Intraosseous (IO) Device: Care and Management
(Adult age 17 years and older)

Site Applicability

VCH and PHC:
- Emergency Departments (ED)
- Urgent Care Centres (UCC)
- Intensive Care Units (ICU)
- Coronary/Cardiac Intensive Care Units (CCU/CICU)
- Cardiac Surgery Intensive Care Unit (CSICU)
- Operating Rooms (OR)
- Post Anesthetic Care Unit (PACU) **[VGH and UBCH Only]**
- Health Care Centres (HCC) [Pemberton Health Centre, Whistler Health Care Centre]
- High Acuity Unit (HAU) **[MSJ Only]**

Practice Level

Care and Maintenance: All Sites

Profession	Basic Skill
RN Anesthesia Assistant **[VCH only]** NP Physician	**With advanced education where the following are core competencies and expectations of the role:** • Assess, care for, and maintain IO device and system • Administer medications and fluids through the IO device • Remove IO device within 24 hours of insertion

Insertion:

Profession	Advanced Skill *(requiring additional education)*
PHC: • ED RN • Critical Care RN (includes: ICU, CCU, CICU, CSICU, PACU) • HAU RN (MSJ Only) • NP • Physician **VCH:** • ED RN • Anesthesia Assistant • NP • Physician	**With successful completion of the required advanced education and training.** **IMPORTANT:** RN/Physician/NP/ Anesthesia Assistant may not insert IO devices if required education has not been completed and competency has not been maintained. **NOTE: Trained Code team members** can insert an IO device anywhere within an acute site in an emergency situation (e.g. Code Blue)

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Policy Statements

VCH and PHC clinicians will use the approved Elsevier Clinical Skills resource, see guideline link below. Please note this skill will be updated from time to time by Elsevier.

Insertion of the intraosseous device:

- Physician/NP Order for insertion required.
- Emergency Nurses, Critical Care Nurses, High Acuity Unit nurses (for sites where there is no ICU) and Anesthesia Assistants **[VCH only]** who have successfully completed education and training (upon their Manager's approval) in intraosseous device insertion (EZ-IO or B.I.G.) may insert the IO device with a Physician/NP Order.
- Physicians/NPs who have received education and training in the intraosseous device insertion (EZ-IO or B.I.G.) can insert the IO device in the appropriate clinical setting/ clinical situation.

Intravenous access replacement

- An IO device is used for emergency resuscitation and must be replaced with an alternative intravenous access **within 24 hours** of placement. An IO cannula should not be left in place for longer than 24 hours.
- An IO device cannot be left in place when the patient is to remain on or is being transferred to an inpatient unit except for Critical Care (ICU, CCU/CICU/CSICU/HAU-PHC only) or transferred to the Operating Room. The use of this device is restricted to critical care areas, Emergency Department (ED)/Urgent Care Centres (UCCs)/Health Care Centres (HCCs) and code blue arrests.

Contraindication for Diagnostic Imaging

- The patient will not have an MRI while the IO device is in situ as the stainless steel cannula is not MRI compatible.

Need to Know

- IO insertion provides vascular access in emergent, resuscitative, trauma situations when peripheral intravenous access attempts have been unsuccessful.
- IO access should be attempted after two peripheral IV attempts or 90 seconds, whichever comes first.
- There should be only one attempt at insertion per bone to prevent leakage of fluids and medications into surrounding tissues.
- Contraindication to IO access is a prior attempt in the same bone within 48 hours.
- Infusion information:
  - Insertion generally requires less than one minute and flow rates up to 125 mL/min can be achieved

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- IO infusion lines have a higher resistance than IV lines, and therefore, require higher infusion pressures; IV solutions infusing via an IO will require a pressure bag or IV infusion pump or manual injections through a syringe and stopcock.
- Advanced cardiac life support medications can be given via IO device.
- Only compatible drugs may be administered simultaneously through an IO cannula (as with IV administration). If the IO cannula is capped, it should be flushed before and after each medication that is administered (with NS 10 mL flush).
- Drug and fluid administration is the same dosing through an IO cannula is the same as for IV drug administration. Refer to your site policy for review of IV and drug compatibilities.

