Rady Children's Hospital San Diego	APPROVAL DATE **June 2017**	MANUAL: **Standardized Procedure**
		SECTION: **Pediatric CHET**
		TRACKING # **SP 3-05**
	TITLE: **INTRAOSSEOUS LINE PLACEMENT**	
	☐ **POLICY** ☐ **PROCEDURE** ☐ **STANDARD OF CARE** ☒ **STANDARDIZED PROCEDURE** ☐ **GUIDELINE** ☐ **OTHER**	

I. PURPOSE

This standardized procedure is designed to establish guidelines that will enable the Advanced Life Support (ALS) Registered Nurse (RN) and ALS Respiratory Therapist (RT) to perform intraosseous needle placement while on transport or within RCHSD Campus in an emergency setting.

II. DEFINITIONS:

This procedure includes intraosseous needle placement for the purpose of: Establishing emergent vascular access

III. POLICY

A. Standardized Procedure (SP) Function(s): patients requiring vascular access and unable to obtain peripheral venous access in an emergency setting.

B. Circumstances under which an ALS RN or ALS RT may perform Standardized Procedure function(s):

1. Setting: Rady Children's Hospital San Diego Campus. Any setting or outlying facility in the process of transferring a patient to a higher level of care via the Rady Children's Emergency Transport system
2. Scope of Supervision /Collaboration: Overall supervision is provided by the appropriate supervising &/or attending physician
    a. In the event that an Advanced Life Support policy or procedure is altered via a referring physician (verbal or written order) then the ALS nurse will inform the physician that he/she is not competent to carry out the altered plan and must either adhere to the procedure or relinquish responsibility to the physician.
    b. When possible, the PICU attending should be contacted before the procedure. In all emergencies, the primary physician will be notified as soon as possible while advanced life support is being initiated.
    c. Under all circumstances the Advanced Life Support team will carry out urgent resuscitation according to the procedure.
3. Patient conditions requiring physician notification:
    a. Unsuccessful Procedure
    b. Profound bleeding
    c. If patient's condition is unstable
    d. If there are any complications or unexpected outcomes from the procedure
    e. In an emergency; as soon as possible while advanced life support is being initiated.
    f. Prior to departure from referring facility with patient status information

C. RN/RT requirements:
   1. Education/Training/Experience – below will be documented and maintained in the employee file
      a. Attend the Advanced Life Support didactic training classes (minimum of 40 hours)
      b. Pass all written and performance tests administered during the course with a minimum of 94% accuracy on the final exam.
      c. Demonstrate procedure on manikin
   2. Initial Competency Assessment: observed and signed off by team manager
      a. At completion of ALS Training will demonstrate assessment and proper preparation of the patient and equipment via simulation
      b. Will function as the Team Leader in the "mega code" testing scenario
   3. Annual competency Assessment:
      a. Complete 2 successful intraosseous needle placements supervised by an Attending Physician, NP or experienced ALS RN or ALS RT.
      b. If minimum number of annual procedures not obtained, the following are options for competency maintenance:
         1. Attend skills lab offered annually (procedure review & simulation)
         2. Complete Annual Competency validation test
         3. 1:1 simulation & demonstration check off
         4. Participation with mock codes (2 annually)
      c. If consecutive years of failure to obtain minimum number required procedures ALS RN will be required to again complete Initial competency assessment again.

D. RN/RTs authorized to perform Standardized Procedure function(s): A written record of initial and ongoing competency will be maintained in the employee file.

IV. PROCEDURE

A. Database
   1. Subjective
      a. Historical information relevant to present illness.
      b. History including reactions/allergies to medications
   2. Objective
      a. Physical examination with focus on pulmonary and cardiovascular systems
      b. Assessment: Decision for Intraosseous needle placement will be based upon subjective and objective data and in collaboration with attending physician prior to the initiation of the procedure when not an emergent/lifesaving procedure.
   3. Plan
      a. Patients and families will be provided with the appropriate information prior to initiation of the procedure if not an emergent lifesaving procedure, and obtain consent as per hospital protocol.
      b. If emergent procedure they will be notified as soon as possible thereafter.

