Insertion site is approximately 2cm below the patella and approximately 2cm (depending on patients' anatomy) medial to the tibial tuberosity.
- Distal Tibia- Insertion site is located approximately 3cm proximal to the most prominent aspect of the medial malleolus. Place one finger directly over the medial malleolus; move approximately 2cm proximal and palpate the anterior and posterior borders of the tibia to assure that your insertion site is on the flat center aspect of the bone.
- Distal femur Midline, 2-3 cm above the external condyle or two fingerbreadths above the superior border of the patella. This is often an accessible site due to children having less muscle bulk. To ensure you avoid the growth plate, the leg should be outstretched when performing your land marking's above and aim about 15 degrees cephalad too.
- Proximal Humerus- Insertion site is located directed on the most prominent aspect of the greater tubercle. Slide thumb up the anterior shaft of the humerus until you feel the greater tubercle, this is the surgical neck. Approximately 1cm (depending on patient anatomy) above the surgical neck is the insertion site. Ensure that the patient's hand is resting on the abdomen and that the elbow is adducted (close to the body).

✓ See appendix 1 for diagrams of insertion sites

Team Safety Briefing:
Appendix 2 Local Safety standards for Invasive Procedure: IO access Invasive procedure safety checklist PRATICE RECORD FOR INTRAOSSEOUS CANNULATION USED FOR EMERGENCY INTRAVASCULAR ACCESS
Sign In:
Appendix 2 Local Safety standards for Invasive Procedure: IO access **Invasive procedure safety checklist** PRATICE RECORD FOR INTRAOSSEOUS CANNULATION USED FOR EMERGENCY INTRAVASCULAR ACCESS
Time Out:
Appendix 2 Local Safety standards for Invasive Procedure: IO access **Invasive procedure safety checklist** PRATICE RECORD FOR INTRAOSSEOUS CANNULATION USED FOR EMERGENCY INTRAVASCULAR ACCESS

Performing the procedure:

INSERTION

- Clean site using cleaning agent currently being used for IV cannulation.

** ANTT is a set of clinical guidelines aimed at standardising aseptic practice in clinical procedures which involve the introduction or access of invasive devices or contact with mucosa or broken skin including IO cannulation. As successful ANTT requires the practitioner to identify 'key parts' which must not be contaminated during the procedure. Key parts are anything that is introduced into the body, in this case the end of the sharp needle. Non touch means not touching key parts and not allowing key parts to come into contact with anything other that another key part ie; a syringe tip and an IO access port.
Due to the fact that IO is usually an emergency procedure an aseptic field, is not required.

- Stabilize the Limb of the selected target site.
- Insert EZ-IO needle into the selected site.
- Position the driver at the insertion site with the needle set at a 90-degree angle to the bone surface. Gently pierce the skin with the needle set until the needle set tip touches the bone.
- Check to ensure that at least one black line is visible, and the needle is touching the bone. If no black line is visible, the patient may have excessive soft tissue over selected insertion site and needle set may not reach the medullary space. Consider an alternative site for insertion or a longer needle.
- Penetrate the bone cortex by squeezing the driver's trigger and applying gentle, consistent, steady, downward pressure (allow the driver to do the work).
- Release the driver's trigger and stop the insertion process when the hub is almost flushed with the skin or when you feel a decrease in resistance.
- Remove EZ-IO power driver from needle set while stabilizing the catheter hub.
- Remove stylet from catheter by turning counter clockwise and immediately dispose of stylet in an appropriate sharp's container.