- Red Blood Cell (RBC) administration: (See **VCH:** D-00-07-30101, **PHC:** B-00-12-10065)
  - RBCs are to be transfused through an IO device for emergency resuscitation. After resuscitation, all blood products should be transfused through intravenous access.
  - There is no evidence that there is damage to RBCs transfused by the intra-osseous (IO) route.
  - When an IO device is used for RBC administration, there is considerable variation in the rate of infusion. Caution is especially needed in using IO devices to transfuse RBCs in the pediatric population.
  - RBC infusion through an IO device may require a pressure infuser.

Equipment and Supplies

Supplies and Equipment for the EZ-IO device and the BIG Device are included in Elsevier Clinical Skills.

Procedure

Clinician to review the extended text tab in the Elsevier Clinical Skills for full information:

To Review Skill:

VCH:

1. First Open Elsevier Clinical Skills in Google Chrome: copy and paste link https://epm601.elsevierperformancemanager.com/Personalization/Home?virtualname=VancouverCoastalHealth
2. When in Clinical Skills website: search for “Intraosseous Access”
3. Then click the **Extended Text** icon

PHC:

1. First Open Elsevier Clinical Skills in Google Chrome: copy and paste link https://epm601.elsevierperformancemanager.com/Personalization/Home?virtualname=providencehealthcare-canada
2. When in Clinical Skills website: search for “Intraosseous Access”
3. Then click the **Extended Text** icon

Landmarking and Insertion Information:

- **EZ IO Device:** Click on the **DEMO** icon in the Elsevier Clinical Skills link (see above)

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- **B.I.G. Device:** B.I.G. Intraosseous Device Insertion Extract

Additional Pre-insertion Information:

- If appropriate, the RN/Physician/NP will explain to the patient the reason for IO access, IO insertion procedure, and expected outcomes of procedure.
- Assess for contraindications to insertion including signs of fracture or infection at potential insertion site – Refer to Elsevier information for contraindications list.
- Obtain baseline VS.
- Establish allergy history status.
- Gather equipment.

Post-insertion confirmation of successful needle placement (if unable to confirm through bone marrow aspirate):

- Lack of bone marrow aspirate does not indicate failed placement. The rapid normal saline flush will displace the thick fibrin mesh that holds the bone marrow in place; some resistance may be met as the mesh is being displaced.
- If needle stands firmly on its own and flushes without significant resistance and with no swelling at the site, the IO access can be used.

Monitoring and Care:

Needle placement and patency:

- Ensure solutions infusing via an IO have a pressure bag or IV infusion pump to overcome the higher resistance of an IO.
- Assess the flow of the solution into the IO access.

Pain:

- Increased pain associated with high-pressure IO infusions in conscious patients is related to stimulation of pressure sensors within the bone.
- If patient is experiencing pain, recommend discussing with most responsible provider the slow administration of 0.5mg/kg Lidocaine 2% (preservative and epinephrine free formulation, maximum dose 40 mg) over one minute through the IO catheter with a provider (Physician/NP) Order is required.
  - Administering Lidocaine slowly allows it to remain in medullary space to provide anesthesia.

Site:

- Apply dressing to allow for insertion site to be visible.

Extravasation (Leakage of fluid around insertion site):

- Signs:
  - Leakage of fluid around insertion site
  - Local swelling of surround tissue.
  - Increased extremity circumference.

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- Increased IO infusion resistance.
- Expanding hematoma with fluid insertion.
- Dependent edema on posterior aspect of extremity.

- Notify Physician of above clinical findings.

Infection:

- Observe for signs and symptoms at IO insertion site. Osteomyelitis, cellulitis, subcutaneous abscesses and septicemia are potential infections related to poor aseptic technique at time of insertion and duration of IO cannula being in situ.
- Notify Physician of above signs and symptoms.

Compartment Syndrome:

- Signs:
  - Increased extremity pain.
  - Continued pain despite interventions.
  - Increased extremity circumference.
  - Changes in extremity sensation, temperature, or pulses.
- Notify Physician re: above clinical findings.

Fat Embolism:

- Fat emboli are a rare and infrequent occurrence.
- Presentation may be neurological (agitation, headache, confusion, coma), pulmonary (shortness of breath, hypoxemia) or dermatological (petechial rash - usually in upper torso).
- Notify Physician re: above clinical findings.

