Royal Cornwall Hospitals
NHS Trust

EZ-IO® Insertion and Care Procedure

V4.0

May 2024

Summary

Stage 1

Step 1

Locate the insertion site.

Step 2

Clean site with 2% Chlorhexidine in 70% Alcohol.

Step 3

Stabilise site.

Stage 2

Step 1

Gently press needle through the skin until the tip touches the bone (The 5 mm black mark on the needle set must be visible above the skin prior to insertion).

Step 2

Squeeze the trigger, apply gentle steady pressure until you feel a decrease in resistance indicating the Needle Set has entered the medullary space.

Step 3

Stabilise hub and remove driver and stylet. Place stylet in an appropriate sharps container.

Stage 3

Step 1

Place the EZ-Stabilizer® Dressing over the catheter hub.

Step 2

Confirm placement. Aspirate blood.

Step 3

Attach primed extension set, firmly secure to catheter hub with clamp open. Flush the EZ-IO Catheter with normal saline (5-10 mL for adults; 2-5 mL for infants/children).

Stage 4

Step 1

Deliver medication and fluids as ordered. Administer medications in same dose, rate and concentration as given via peripheral IV. For optimal flow infuse with pressure.

Step 2

Apply EZ-IO wrist band to patient and document in the notes.

Table of Contents

Data Protection Act 2018 (UK General Data Protection Regulation – GDPR) Legislation.

The Trust has a duty under the Data Protection Act 2018 and UK General Data Protection Regulations 2016/679 to ensure that there is a valid legal basis to process personal and sensitive data. The legal basis for processing must be identified and documented before the processing begins. In many cases we may need consent; this must be explicit, informed, and documented. We cannot rely on opt out, it must be opt in.

Data Protection Act 2018 and UK General Data Protection Regulations 2016/679 is applicable to all staff; this includes those working as contractors and providers of services.

For more information about your obligations under the Data Protection Act 2018 and UK General Data Protection Regulations 2016/679 please see the Information Use Framework Policy or contact the Information Governance Team.

Royal Cornwall Hospital Trust rch-tr.infogov@nhs.net

1. Introduction

1.1. Intraosseous (IO) cannulation is inserting a needle into a bone to allow the delivery of intravenous therapy. If intravenous access has failed, is inadequate, unlikely to be achieved or would significantly delay time critical treatment in the peri-arrest situation the intraosseous route should be considered.

1.2. Resuscitation Council (UK) Guidelines 2021 recommend the IO route if no other access has been established in the first two minutes of cardiac arrest for adult advanced life support. In paediatrics where there is no vascular access, IO should be attempted.

1.3. The EZ-IO® intraosseous infusion system allows for immediate vascular access within seconds, to enable the delivery of medications and intravenous fluids. The EZ-IO® provides rapid, smooth entry into the bone's medullary cavity, creating an immediate conduit to the central circulation utilising a cutting IO needle and small power driver.

1.4. This procedure was developed from policy, procedure and protocol guidance provided by Teleflex, the manufacturers of ARROW® EZ-IO®.

1.5. This version supersedes any previous versions of this document.

2. Purpose of this Policy/Procedure

2.1. To ensure that the Trust maintains standards for administration of IO therapy and in accordance with national and professional guidelines, and in accordance with Teleflex ARROW® EZ-IO® Directions For Use (DFU).

2.2. To ensure that the Practitioner is able to carry out IO cannulation in order to meet patient needs. The practitioner must relate theory to practice knowledgeably, skillfully, and safely, demonstrating a caring attitude, and achieve competence by the Royal Cornwall Hospitals NHS Trusts standards.

3. Scope

3.1. This procedure applies to all clinical staff who insert IO cannulas and/or who care for and maintain intraosseous cannulas for any patient at the Royal Cornwall Hospitals NHS Trust.

3.2. It includes the responsibilities of staff involved in IO cannulation and care and maintenance of intraosseous cannulas and the standards that should be adopted for each step in the process.

4. Definitions / Glossary

- **Intraosseous -** Situated within, occurring within, or administered by entering a bone.

- **Infusion -** The introduction of a substance, such as a fluid, electrolyte, nutrient, or drug, directly into the body.

- **Vascular access -** The ability to enter the vascular system via indwelling catheter, cannula, or other instrument used to obtain venous or arterial access for administering therapy or obtaining blood for testing.

