Guideline and Procedure

HNEkidshealth Children, Young People & Families

NSW GOVERNMENT Health Hunter New England Local Health District

# EZ-IO® - Intraosseous Needle Insertion in Children

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|---|---|
| **Sites where Local Guideline and Procedure applies** | All HNE Health Facilities that treat children |
| **This Local Guideline and Procedure applies to:** | |
| **1. Adults** | No |
| **2. Children up to 16 years** | Yes |
| **3. Neonates – less than 29 days** | Yes (≥ 3 kgs) |
| **Description** | Procedure for the insertion of an intraosseous needle in paediatric patients via the EZ-IO® vascular access system |

**Go to Procedure**

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|---|---|
| **Keywords** | Intraosseous, vascular access, paediatric, EZ-IO® |
| **Document registration number** | |
| **Replaces existing document?** | Yes |
| **Document number and dates of superseded document/s** | HNELHD GandP 17_35. EZ-IO® Intraosseous Needle Insertion in Children |

**Related Legislation, Australian Standard, NSW Ministry of Health Policy Directive or Guideline, National Safety and Quality Health Service Standard (NSQHSS) and/or other, HNE Health Document, Professional Guideline, Code of Practice or Ethics:**

- PD2017_032:PCP 2 - Clinical Procedure Safety (Levels 1, 2 and 3)
- HNELHD Pol 18_03- Aseptic Technique for Level 1 to Level 2 Procedures Conducted in Clinical Settings
- Australian Resuscitation Council Policy Statement 12.6 January 2016
- NETS NSW clinical guideline Intraosseous Access; Insertion of the EZ-IO®
- Rural Paediatric Emergency Clinical Guidelines, 2020 Third Edition
- RCH Clinical Practice Guideline - Intraosseous access

| | |
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| **Prerequisites (if required)** | Nursing:<br>- Registered nurse with evidence of completion of the Resus4kids Intraosseous online module and completion of a practical session conducted by a CNE/CNC.<br>- Paediatric FLEC credentialed registered nurse with evidence of completion of the Resus4kids Intraosseous online module and completion of a practical session conducted by a Paediatric FLEC assessor/CNC/CNE. |
| **Guideline and Procedure note** | This document reflects what is currently regarded as safe and appropriate practice. The guideline section does not replace the need for the application of clinical judgment in respect to each individual patient but the procedure/s **require mandatory compliance**. If staff believe that the procedure/s should not apply in a particular clinical situation they must seek advice from their unit manager/delegate and document the variance in the patient's health record. |
| **Position responsible for and document authorised by** | Dr Paul Craven - Executive Director Children Young People and Families - HNE Health |
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| **Date authorised** | 14 June 2021 |
| **This document contains advice on therapeutics** | Yes - Approval gained from HNE Quality Use of Medicines Committee on 4th March 2021. |
| **Issue date** | 18 June 2021 |
| **Review date** | 18 June 2024 |

Note: Over time, links in this document may cease working. Where this occurs, please source the document in the PPG Directory at: http://ppg.hne.health.nsw.gov.au/

## PURPOSE AND RISKS

- When other methods of access to the vascular system have failed, an intraosseous (IO) needle can be inserted to provide safe, rapid and successful administration of emergency drugs and fluids to the critically-ill child.
- An IO needle is not recommended for use for longer than 24 hours in children < 12 years. It may remain in place and be utilised for up to 48 hours in children ≥ 12 years, if no other vascular access is available.
- The Australian Resuscitation Council Guidelines state "valuable time should not be wasted (more than 60 seconds) with repeated unsuccessful attempts at cannulation because alternative access to the circulation is possible via the bone marrow intraosseous route".