Bone Injury:

- Bone fractures or bony defect may occur with IO device insertion.
- Bony defect may be identified on x-ray which usually heals in 30 to 40 days and is not clinically significant despite potentially causing the client pain.

Removal:

- Apply pressure to the removal site until there is hemostasis
- Refer to Elsevier Clinical for more clinical information.

Expected Patient/Client/Resident Outcomes:

Intended Outcomes

- Provide vascular access in emergent, resuscitative, trauma situation when peripheral intravenous access attempts have been unsuccessful.
- A patent IO catheter to deliver IV fluids and medications.

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Unintended Outcomes

- Unsuccessful penetration of bony cortex or bending needle by use of excessive force delays vascular access.
- Puncture of the posterior cortex occurs as a result of excessive pressure during needle insertion.
- Fluid leakage from the infusion site; fluid extravasation or infiltration may occur, especially if the insertion was difficult or both cortices were penetrated. This may lead to compartmental syndrome.
- Fat embolism from use of high-pressure volume infusions.
- Osteomyelitis is rare.
- Clot formation within the bone marrow needle causes slowing of the infusion rate. In many cases, the use of a pressure bag alleviates this problem.
- Fracture of target bone or other injuries sustained as a result of device insertion.

Patient/Client/Resident Education:

- Explain the procedure, rationale for the treatment, and possible side effects as time and patient's condition allows to provide information and decrease anxiety.
- Instruct to avoid unnecessary movements of the body part where the IO device has been inserted.
- Advise patient / family to report any wetness felt at the site, any blood on the dressing, or any increased sense of pressure or pain at the insertion site.
- Encourage questions and answer them as they arise.

Evaluation:

- Refer to site specific practices to monitor instances of RN IO device insertion with an Order. See Data Collection Form (Appendix C).

Site Specific Practices:

- Refer to your site specific practices regarding obtaining lab samples from an intraosseous device.
- **VCH sites to complete:**
  - Performance Checklist (Appendix B) and
  - Procedure Record/Data Collection Form (Appendix C) and
  - Forward to the appropriate department clinician.
  - Sites that insert the EZ-IO, can utilize the education material from the manufacturer and the accompanying app
    - https://www.teleflex.com/usa/clinical-resources/ez-io/
    - http://www.ezioapp.com/

  And the Post Learning Assessment (Appendix A) to assess successful learning of required education.
- **Sites that use the B.I.G. (PHC - SPH and MSJ)**, refer to practice standard (B-00-12-10117)

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Documentation

On Emergency Department Nursing Assessment, Code Blue Record or Critical Care Nursing Assessment Record:

- Document Insertion:
  - Date and time of IO device attempts/insertion, who inserted, dose of lidocaine if used, any complications encountered
  - Pain assessment scale score for IO device attempt/insertion at time of insertion (examples of pain assessment scales)
  - IO site/infusion assessment immediately after insertion and ongoing assessment

- Ongoing Documentation:
  - Pain assessment for IO attempt/insertion site
  - IO site assessment – ensure that dressing is applied to allow for insertion site to be visible
  - Type and amount of fluid/medications being infused through the IO cannula
  - Patency of system every 4 hours

- Document Removal:
  - Date and time
  - Site condition following removal of IO cannula
  - Any complications related to removal
  - Dressing application

- Ongoing patient/family teaching

Related Documents

VCH:

- Pain Assessment and Management in the Older Adult with Cognitive and/or Language Impairment (D-00-07-30068)
- General Policies: Transfusion of Blood Components and/or Blood Products (D-00-07-30101)

PHC:

- Pain Assessment and Management in the Older Adult in Acute Care (B-00-13-10160)
- Blood/Blood Product Administration (B-00-12-10065)