- **A Practitioner -** A person who is legally accountable or responsible for their practice, Doctors, Nurses, Operating Department Practitioners, Radiographers, Midwives etc.

- **Resuscitation -** The attempt which is made to revive a person who is in cardiac or respiratory arrest.

- **Cardiac Arrest -** The cessation of cardiac output. There is abrupt loss of consciousness, absence of a central pulse and spontaneous breathing stops.

5. Ownership and Responsibilities

5.1. Role of the Managers

Ward, department, and line managers have a responsibility to ensure that all staff members have access to this procedure and adhere to it. Managers must also recognise the training needs of their staff to ensure sufficient and appropriate training is undertaken before carrying out this procedure.

5.2. Role of the Resuscitation Committee

The Resuscitation Committee/ Resuscitation Officers are responsible for procedure distribution, providing training, and monitoring the use of the EZ-IO® during arrests.

5.3. Role of Individual Staff

All clinical staff that undertake IO cannulation, use IO cannula, or remove IO cannula must:

- Understand the Trust's procedure on IO cannulation.

- Receive training before practicing and attend refresher training as required (Contact Resuscitation Officers).

- Take responsibility for arranging further practice to maintain and increase competency within the workplace.

- Practice in accordance with their professional duties.

- Follow the Trusts Standard infection prevention and control precautions policy including Hand Hygiene and Safe Handling and Disposal of Sharps.

- Practice an aseptic technique.

- Delegate to a more experienced practitioner if they are not competent to insert, use or remove intraosseous cannula.

6. Standards and Practice

6.1. Equipment

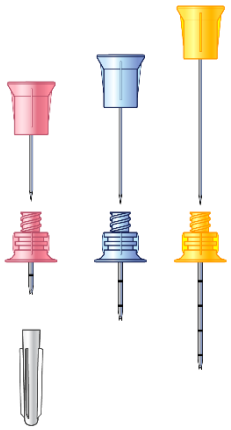
6.1.1. EZ-IO® Power Driver

The EZ-IO® Power driver can achieve approximately 500 needle set insertions under ideal conditions and contains a non-rechargeable manganese dioxide lithium battery.

6.1.2. EZ-IO® Needle Sets

Needle sets come in three lengths and are all 15g:

- Pink - 15mm.
- Blue - 25mm.
- Yellow - 45mm.



Each needle set pack contains the following items:

1 x EZ-Connect® Extension Set.

1 x Needle Vise sharps disposal device.

1 x Patient wrist band.

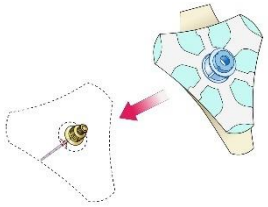
1 x EZ-Stabilizer® Dressing.

Images reproduced with permission from www.teleflex.com**NEEDLE SET SELECTION**

Select EZ-IO® Needle Set based on patient weight, anatomy, and clinical judgment. The EZ-IO® Catheter is marked with a black line 5 mm proximal to the hub. Prior to drilling, with the EZ-IO® Needle Set inserted through the soft tissue and the needle tip touching bone, adequate needle length is determined by the ability to see the 5 mm black line above the skin.

- EZ-IO® 45 mm Needle Set (yellow hub) should be considered for proximal humerus insertion in patients 40 kg and greater and patients with excessive tissue over any insertion site.
- EZ-IO® 25 mm Needle Set (blue hub) should be considered for patients 3 kg and greater.
- EZ-IO® 15 mm Needle Set (pink hub) should be considered for patients approximately 3-39 kg.

6.2. EZ-IO® Stabilizer dressing



The EZ-IO® stabilizer dressing is used to secure and protect the needle once inserted.

Other equipment required:

- Sharps container.
- Cannulation tray.
- 3x10 ml Luer syringes.
- Alcohol based hand rub.
- non-sterile gloves.
- Plastic apron.
- Skin prep (2% Chlorhexidine in 70% Alcohol).
- 1x EZ-IO Stabiliser dressing.
- 1x sterile 2x2 or 4x4 gauze pad10mls.
- 0.9% saline flush Intravenous solution (5-10 mL for adults, 2-5 mL for infant/child).
- 1x fluid administration pump or pressure bag (If pump or pressure bag unavailable fluid will need to be bolused manually using a 50ml syringe and 3-way tap).

6.2.1. Indications for Use

For adults and paediatrics anytime in which vascular access is difficult to obtain in emergency, urgent or medically necessary cases.