**Risk Category*:*** Clinical Care & Patient Safety;

## GLOSSARY

| Acronym or Term | Definition |
|---|---|
| CNC | Clinical Nurse Consultant |
| EZ-IO® | Intraosseous vascular access system |
| FLEC | First Line Emergency Care |
| IO | Intraosseous |
| MRI | Magnetic resonance imaging |
| PoCT | Point of care testing |

## GUIDELINE

- This Guideline does not replace the need for the application of clinical judgment in respect to each individual patient
- This guideline outlines the procedure for the insertion and management of an intraosseous needle in children via the EZ-IO® vascular access system

### Indications

- For emergency situations where vascular access is urgently required and has been unable to be achieved within **60 seconds**
- Including but not limited to: Cardiac arrest, major trauma, shock, hypoperfusion and diabetic ketoacidosis

### Contraindications to IO needle insertion and infusion

- Fracture or suspected fracture of the target bone
- Previous orthopaedic procedures near insertion site (prosthetic limb or joint)
- IO within the past 48 hours in the targeted bone
- Infection at the insertion site
- Bone disease e.g. osteogenesis imperfecta

- Vascular injuries that may prevent reliable venous outflow
- Inability to locate landmarks – excess tissue at site

**ALERT**

**IO is incompatible with MRI – cannot go into an MRI scanner**

**Potential complications**

- Failure to enter the bone marrow, with extravasation or subperiosteal infusion
- Through and through penetration of the bone
- Osteomyelitis (rare in short-term use)
- Physeal plate injury
- Local infection, skin necrosis, pain, compartment syndrome, fat and bone microemboli have all been reported but are rare

**General Information**

- Drugs and fluids administered via an intraosseous needle are distributed as fast and attain similar plasma concentrations as those administered intravenously
- Bone marrow aspirate can be obtained before infusion for analysis of blood chemistry, culture, haemoglobin concentration and for cross-matching. – ensure all pathology is labelled 'Intraosseous sample'.

**ALERT**

IO samples are not compatible with Point of Care Testing (PoCT) devices

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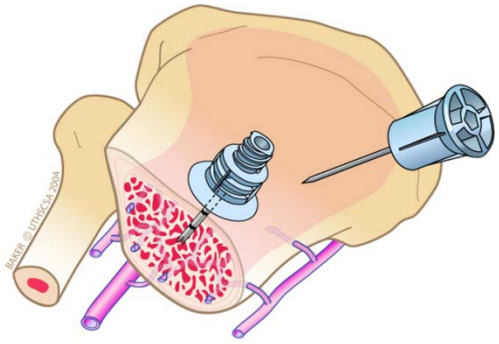
- Intraosseous infusion uses the rich vascular network of long bones to transport fluids and drugs from the medullary cavity to the general circulation. The medullary cavity is composed of a spongy network of venous sinusoids that drain into a central venous canal. Blood then exits the venous canal by nutrient or emissary veins into the circulation (figure 1).
- The anatomical advantage of the medullary cavity is that it functions as a rigid vein that does not collapse in the presence of hypovolaemia and profound peripheral circulatory shock.

**Figure 1**



**The intramedullary venous system demonstrates position of the intraosseous needle in the medullary sinusoids**

- All intravenous fluids and drugs that can be administered via the intravenous route can be administered via the intraosseous route.
- All drug doses and fluid rates are the same as for conventional vascular routes.

**ALERT**

If the patient is responsive to pain, insertion of drugs/fluids into the medullary cavity can be painful

If patient is responsive, administer preservative and adrenaline -free lignocaine (see procedure considerations)

**EZ-IO® vascular access system**

The EZ-IO® vascular access system is a small, battery powered device with specially-fitted, bevelled, hollow drill-tipped IO needle sets. The EZ-IO® Power driver can achieve approximately 500 needle-set insertions under ideal conditions and contains a non-rechargeable manganese dioxide lithium battery.