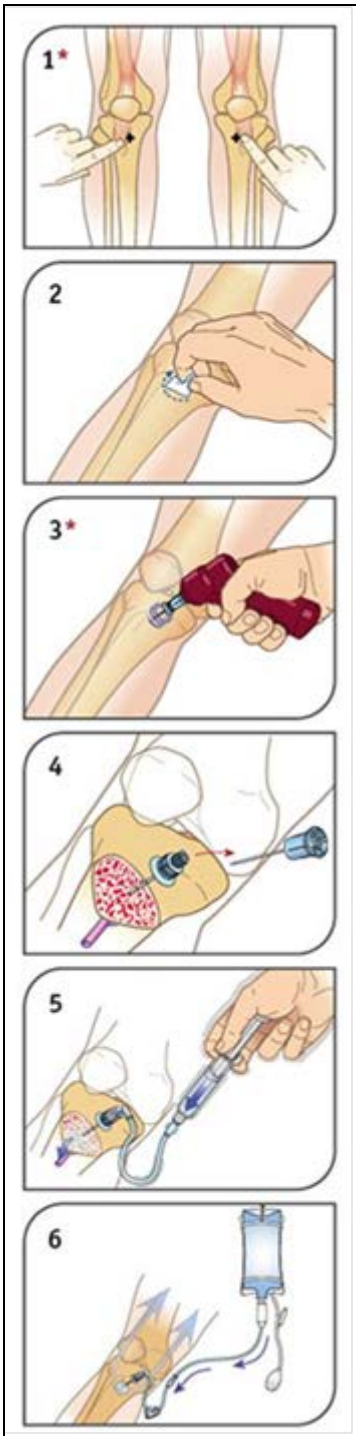
- Connect primed EZ-Connect to exposed luer-lock hub on EZ-IO needle.

- Confirm placement by aspirating bone marrow into EZ-Connect.

- Syringe bolus: flush the catheter with the remaining Sodium Chloride 0.9%.

- Assess for post-insertion complications.

- Disconnect 10ml syringe from EZ-Connect extension set and provide therapy


1*
2
3*
4
5
6

✓ What medications and fluids can be infused via the catheter?

Virtually any fluid and medication that can be safely infused via peripheral IV route may be safely infused through the IO route using the same dosage, rate and concentration. Adequate flow rates are dependent on periodically performing a syringe flush and infusing fluids and medications under pressure via infusion pump, pressure bag or syringe boluses.

✓ Laboratory Analysis/ Blood Sampling

Based on preclinical and clinical evidence comparing IO and venous or arterial blood specimens a number of common laboratory values correlate well; other values show clinical similarity without statistically significant correlation, therefore caution should be exercised with their interpretation.

Specimens must be identified as IO blood and must call the lab!

Monitoring:

The patient will be monitored throughout the time in the procedural area. Consider:

- O2 Sats
- ECG
- Blood Pressure
- Pulse rate
- Respiratory rate
- GCS
- Temp
- BMs

Guidance from a leading manufacturer of battery-powered IO injectors states that “a green light indicates it is suitable for use, a flashing red light indicates there is only 10% of battery life remaining. Purchase and replace [the injector] when the red LED begins blinking

Radiography:

- ✓ The stylet and catheter are made from tungsten steel and therefore are NOT MRI compatible- Therefore, must not go into an MRI scanner.

Sign Out:

Please refer to
Appendix 2
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Handover:

If the patient is transferred to another ward/ area for further management the receiving team should receive handover regarding the IO access – and continue the **IO access Monitoring form and removal in line with the guideline (Appendix 3)**

Team Debrief:

Debrief should include:

- Things that went well
- Any problems with equipment or other issues
- Areas for improvement
- An action log – please complete Invasive procedure safety checklist and the Intraosseous access Monitoring form as well as the Removal form
- Named person for escalating issues : Katie Meimeti (PEM Consultant)

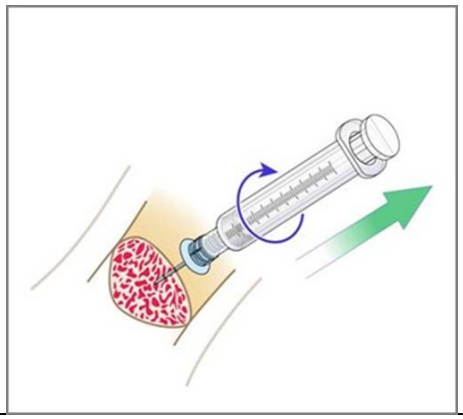
Post-procedural aftercare:

EZ-IO AFTERCARE

- Begin infusion utilizing a pressure delivery system- via a pressure bag or syringe.
- Secure needle using an appropriate dressing.
- Continue to monitor extremity for complications on a regular basis, especially pre and post infusions.
- Document time, date rationale and any supporting information for EZ-IO insertion in the medical notes.
- Ensure all multi-disciplinary staff is fully informed of the procedure.
- Insert care pathway into patients notes (see appendix 3).