6.2.2. Contraindications

- Fracture of the targeted bone.
- Previous orthopaedic procedures at insertion site (prosthetic limb or joint).
- IO in the targeted bone within the past 48 hours.
- Infection at area of insertion.
- Excessive tissue or absence of adequate anatomical landmarks
- The stylet and catheter are not MRI compatible so must not go into an MRI scanner.

6.2.3. Complications

The following are potential complications and should be observed for:

- Dislodgement.
- Extravasation.
- Compartment syndrome.
- Fracture of the targeted bone.
- Infection.
- Pain on use.

6.2.4. Battery testing of the EZ-IO

The battery in the devise must be tested monthly and the check recorded in the Resuscitation Trolley check record book.

1. Depress the trigger to initiate the device.
2. Observe the colour of the LED on the handle whilst the device is operating:

- **Green:** Device is ready for use.
- **Red - flashing:** Order a new device.
- **Red - solid:** Discard device and ensure that a new one has been ordered.

6.2.5. Location of appropriate site

Images reproduced with permission from www.teleflex.com**Please refer to**

Appendix 3 for guidance.

6.3. Procedure

Insertion Preparation

6.3.1. Explain procedure to patient/family.

6.3.2. Obtain assistance as needed.

6.3.3. Wash hands.

6.3.4. Choose appropriate intraosseous needle set (ensure sterile pack intact) and assemble equipment.

6.3.5. Clean tray using 2% Chlorhexidine in 70% alcohol swabs and allow to dry.

6.3.6. Drop the following onto tray:

- Skin cleaner (2% Chlorhexidine in 70% Alcohol).
- 2x2 gauze or 4x4 gauze.
- 1x EZ-IO Stabiliser dressing.
- Needle Set, in cartridge, and EZ-Connect (with attached syringe).

6.3.7. Connect 10 ml syringe to EZ-Connect, primed with sterile saline or lidocaine as appropriate, using a non-touch technique.

6.3.8. Leave syringe attached to EZ-Connect.

6.3.9. Locate appropriate insertion site.

6.3.10. Palpate site to locate appropriate anatomical landmarks for Needle Set placement.

6.3.11. Wash hands.

6.3.12. Apply non-sterile latex free gloves.

6.3.13. Cleanse site using Chloraprep (2% Chlorhexidine in 70% Alcohol). Allow to air dry thoroughly.

6.3.14. Using a non-touch technique:

- Connect appropriate Needle Set to driver.
- Stabilise site.
- Remove needle cap.

6.4. Insertion technique

6.4.1. Adult

6.4.1.1. Proximal Humerus – Adult:

1. Aim the needle set at a 45-degree angle to the anterior plane and posteromedial.

2. Push the needle set tip through the skin until the tip rests against the bone.

   The 5 mm mark must be visible above the skin for confirmation of adequate needle set length.

3. Gently drill into the humerus approximately 2 cm or until the hub is close to the skin; the hub of the needle set should be perpendicular to the skin.

6.4.1.2. Tibia – Adult:

1. Aim the needle set at a 90-degree angle to the bone.

2. Push the needle set tip through the skin until the tip rests against the bone.

   The 5 mm mark must be visible above the skin for confirmation of adequate needle set length.

3. Gently drill, advancing the needle set approximately 1-2 cm after entry into the medullary space or until the needle set hub is close to the skin.

6.4.2. Infant/Child

6.4.2.1. Proximal Humerus – Infant/Child:

1. Aim the needle set tip at a 45-degree angle to the anterior plane and posteromedial.

2. Push the needle set tip through the skin until the tip rests against the bone.

   The 5 mm mark must be visible above the skin for confirmation of adequate needle set length.

3. Gently drill, immediately release the trigger when you feel the loss of resistance as the needle set enters the medullary space; avoid recoil – do NOT pull back on the driver when releasing the trigger.

6.4.2.2. Femur and Tibia – Infant/Child:

1. Aim the needle set at a 90-degree angle to the bone.

2. Push the needle set tip through the skin until the tip rests against the bone.

   The 5 mm mark must be visible above the skin for confirmation of adequate needle set length.

3. Gently drill, immediately release the trigger when you feel the loss of resistance as the needle set enters the medullary space; avoid recoil – do NOT pull back on the driver when releasing the trigger.