**Figure 2**

**Components**

EZ-IO® Needle sets come in three lengths and are all 15 gauge:

Recommended weights

- Pink 15 mm (3–39 kg)
- Blue 25 mm ( ≥ 3 kg)
- Yellow 45 mm ( ≥ 40 kg or excessive tissue over site)


**Figure 3**

**NOTE**

***The weight range on the needle-set pack is a guide only and not an absolute indication that the needle is appropriate for that weight. The most important check of correct needle length is tissue thickness above the bone. Once the needle is inserted through the skin and makes contact with the target bone there must be at least 1 black line visible on the needle (see insertion procedure)***

**IO insertion sites**

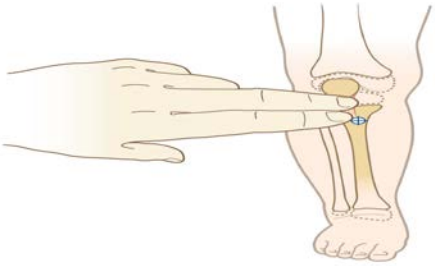
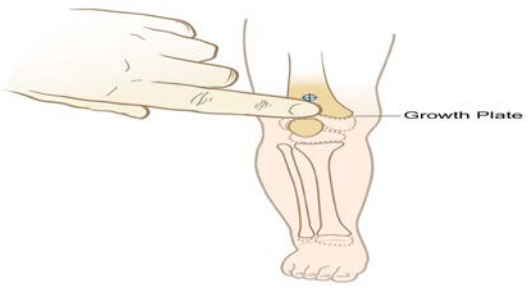
| | |
|---|---|
| **Proximal Tibia – Paediatric**<br><br>**This is the preferred site in children as it has a broad surface with a thin layer of skin covering the bone.**<br><br>Insertion site is anteromedial surface aspect of the tibia, located approximately 1–3 cm below the tibial tuberosity |  |
| **Distal Tibia – Paediatric**<br><br>Insertion site is located approximately 1–2 cm proximal to the most prominent aspect of the medial malleolus.<br><br>Place one finger directly over the medial malleolus; move approximately 1–2 cm (depending on patient anatomy) proximal and palpate the anterior and posterior borders of the tibia to ensure that your insertion site is on the flat, centre aspect of the bone. |  |
| **Distal Femur – Paediatric**<br><br>Insertion site is located approximately 2 cm above the patella (depending on patient anatomy) on the anterior femur and 1 cm medial to avoid the patella tendon. |  |

**Table 1**

## PROCEDURE

### CLINICAL PROCEDURE SAFETY LEVEL

Every clinician involved in the procedure is responsible for ensuring the processes for clinical procedure safety are followed. Refer to: http://intranet.hne.health.nsw.gov.au/__data/assets/pdf_file/0003/375222/PD2017_032_PCP_2_Clinical_Procedure_Safety.pdf -

The following level applies to this procedure (click on the link for more information):

This is a Level 2 procedure.

***Note: Emergency use overrides the procedure level requirements***

**Level 2 procedure**

### Staff Preparation

It is mandatory for staff to follow relevant: "Five moments of hand hygiene", infection control, moving safely/safe manual handling, documentation practices and to use HAIDET for patient/carer communication: **H**and hygiene **A**cknowledge, **I**ntroduce, **D**uration, **E**xplanation, **T**hank you or closing comment.

### Equipment Requirements

- EZ-IO® Power Driver
- EZ-IO® Needle – recommended size for patient
- 2% chlorhexidine in 70% alcohol for cleaning/skin preparation
- 2 x pairs non-sterile, non-latex gloves
- PPE
- 5 mL syringe
- 3 x 10 mL syringes
- 5–10 mL sodium chloride 0.9%
- Primed extension tubing and three-way tap
- Primed IV tubing
- IV pressure bag OR 20–30 mL syringes for manual fluid insertion
- Splint (optional)
- Lignocaine 1% -2% (preservative and adrenaline free)
- EZ-IO® Stabiliser dressing
- Sharps container

### Patient preparation

Process may include documentation on HNE LHD Procedural Safety Checklist (HNEMR223), or in ARIA or RIS systems.