4.5 EZ-IO REMOVAL

- Remove the extension set from the needle hub.
- Attach a sterile syringe (with standard Luer lock) to act as a handle and to cap the open IO port.
- Grasp the syringe and continuously rotate clockwise while gently pulling the catheter out (maintain a 90-degree angle to the bone). Do not rock or bend during removal.
- Dispose of IO needle into an appropriate receptacle for sharps.
- Apply pressure to site as needed; apply adhesive dressing as indicated.
- The catheter should not remain in place for greater than 24 hours.
- Document time and date of removal in medical and nursing notes.



Governance and Audit:

All incidents will be reported on Datix

Documentation:

Please refer to Appendix 2 and Appendix 3

Training:

EDUCATION AND TRAINING

- ✓ Intraosseous cannulation, use and removal require training prior to practice.
- ✓ Training will be provided on all Resuscitation Council (UK) Advanced Life Support and Modified Immediate Life Support courses. These can be accessed via the clinical skills unit National course lead/Senior Resuscitation Officer. Non-medical (Nursing staff) can perform IO cannulation if they have a valid in date APLS/ALS or ATLS certificate and are confident to perform the procedure.
- ✓ Refresher training is not mandatory, but practitioners must be satisfied that they are meeting their professional requirements and seek training if there is any doubt about their competency.
- ✓ Use of the IO cannula is similar to the use of an IV cannula and staff that uses these cannulas must also undertake an intravenous course.

References to other standards, alerts and procedures:

NatSSIPs and the UHL Safer Surgery Policy:
National Safety Standards for Invasive Procedures, NHS England 2015:
https://www.england.nhs.uk/patientsafety/wp-content/uploads/sites/32/2015/09/natssips-safety-standards.pdf
UHL Sedation Policy: Safety and Sedation of Patients Undergoing Diagnostic and Therapeutic Procedures B10/2005
UHL Consent to Treatment or Examination Policy A16/2002
UHL Delegated Consent Policy B10/2013

Supporting References

Vidacare Corporation: ***The Science & Fundamentals of Intraosseous Vascular Access*** *(2013) Science and Clinical Department.*

Resuscitation Guidelines: ***Advanced Life Support*** *(2021), Resuscitation Council.*

https://dontforgetthebubbles.com/intraosseous-access/

Teleflex, the main supplier of battery-powered IO injectors, provide training and resource material
https://www.teleflex.com/emea/en/index.html

on its website. The training materials include techniques to avoid stalling, how to overcome stalling and how to continue the procedure manually if unable to resume use of the injector

CONTACT AND REVIEW DETAILS

Guideline Lead

Dr Katie Meimeti – Consultant in Emergency Medicine

Details of Changes made during review:

- ✓ More information given for the care of IO needles, including a care pathway, information sheet and insertion site diagram.
- ✓ Stated that this guideline is a LOCSSIP for IO cannulation.
- ✓ Limb monitoring chart for hourly observations.
- ✓ Clarified that this procedure is only to be undertaken if trained.
- ✓ Clarified that UHL uses the EZ-IO system.
- ✓ Reviewed by the Resuscitation Committee

Appendix 1

Intraosseous Insertion Sites

Please note: proximal tibia and femoral access is the preference for children – adults preference is humerus
humerus placement in infants is tricky because anatomical landmarks are not developed clearly

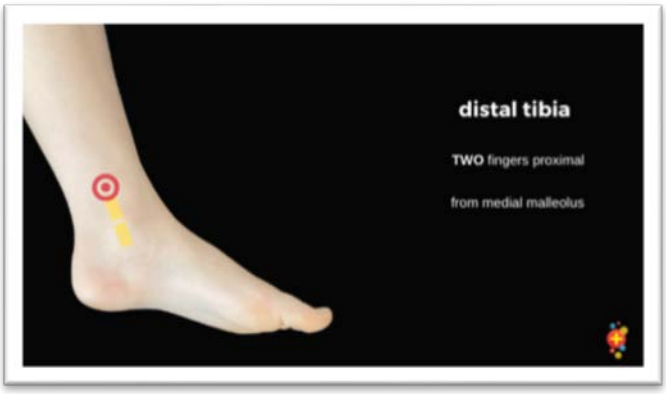
Ensure adequate training has been taken in the correct land marking techniques for the following sites, prior to using the IO