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	Professional Practice Standards Committee, PHC	**Endorsed by:** (Regional SharePoint 2nd Reading) Health Authority Profession Specific Advisory Council Chairs (HAPSAC) Health Authority & Area Specific Interprofessional Advisory Council Chairs (HAIAC) Operations Directors Professional Practice Directors **Final Sign Off:** Vice President, Professional Practice and Chief Clinical Information Officer Professional Practice, VCH
Owners:	PHC	VCH
	Developer Leads: Clinical Nurse Educator, HAU, PHC **Other members:** Emergency Educator, PHC	**Developer Leads:** Emergency Clinician, VGH Head Nurse Educator, VGH Regional Program Planning Lead, Emergency and Trauma Services, VCH Practice Initiatives Lead Professional Practice, VCH **Other members:** Associate Medical Director, Regional Emergency Services Program, VCH Clinical Educator, Critical Care, VCH Clinical Nurse Specialist, ICU & HAU, VGH RN, ICU, VGH, VA

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Appendix A: Post Learning Assessment

Learning Module Intraosseous – Post Learning Assessment & Module Evaluation

Learning Assessment

1. Describe which patients are candidates for insertion of an Intraosseous Catheter?

   _____

   _____

2. What are 4 contraindications to intraosseous insertion?
   i. _____
   ii. _____
   iii. _____
   iv. _____

3. What are 2 potential complications from intraosseous insertion?
   i. _____
   ii. _____

4. Describe the "5 Rights" of EZ-IO insertion.
   i. _____
   ii. _____
   iii. _____
   iv. _____
   v. _____

5. How do you select the correct needle size for your patient?

   _____

   _____

   _____

   _____

6. Which of the following statements concerning placement of the EZ-IO are correct?
   1. Grip the driver lightly and avoid excessive force during insertion
   2. Maintain a 90 degree angle to the bone during insertion
   3. Monitor the extremity for signs of complications
   4. Avoid attaching a syringe directly to the EZ-IO catheter hub
      a) 1, 2, & 3
      b) 2, 3, & 4
      c) 1, 3, & 4
      d) All of the above

7. For an adult, what is the appropriate amount of Normal Saline required to flush an EZ-IO post insertion?

   _____

   _____

8. Describe the process for the administration of Lidocaine for pain control during IO insertion in an adult:

   _____

   _____

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Learning Module Intraosseous – Post Learning Assessment & Module Evaluation

9. Is a physician's order required for IO insertion?
   a) Yes
   b) No

10. A patient with an IO in situ may be transferred to which of the following units?
    1. ICU
    2. CCU
    3. OR
    4. Medical / Surgical unit
       a) 1
       b) 1 & 3
       c) 1, 2, & 3
       d) All of the above

11. Describe the procedure for removal of the IO.
    a) _____
    _____
    b) _____
    _____
    c) _____
    _____
    d) _____
    _____
    e) _____
    _____

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Module Evaluation

Participant's Name (optional): _____

Date:_____

1.	The module was easy to read and comprehend.	Yes	No
2.	The directions and learning objectives were clear and easy to understand.	Yes	No
3.	The amount of detail was appropriate.	Yes	No
4.	The learning activities were appropriate.	Yes	No

5. What, if any, additional resources did you access in order to complete this module?

6. Having completed this module, how confident do you feel in managing Intraosseous Insertion, Maintenance and Removal?

7. Is there any information in the module that you think is **not** relevant to the topic of Intraosseous Insertion, Maintenance and Removal? If so, please identify the information specifically.

8. Is there any additional relevant information that you think needs to be included in the module? If so, please identify it.

9. How long did it take for you to complete this learning module? _____

10. Any other comments:

Thank you for completing this Intraosseous Insertion, Maintenance and Removal Learning Module Evaluation

Please submit completed evaluation to Nurse Clinician or Nurse Educator at your site.

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Appendix B: IO Performance Checklist

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Intraosseous Performance Checklist

Date _____

Criteria	Met	Not Met	Comments
Demonstrates use of standard precautions.			
Verbalizes indications for EZ-IO use.			
Verbalizes contraindications for EZ-IO use.			
Discuss which Needle Set size is most appropriate for different patient populations.			
Properly identifies the acceptable insertion sites for the EZ-IO			
Verbalizes proper cleaning of the insertion site according to protocol.			
Demonstrates how to correctly administer medications for pain management.			
Correctly assembles EZ-IO Driver and Needle Set.			
Using the training device, stabilizes the insertion site, inserts EZ-IO Needle Set, removes stylet and confirms placement.			
Demonstrates safe stylet disposal.			
Connects primed extension set and flushes the catheter.			
Demonstrates appropriate securing of the EZ-IO.			
Demonstrates options for administering IV fluid under pressure.			
Verbalizes need to apply EZ-IO ID band.			
Verbalizes the maximum amount of time the EZ-IO can remain in place.			
Demonstrates proper removal procedure.			
Successfully completed the written examination: Exam Result: %			