### Pre-procedure

STOP and confirm the following before commencing the procedure:

- Patient identification using three core patient identifiers (Name – family and given names, date of birth and Medical Record Number – MRN http://intranet.hne.health.nsw.gov.au/__data/assets/pdf_file/0004/136660/HNELHD_Pol_15_06_Patient_Identification.pdf
- Procedure verification – procedure + site/side/level, where appropriate, matches consent

- Allergy/adverse reaction check
- Anticipated critical events
- Verbal consent to be obtained from the patient or legal guardian, written consent is not mandatory

## PROCEDURE

**Considerations:**
**Lignocaine for local anaesthetic pre-intraosseous infusion**
There is evidence that there is pain at the point of insertion of the intraosseous device and again at infusion of fluid. The latter is modulated by pressure sensors and significantly greater than insertion pain.

*For a larger proportion of patients in which IO is used, analgesia/local anaesthesia is not an issue as the patient is unresponsive to pain.*

For patients who are responsive to pain, use of lignocaine is recommended.

Preservative- and adrenaline-free lignocaine, either 1% or 2% is recommended.

**Dose**
0.5 mg/kg (0.05 mL/kg of 1%- maximum 20 mg).
Administer 'slowly' to ensure it has time to exert its effect on the nervous tissue within the medulla of the bone.
For ongoing pain, repeat dose with an upper limit of total lignocaine of 20 mg

**Technique for using the EZ-IO® vascular access system**

1. Explain procedure to patient/family
2. Obtain assistance as required
3. Wash hands
4. Connect a 10 mL syringe of sodium chloride 0.9% to extension set and prime the tubing
5. Identify appropriate site
6. Palpate site to locate appropriate anatomical landmarks for correct needle insertion
7. Wash hands
8. Apply non-sterile, latex-free gloves
9. Apply PPE
10. Hold/restrain patient's leg. Note: Hold leg away from the insertion site to avoid injury to staff
11. Using aseptic technique, swab skin with 2% chlorhexidine in 70% alcohol
12. Ensure that the driver and needle set are securely seated (figure 4)
13. Remove and discard the needle safety cap from the IO needle set and install on the power driver – DO NOT touch the needle