   Should the driver slow or fail during insertion the needle set can be inserted manually. Hold the needle set with the catheter hub and stylet as one piece (ensuring the stylet and hub remain screwed together). Rotate clockwise/counter-clockwise while applying gentle moderate, steady downward pressure without rocking the needle set. Allow rotation and pressure to penetrate the bone cortex, not excessive force.

6.5. Insertion Completion

6.5.1. Remove EZ-IO Power Driver from Needle Set while stabilising the catheter hub.

6.5.2. Continue to hold the hub while twisting the stylet off the hub with counterclockwise rotations; catheter should feel firmly seated in the bone (1st confirmation of placement).

6.5.3. Dispose of stylet in appropriate biohazard sharps container ***NEVER return used stylet or cartridge to the EZ-IO kit or Resuscitation trolley**.

6.5.4. Place the EZ-Stabilizer® Dressing over the hub.

6.5.5. Aspirate for blood/bone marrow (2nd confirmation of placement). *

*Inability to withdraw/aspirate blood from the catheter hub does not mean the insertion was unsuccessful. Intraosseous blood must only be sent for analysis in a critical emergency, when arterial or venous blood sampling is not a possibility. This must be discussed with the relevant laboratory.

6.5.6. If the patient is responsive to pain the practitioner may consider use of 2% preservative and epinephrine-free lignocaine (intravenous lignocaine for anaesthetic effect prior to the 10ml normal saline flush and it may be necessary to administer additional lignocaine following the saline flush. (see appendix 4).

6.5.7. Connect primed EZ-IO extension set to exposed Luer-lock hub.

6.5.8. Syringe bolus: flush the catheter with 5-10 ml of normal saline (Adult), 2-5ml of normal saline (child).

6.5.9. Assess for potential IO complications (See section 6.8).

6.5.10. Disconnect 10 ml syringe from EZ-Connect extension set.

6.5.11. Connect primed EZ-Connect extension set to primed IV tubing.

6.5.12. Begin infusion utilising a pressure delivery system.

6.5.13. Monitor extremity continuously for any complications.

6.5.14. Place EZ-IO armband on patient, document time and date.

6.5.15. Dispose of all items in accordance with the Trusts waste policy.

6.5.16. Clean the Driver using 2% Chlorhexidine in 70% Alcohol swabs. Allow to dry.

6.5.17. Wash hands with soap and water.

6.5.18. Clearly document in the patient's medical notes:

- Site of EZ-IO insertion.
- Size of needle used.
- Reason for insertion.
- Signature, Date and Time.