☐ **Passed**
☐ **Needs to Repeat**

Evaluator Name _____ Signature _____

Emergency Nurse Name _____ Signature _____

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Appendix C: IO Data Collection Form

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Data Collection Form
Nurse Intraosseous Insertion
Name_____

Complete form and return it to Vancouver General Hospital Emergency Nurse Clinician or Nurse Educator

Patient Label

Type of access attempted prior to IO insertion & attempts

Peripheral IV:

- ☐ Yes *(# of attempts)*
- ☐ No

Central

- ☐ Yes *(# of attempts)*
  Location: ☐ IJ ☐ Femoral ☐ Subclavian
- ☐ No

Indication influencing the need for IO Access

- ☐ Cardiac Arrest
- ☐ Hemorrhage
- ☐ Sepsis
- ☐ Seizure
- ☐ Hypotension (SBP <80)
- ☐ History of IVDU
- ☐ Obesity
- ☐ Trauma
- ☐ Pre-existing IV inadequate
- ☐ Burns
- ☐ History of chemotherapy
- ☐ Other

Approximate time elapsed prior to decision made to place IO (in minutes):

Verifier present at time of IO insertion

- ☐ Emergency Physician
- ☐ Trauma Physician
- ☐ ED Head Nurse, ED Nurse Clinician, ED Nurse Educator
- ☐ Other _____ **Verifier initial _____**

What the IO insertion successful?

- ☐ Yes (*Total # of attempts until successful*:____) ☐ No (*total # of attempts until abandoned* __)
- Did you switch to an alternate site if initial attempts failed
- What site was used first, and how many attempts until you switched sites _____
- What site did you switch to, and for how many attempts?_____
- Any draw backs to site chosen?

Were their anytime delay from the time of decision to insert IO until actual attempt at insertion?

_____

Time require for IO insertion? _____

IO needle size used

- ☐ 45mm (yellow)
- ☐ 25mm (blue)
- ☐ 15mm (pink)

Location

- ☐ _____

Provider Information

- What was your previous experience with IO insertion?
  - ☐ Only experience is with education/training
  - ☐ <5 procedures

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- ☐ 6-10 procedures
- ☐ 11-15 procedures
- ☐ 16-10 procedure
- ☐ > 20 procedures

- Course Training
  - ☐ EPICC
  - ☐ ACLS
  - ☐ TNCC
  - ☐ VGH ED Team site Module and successful completion of quiz
  - ☐ Other course (*please list*) _____
- Time since last IO insertion
  - ☐ < 1 month
  - ☐ 2- 6 months
  - ☐ >6 months
  - ☐ > 1 year
- Ease of IO insertion
  - ☐ Easy and straightforward
  - ☐ Difficult (please circle reason why)
    - ☐ Unable to recall insertion procedure
    - ☐ Difficulty assembling equipment
    - ☐ Difficulty land marking site
    - ☐ Unable to penetrate bone
    - ☐ Bent or broken needle
    - ☐ Dislodgement
    - ☐ Unable to aspirate
    - ☐ Unable to flush/no flow

Inserting Providers Satisfaction

Very dissatisfied	Somewhat dissatisfied	Neither satisfied or dissatisfied	Somewhat satisfied	Very satisfied
1	2	3	4	5

Did your training adequately prepare you for insertion of IO in real life?

- ☐ Yes
- ☐ No

If no, ***recommendation for future training?***

Ease of IO use once inserted

- ☐ Easy and straightforward
- ☐ Difficult (*please indicate why*)

How did you maintain sufficient flows once IO inserted

- ☐ Pressure bag @ 300mmHg
- ☐ IV Pump

What solutions, drugs, or blood products were infused through the IO once inserted?

Were there any immediate complications:

- ☐ patient discomfort
- ☐ needle displacement
- ☐ extravasation
- ☐ needle stick injuries to staff
- ☐ difficult to infuse

Any other comments or feedback?

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