**Figure 4**

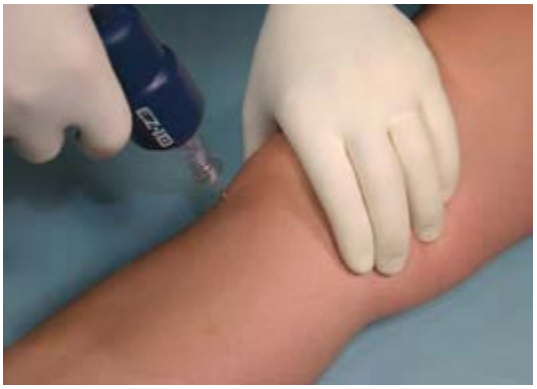


Figure 5

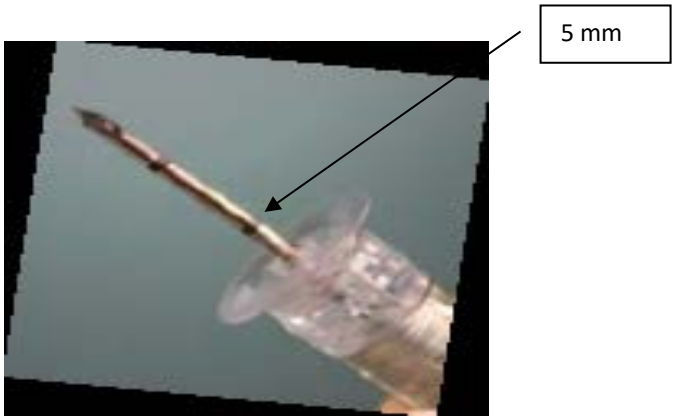



Figure 6

14. Position driver at insertion site with needle set at a 90-degree angle to the bone and GENTLY power or press needle set until needle set tip touches the bone (figure 5)
15. Ensure at least one black line (5 mm) on the needle is visible (figure 6)
16. If no black line is visible consider an alternative site or longer needle
17. Penetrate bone cortex by squeezing the driver's trigger and applying **gentle, steady downward pressure**
18. Release the driver's trigger and stop insertion process when a sudden "give" or "pop" is felt upon entry into the medullary space – only use gentle-steady pressure. If driver stalls and will not penetrate you may be applying TOO MUCH downward pressure
19. Remove power driver and stylet while stabilising the catheter hub
20. Confirm signs of correct placement of the intra osseous needle. These include loss of resistance, sustained erect posture of the needle without support and free fluid infusion or marrow aspiration
21. Attach 10 mL syringe to IO needle and if able, aspirate bone marrow and send to pathology for desired biochemical/haematological analysis (cross matching, culture, blood gases, haemoglobin & blood chemistry). Ensure pathology is labelled 'Intraosseous sample'
22. If required administer 0.5 mg/kg of 1% - 2% preservative and adrenaline free Lignocaine (maximum 20mg in total)
23. If unable to aspirate blood/marrow attach the primed extension tubing + 3-way tap and flush IO needle with 5–10 ml sodium chloride 0.9%
24. Attach IV tubing if using infusion pump
25. Secure, monitor and document
26. Attach EZ-IO® armband to patient, documenting time and date

**ALERT**

Due to pressure in the medullary cavity, fluids may not run freely via an infusion pump.

A pressure bag may be required or alternatively fluids can be pushed via a syringe into the IO needle.

Fluids must always be 'pushed' via the extension tubing and NOT directly into the IO needle.

**Securing the IO needle and giving set**

- Secure IO needle with the EZ-IO® stabilizer dressing (figure 7) or alternatively secure the IV tubing to skin using hinge technique (figure 8)
- Do not put dressings/gauze over/around the IO needle, leave with no dressing to enable frequent and quick inspection of the IO site
- Immobilise limb with splint if necessary and secure above and below the insertion sit