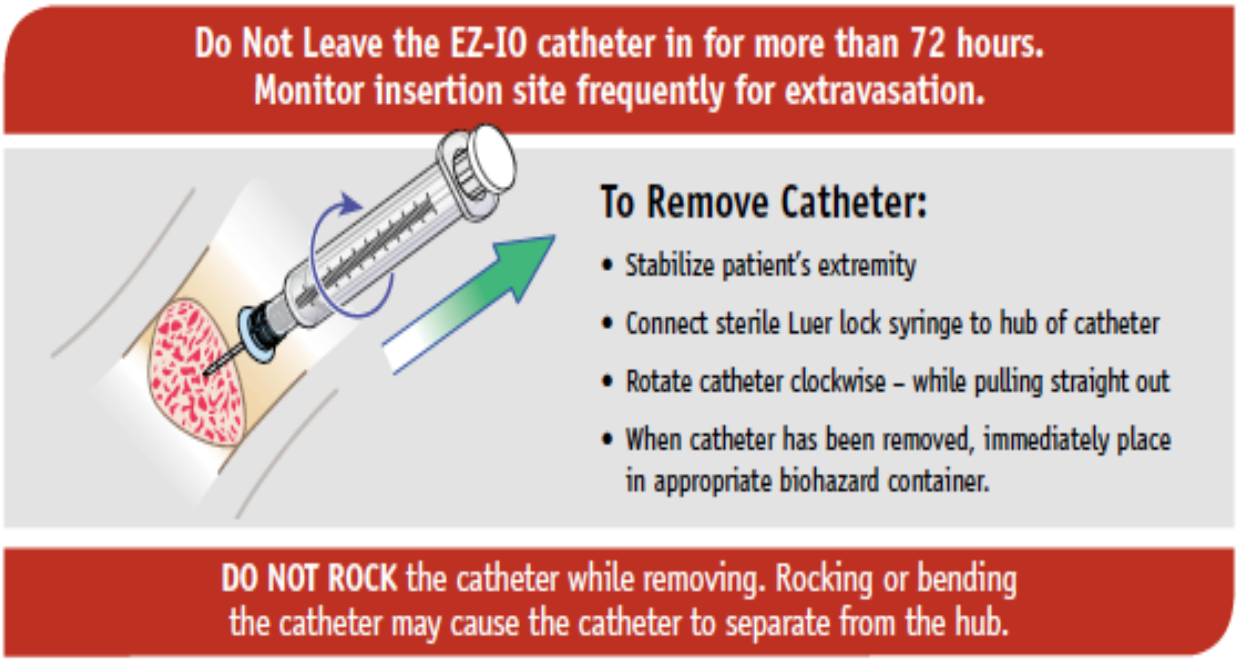
6.6. Catheter Removal

If you have not been trained to remove an IO cannula you must seek the assistance of someone who has.

An aseptic technique must be maintained throughout.

To remove the EZ-IO® needle:

1. Remove extension set and dressing.
2. Stabilise catheter hub and attach a Luer lock syringe to the hub.
3. Maintaining axial alignment, twist clockwise and pull straight out. **Do not** rock the syringe.
4. Dispose of catheter with syringe attached into sharps container.
5. Apply pressure to site as needed to control bleeding and apply dressing as indicated.
6. Insertion site should be assessed hourly after removal for signs of infection for 48 hours.
7. Document removal in the patient's medical notes and ensure the IO wristband stays on the patient for 48 hours following removal of the catheter.



Images reproduced with permission from www.teleflex.com**Location of Devices within the Trust**

- Emergency Department.
- Critical Care Unit.
- Critical Care grab bag (brought to cardiac arrest calls).
- Theatre recovery (Trelawney).
- Theatre recovery (Tower block).
- Theatres (obstetric) Princess Alexandra Maternity Wing (PAMW).
- Paediatric HDU.
- Urgent Treatment Centre West Cornwall Hospital.
- Theatre St Michaels Hospital.

7. Dissemination and Implementation

7.1. This procedure will be available on the Trusts Documents Library.

7.2. Targeted staff members will be alerted by:

- Series of training workshops.
- Inclusion in the RCHT Staff daily bulletin.
- Cascading by the Divisional Management Teams to the relevant clinical areas involved in the use of Intraosseous access.

8. Monitoring compliance and effectiveness

Information Category	Detail of process and methodology for monitoring compliance
Element to be monitored	1. Equipment availability in the relevant clinical areas. 2. The use of EZIO during cardiac arrest calls. 3. All incidents involving the use of EZIO.
Lead	1. Ward/Department managers/Resuscitation Officers 2. Resuscitation Officers 3. Resuscitation Officers
Tool	1. Annual Equipment Audit and Arrest Audit form. 2. Arrest audit form. 3. Datix (staff able to select tick box for resuscitation). Electronic system used for reporting incidents/non-compliance.
Frequency	1. Annual audit and daily follow-up of arrest incidents. 2. Ongoing monitoring. 3. Whenever an alert occurs.
Reporting arrangements	All elements will be reported back to the Resuscitation Committee. All reports presented and discussed by the Resuscitation committee are minuted. These minutes feed into the Governance Committee reporting structure which in turn reports to the Board. Any specific learning outcomes and issues will be shared with the Governance Lead(s) for the appropriate division(s) via the Divisional Governance and Clinical Leads Advisory Group.
Acting on recommendations and Lead(s)	Divisional Governance and Clinical Leads Advisory Group is responsible for interrogating required actions and to designate a named lead where appropriate. This is documented in meeting minutes.
Change in practice and lessons to be shared	The Resuscitation Officers will take any necessary changes to practice forward where appropriate. Lessons will be shared with all the relevant stakeholders.

9. Updating and Review

9.1. This procedure will be due to have a review by April 2027.

9.2. This procedure will be reviewed by the Resuscitation Committee prior to the next review date. New Resuscitation Council UK Guidelines are due to be published in 2026 which may result in changes being made to this policy.

10. Equality and Diversity

10.1. This document complies with the Royal Cornwall Hospitals NHS Trust service Equality and Diversity statement which can be found in the Equality Diversity And Inclusion Policy or the Equality and Diversity website.

10.2. Equality Impact Assessment

The Initial Equality Impact Assessment Screening Form is at Appendix 2.