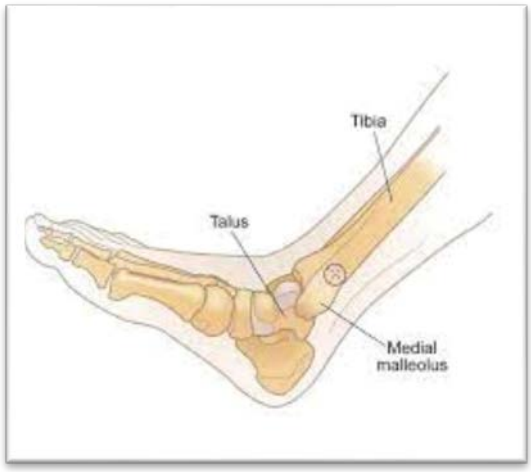
Proximal Tibia-

Insertion site is approximately 2cm below the patella and approximately 2cm (depending on patients' anatomy) medial to the tibia tuberosity. Placing the needle over the landmark site at 90 degrees.

Distal Tibia

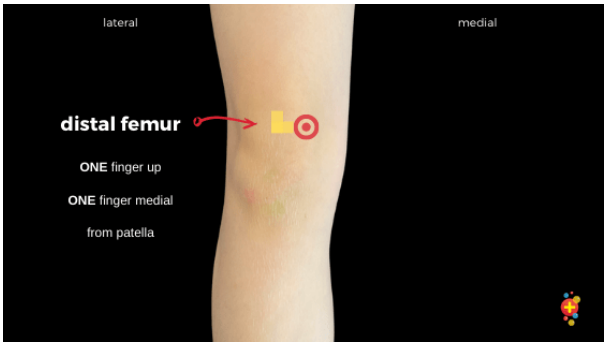
Place one finger directly over the medial malleolus; move approximately 3 cm or 2 fingerbreadths proximal and palpate the anterior and posterior borders of the tibia to assure that your insertion site is on the flat center aspect of the bone.

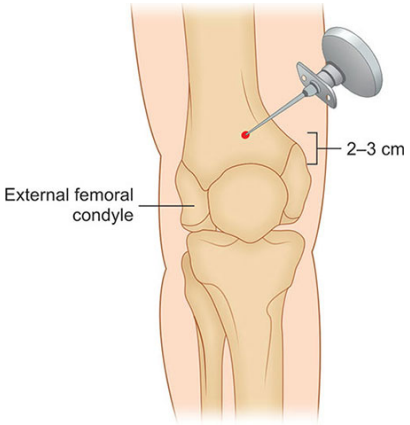




Distal Femur

Midline, 2-3 cm above the external condyle or two fingerbreadths above the superior border of the patella. This is often an accessible site due to children having less muscle bulk. To ensure you avoid the growth plate, the leg should be outstretched when performing your land marking's above and aim about 15 degrees cephalad too.



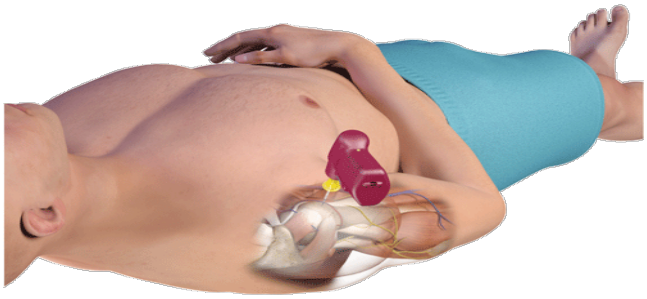


Humeral Head: Paeds specifications – not for infants

- **The humeral head represents an excellent access point for large proximal vasculature (lies closer to the heart). Flow rates may be higher here too due to lower intramedullary pressures. The greater tuberosity secondary ossification centre doesn't appear until about 5 years of age making palpation of this landmark more of a challenge in the younger child. For this reason, it is more often used in older children, typically over 7 years of age or only in those in whom the anatomy can be readily identified.**
- **You may need to consider using a longer needle here due to the larger amount of soft tissue over this axillary area.**
- **The insertion site is located directly on the most prominent aspect of the greater tubercle. 1 cm above the surgical neck. The surgical neck is where the bone juts out slightly – you will find this by running a thumb up the anterior aspect of the humerus until you feel a prominence. This is the greater tuberosity. The insertion site is approximately 1cm above this.**