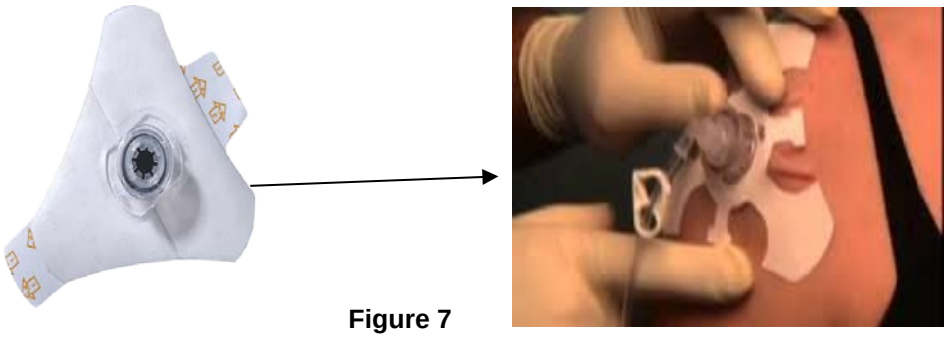


**Figure 7**

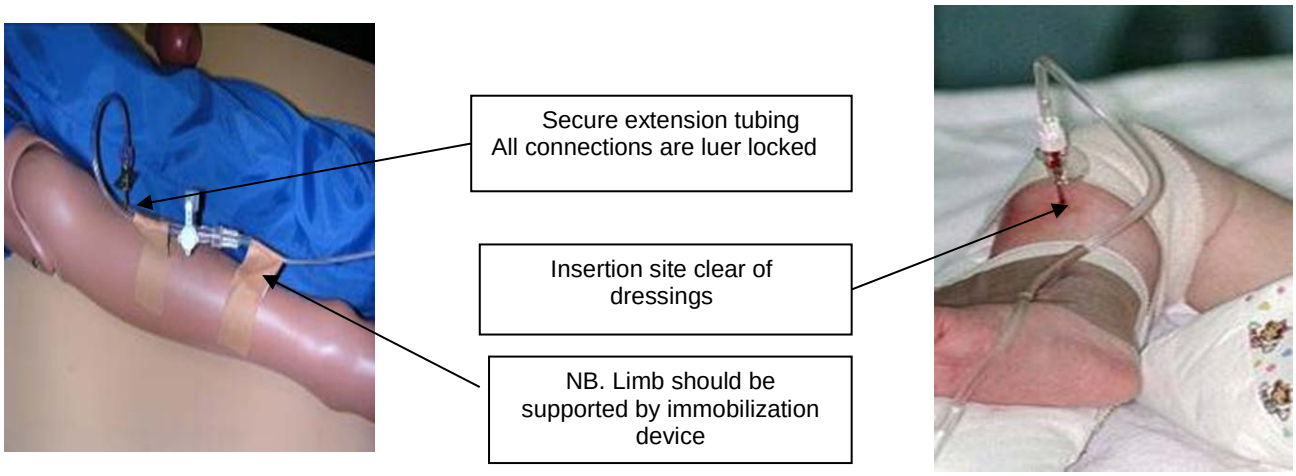



**Figure 8**

**Family and child**

- IO needles are rarely used in patients who are not severely compromised/collapsed and therefore time for immediate explanations may not be appropriate. However, parents should be informed about the reasons for the use of the IO, expected length of time it will be used for and the expected outcome and the potential risks
- Warn parents/carers they may find it unpleasant to view the limb with the IO needle inserted
- Inform parents/carers of the restraint and limitations that may be required to ensure the needle does not become dislodged

**Removal of intraosseous needle**

- Should be removed using an aseptic technique
- Loosen and remove any devices used to secure needle and extension devices
- Attach a 5 mL Luer lock syringe to needle for traction, then gently rotate the syringe and needle in a clockwise motion and pull smoothly with an upward motion.
- Cover the puncture site with a sterile gauze pad and apply direct pressure until ooze has ceased, then apply dry dressing

- Dispose of items as per policy
- Record removal in patient notes
- Observe limb for a further 24 hours to ensure no adverse outcomes such as infection occurs

**Post-procedure**

- Document procedure in patient's health care record or Radiology Information System:
    - Site of IO insertion
    - Size of needle (EZ-IO® system)
    - Reason for insertion
    - Signature, date and time
- Provide advice for clinical handover to staff caring for patient
- Equipment problems/issues
- Specimens/images labelled correctly
- Arrange post-procedure tests where clinically relevant

## IMPLEMENTATION AND MONITORING COMPLIANCE

The level of implementation, monitoring or compliance and audit will be based on the risk rating of the document. Owners/developers must detail how:

1. This document will be communicated to all facilities that treat children in HNE LHD via the CYPF Clinical Network
2. Paediatric CNC's will liaise with individual site to assist with resources, education and training
3. The document will be monitored for effectiveness and compliance via IMS+ and adverse events
4. The document will be audited.

   Clinical audit template

## APPENDICES

Clinical Audit Tool

## REFERENCES

1. Arrow® EZ-IO® Intraosseous Vascular Access System – https://www.teleflexvascular.com/files/ifu/8087A.pdf
2. ACI-NSW Agency for Clinical Innovation - Lignocaine for local anaesthetic pre-intraosseous infusion
3. JEMS: Emergency Medical Services – Pain Management with the use of IO: easing IO pain and pressure
4. Vidacare - References: Management of Pain associated with IO Vascular Access
5. Vidacare – Complete industry guide

## FEEDBACK

Any feedback on this document should be sent to the Contact Officer listed on the front page.

**Appendix 2**

**Clinical Audit Tool –** (**National Standard 1:** 1.7.2 The use of agreed clinical guidelines by the clinical workforce is monitored)

| Criterion no. | Criterion | Exceptions | Definition of terms and/or general guidance | Data source | Frequency | Position Responsible |
|---|---|---|---|---|---|---|
| **1** | Insertion of an intraosseous needle can be attended by:<br>A medical officer<br>Paediatric FLEC and IO credentialed registered nurse<br>Competent paediatric/emergeny registered nurse with current paediatric IO accreditation. | None | IO education, training competency assessment is renewed annually | Completion of practice standard | Annually | NUM/CNE/CNC |

**Reference:** *Electronic audit tool - National Institute for Health and Clinical Excellence (NICE)*