Appendix 1. Governance Information

Information Category	Detailed Information
Document Title:	Insertion and care of an EZ-IO® Procedure V4.0
This document replaces (exact title of previous version):	Insertion and care of an EZ-IO® Procedure V3.0
Date Issued/Approved:	25 April 2024
Date Valid From:	May 2024
Date Valid To:	May 2027
Author/Owner:	Resuscitation officers, Department of Postgraduate Education
Contact details:	01872 252124
Brief summary of contents:	Procedural guidance for staff regarding all aspects of insertion and care of an EZ-IO® including roles and responsibilities, training, and equipment.
Suggested Keywords:	EZ-IO®, Intraosseous, Infusion, access
Target Audience:	**RCHT:** Yes **CFT:** No **CIOS ICB:** No
Executive Director responsible for Policy:	Chief Medical Officer
Approval route for consultation and ratification:	Resuscitation Committee
Manager confirming approval processes:	Claire Blake, HON ACCT
Name of Governance Lead confirming consultation and ratification:	James Masters
Links to key external standards:	None

Information Category	Detailed Information
Related Documents:	▪ National Infection prevention and control manual for England (2024) V2.9. ▪ RCHT (2024) Cardiopulmonary Resuscitation Policy. ▪ Resuscitation Guidelines 2021, Resuscitation Council (UK). ▪ Teleflex (2017) The Science and Fundamentals or Intraosseous Vascular Access 3rd(ed). ▪ Teleflex (2020) IO infusion pain management. https://www.teleflex.com/usa/en/clinical-resources/ez-io/documents/EM_IOS_EZ-IO-Recommended-Anesthetic-Template_MC-000554rev2b.pdf
Training Need Identified:	Yes – staff will need to carry out training to achieve successful implementation of this procedure. Training can be sought from Resuscitation Officers, Teleflex, and in-house clinical supervision.
Publication Location (refer to Policy on Policies – Approvals and Ratification):	Internet and Intranet
Document Library Folder/Sub Folder:	Clinical / Critical Care and Resuscitation

Version Control Table

Date	Version Number	Summary of Changes	Changes Made by
January 2015	V1.0	Original document produced.	Gemma Ashton-Cleary, Resuscitation Skills trainer
January 2018	V2.0	Addition of summary flow chart.	Gemma Ashton-Cleary, Resuscitation Officer
January 2021	V3.0	Full document review. Changes made to all sections of this procedure and appendices.	Gemma Ashton-Cleary, Resuscitation Officer
April 2024	V4.0	Review with minor changes.	Gemma Ashton-Cleary, Resuscitation Officer

All or part of this document can be released under the Freedom of Information Act 2000.

All Policies, Strategies and Operating Procedures, including Business Plans, are to be kept for the lifetime of the organisation plus 6 years.

This document is only valid on the day of printing.

Controlled Document.

This document has been created following the Royal Cornwall Hospitals NHS Trust The Policy on Policies (Development and Management of Knowledge Procedural and Web Documents Policy). It should not be altered in any way without the express permission of the author or their Line Manager.

Appendix 2. Equality Impact Assessment

Section 1: Equality Impact Assessment (EIA) Form

The EIA process allows the Trust to identify where a policy or service may have a negative impact on an individual or particular group of people.

For guidance, please refer to the Equality Impact Assessment Policy (available from the document library) or contact the Equality, Diversity, and Inclusion Team rcht.inclusion@nhs.net

Information Category	Detailed Information
Name of the strategy/policy/proposal/service function to be assessed:	Procedure for the Insertion and care of an EZ-IO® V4.0
Department and Service Area:	Critical Care and Resuscitation, Trust wide
Is this a new or existing document?	Existing
Name of individual completing EIA (Should be completed by an individual with a good understanding of the Service/Policy):	Gemma Ashton-Cleary, Resuscitation Officer
Contact details:	(01872) 252124

Information Category	Detailed Information
1. Policy Aim - Who is the Policy aimed at? (The Policy is the Strategy, Policy, Proposal or Service Change to be assessed)	To provide procedural guidance for the insertion of an EZ-IO®
2. Policy Objectives	To ensure that all relevant clinical staff are fully competent in the insertion and care of an EZ-IO®
3. Policy Intended Outcomes	Effective management of all critically ill/arrested patients requiring urgent drug or fluid therapy where vascular access is difficult to obtain.
4. How will you measure each outcome?	Audit of every 2222 cardiac arrest call.
5. Who is intended to benefit from the policy?	Critically ill patients where vascular access is difficult to obtain. Clinical Staff trained in the use of EZ-IO®