Humeral IO placement techniques:

- **Thumb to Bum – Move the patient's hand (on the targeted arm) so that the patient's thumb and dorsal aspt of hand rest against the hip ("thumb-to-bum").**
- **Palm to umbilicus – Move the patient's hand (on the targeted arm) so that the palm rests over the umbilicus, while still maintaining the elbow close to the body.**



Appendix 2

Local Safety standards for Invasive Procedure: IO access
Invasive procedure safety checklist

PRATICE RECORD FOR INTRAOSSEOUS CANNULATION USED FOR EMERGENCY INTRAVASCULAR ACCESS

Patient's identity sticker

Signature of the operator	

Indication for IO access	
Operator (name and Grade)	
Operator specialty	
Site of insertion	
Clinical area	
Procedure date	
Supervisor (if required)	
Lever of supervision	
Assistant	

BEFORE THE PROCEDURE	**Y**	**N**
Appropriate consent if applicable		
Is all equipment available?		
Hand washed by operator and assistant		
Any concerns before the procedure? If yes, please specify		

SIGN OUT	
Number of attempts	
Size of needle	
Site of insertion	
Area cleaned appropriately before insertion	
Secured with appropriate dressing	
Post insertion complications	

Appendix 3

Intraosseous access Care Pathway

A. *Information sheet for the* ***Care and Maintenance*** *of IO needles.*

How to assess the IO site for patency

- If there are no signs of complications or infection, attempt a flush of 5-10mls 0.9% Normal Saline.
- If there is resistance in the line, perform a rapid syringe flush of 5-10 mls 0.9% normal saline. ***(This helps clear the intraosseous marrow and fibrin allowing for effective infusion rates.)***
- Complete flushes minimal of 8 hourly.

What to assess

- Frequent assessment is essential for safe vascular access management.
- Verify placement prior to each infusion.
- Assess for signs of complications- including infiltration/ extravasation.
- Assess flow rates and for any pharmacological effects of infusions.
- Whilst IO needles are in place in the humerus, movement of the affected arm should be minimized- it must not be elevated above the shoulder.
- Patients must not have an MRI whilst the IO needle is in place.

Signs of Infiltration/ extravasation

- Inflammation at or near the insertion site.
- Blanching and coolness of the skin around the insertion site.
- Damp or wet dressing.
- Slowed or stopped infusion.
- Burning/ stinging pain.
- Redness, followed by blistering, tissue necrosis and
- ulceration.

✓ **Please use the Intraosseous Monitoring form (found in page of this document) until the removal of the IO line.**

Affix Patient Sticker Here

Intraosseous access Monitoring form

Please complete on receiving the patient and every hour following this, until removal of IO.

*IO must be removed- once IV access is obtained, or within **24 hours.***

	Is your IO needle still required?	Is the IO needle still patent?	Any signs of infiltration/ extravasation?	Any signs of infection?	Flush?
On handover					
1 hour					
2 hours					
3 hours					
4 hours					
5 hours					
6 hours					
7 hours					
8 hours					
10 hours					
11 hours					
12 hours					
13 hours					
14 hours					
15 hours					
16 hours					
17 hours					
18 hours					
19 hours					
20 hours					
21 hours					
22 hours					
23 hours					
24 hours					

Intraosseous access Care Pathway

B. *Information sheet for the* ***Removal*** *of IO needles*

How to remove IO needle

- Remove any extension set and any dressing in situ.
- Attach a 10ml luer-lock syringe to the hub.
- Whilst maintaining axial alignment, twist the syringe and catheter clockwise whilst pulling straight out.
- **Do not rock or bend during removal.**
- Place the needle into a designated sharps container.
- Apply gentle pressure as needed and apply a clean dressing to site
- There are no activity restrictions after removal.
- Document in medical notes; time and date of removal
- Please complete the **Intraosseous access removal form** and put in the patient's medical notes

INTRAOSSEOUS ACCESS REMOVAL FORM

REMOVAL	
DATE	
TIME	
REMOVED BY	
SIGNATURE	

REASON FOR REMOVAL	***Y***	***N***
IV access gained		
Removal at 24hours post insertion		
Complications If yes please specify		