Information Category	Detailed Information
6a. Who did you consult with? (Please select Yes or No for each category)	•Workforce: Yes •Patients/visitors: No •Local groups/system partners: No •External organisations: No •Other: No
6b. Please list the individuals/groups who have been consulted about this policy.	**Please record specific names of individuals/ groups:** RCHT Resuscitation Committee.
6c. What was the outcome of the consultation?	Agreed.
6d. Have you used any of the following to assist your assessment?	**National or local statistics, audits, activity reports, process maps, complaints, staff, or patient surveys:** No

7. The Impact
Following consultation with key groups, has a negative impact been identified for any protected characteristic? Please note that a rationale is required for each one.

Where a negative impact is identified without rationale, the key groups will need to be consulted again.

Protected Characteristic	(Yes or No)	Rationale
Age	No	
Sex (male or female)	No	
Gender reassignment (Transgender, non-binary, gender fluid etc.)	No	
Race	No	
Disability (e.g. physical or cognitive impairment, mental health, long term conditions etc.)	No	
Religion or belief	No	

Protected Characteristic	(Yes or No)	Rationale
Marriage and civil partnership	No	
Pregnancy and maternity	No	
Sexual orientation (e.g. gay, straight, bisexual, lesbian etc.)	No	

A robust rationale must be in place for all protected characteristics. If a negative impact has been identified, please complete section 2. If no negative impact has been identified and if this is not a major service change, you can end the assessment here.

I am confident that section 2 of this EIA does not need completing as there are no highlighted risks of negative impact occurring because of this policy.

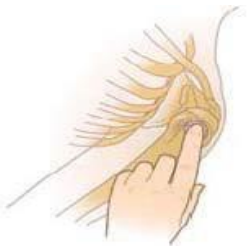
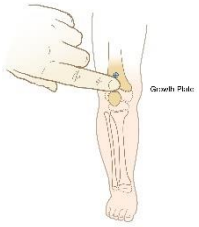
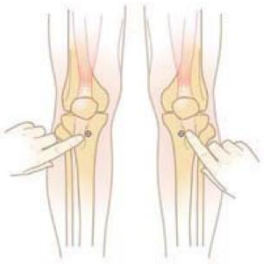
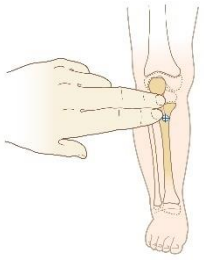
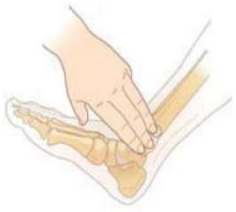
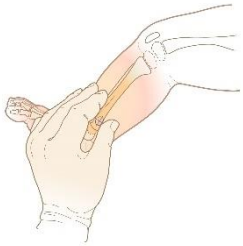
Name of person confirming result of initial impact assessment: Gemma Ashton-Cleary, Resuscitation Officer.

If a negative impact has been identified above OR this is a major service change, you will need to complete section 2 of the EIA form available here:
Section 2. Full Equality Analysis

Appendix 3. IO Insertion Sites

Ensure thorough training in the correct land marking techniques is undertaken prior to practitioner's first use of EZ-IO®.

Images reproduced with permission from www.teleflex.com

Proximal Humerus Insertion site is located directly on the most prominent aspect of the greater tubercle. Ensure that the patient's hand is resting on the abdomen (over the umbilicus) and that the elbow is adducted (close to the body). Slide thumb up the anterior shaft of the humerus until you feel the greater tubercle, this is the surgical neck. Approximately 1-2 cm (depending on patient anatomy) above the surgical neck is the insertion site.	
Distal Femur - **Paediatric** (below the age of 6) Secure the leg outstretched to ensure the knee does not bend. Identify the patella by palpation. The insertion site is just proximal to the patella (maximum 1 cm) and approximately 1-2 cm medial to midline.	
Proximal Tibia - Adult Extend the leg. Insertion site is approximately 2 cm medial to the tibial tuberosity, or approximately 3 cm below the patella and approximately 2 cm medial, along the flat aspect of the tibia.	
Proximal Tibia - Paediatric Extend the leg. Pinch the tibia between your fingers to identify the medial and lateral borders. Insertion site is approximately 1 cm medial to the tibial tuberosity, or just below the patella (approximately 1 cm) and slightly medial (approximately 1 cm), along the flat aspect of the tibia.	
Distal Tibia - Adult Insertion site is located approximately 3 cm proximal to the most prominent aspect of the medial malleolus. Place one finger directly over the medial malleolus; move approximately 2 cm (depending on patient anatomy) proximal and palpate the anterior and posterior borders of the tibia to assure that your insertion site is on the flat centre aspect of the bone.	
Distal Tibia - Paediatric Insertion site is located approximately 1-2 cm proximal to the most prominent aspect of the medial malleolus. Palpate the anterior and posterior borders of the tibia to assure that your insertion site is on the flat centre aspect of the bone. Please note that in paediatrics this distance may be slightly less.	

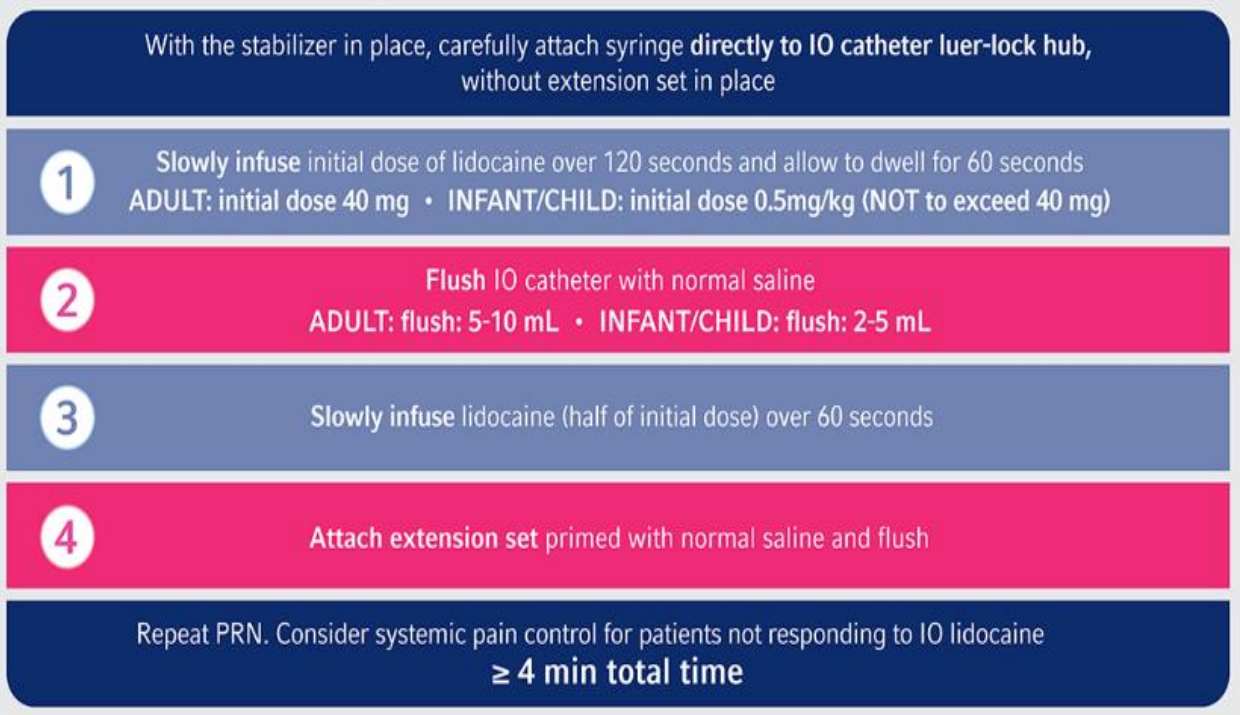
Appendix 4. IO Infusion Pain Management

For patients able to perceive pain, there can be significant discomfort associated with the initial flush as well as the infusion process. Pressure Changes occur within the bone as a result of infusion of medications and fluids. Infusion pain may be minimised with correct administration of 2%preservitive-free and epinephrine-free Lidocaine (intravenous lidocaine) in accordance with hospital protocols and policies.

Anesthetising the IO space prior to the initial flush should be considered by a qualified healthcare provider for any patient who is conscious/alert to pain. If time constraints do not permit anaesthetisation prior to the initial flush, pain management should be considered as necessary.

IO Infusion Pain Management Using 2% Lidocaine (preservative-free and epinephrine-free)

Review lidocaine manufacturer's IFU prior to administration and observe recommended cautions/contraindications.



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