B. Indication
   1. Establishment of reliable vascular access is a critical step in pediatric ALS. If vascular access is accomplished within the first minutes of resuscitation, infusion of medications and fluids is possible and successful resuscitation may be more likely.
   2. Vascular access is vital for drug and fluid administration, but venous access may be difficult to achieve in the pediatric patient. During CPR the preferred venous access site is the largest most accessible vein that does not require the interruption of resuscitation. The intraosseous route enables infusion of drugs, fluid and blood products. This route is a reliable alternative to venipuncture in infants and children who are in shock or cardiopulmonary arrest if peripheral venous access cannot be achieved within a few minutes.
   3. The intraosseous route provides access to a non-collapsible venous plexus in the medulla of the vein and can usually be established within seconds.

C. Contraindications
   1. Fracture of the tibia or long bones, which are potential sites for intraosseous (IO) insertion.
   2. Relative contraindications to IO insertion include the following:

a. Cellulitis overlying the insertion site (Despite the risk of introducing bacteria into the bone or bloodstream, in the absence of other alternatives, cellulitis overlying the selected site does not preclude IO needle placement.)
b. Inferior vena cava injury (The fluid infused must be able to drain into the central circulation. If this injury is suspected, central venous access superior to the injury is preferred.)
c. Previous attempt on the same leg bone
d. Osteogenesis imperfecta because of a higher likelihood of fractures occurring
e. Osteopetrosis

D. Equipment
1. Gloves
2. Antiseptic Solution
3. Intraosseous needle - 18 gauge
4. Extension tubing with 3-way stopcock
5. Saline flush syringes
6. Small sandbag or rolled towel
7. Tape
8. Long arm board

E. Precautions
1. Discontinue intraosseous infusion as soon as alternative vascular ~~access~~ is achieved.
2. Extravasation of fluid is the most common complication. It typically occurs when a needle is misplaced as shown below. Rarely, extravasation occurs with a properly placed needle and is associated with excessive movement during or after insertion, which may lead to enlargement of the entry site in the bone relative to the diameter of the needle.
3. Compartment syndrome is a risk with IO insertion. The needle must enter through the cortex and into the marrow cavity without passing through the cortex on the other side. If the needle is passed through the opposite cortex, infused fluid enters the calf rather than the venous system. If left undetected, fluid accumulation may lead to a compartment syndrome, with potential loss of the limb. Frequent checks are therefore essential. This complication can also be limited by making only one attempt per tibia. Repeated attempts in the same bone allow fluid to flow through the previous holes produced in the bone.
4. Extravasation of hypertonic or caustic medications, such as sodium bicarbonate, dopamine, or calcium chloride, can result in necrosis of the muscle.
5. Infection and osteomyelitis are relatively rare complications and occur most commonly if aseptic technique is not followed during insertion. Children with bacteremia can develop this complication, as well. Cellulitis at the insertion site has also been reported.
6. Other possible complications include local hematoma, pain, fracture and growth plate injuries (with incorrect placement), and fat micro emboli (not clinically significant) and compartment syndrome if extravasation is not recognized upon insertion. With increased awareness of complications and improved training, complications may be less common than previously seen
7. Obtaining alternative IV access soon after the emergency and subsequent removal of the IO needle decreases the likelihood of these complications. In most instances, the goal is to remove the IO needle within 3-4 hours. IO needles may be left in place for 24 hours, but the risk of infection and dislodgment increase; in practice, the IO needle is removed once alternative vascular access is obtained.

F. Considerations
1. The recommended site for insertion of an IO needle is the anterior tibia
2. Alternative sites include the distal femur, medial malleolus, and anterior superioriliac spine
3. This technique can be used in all ages of patients

G. Guidelines for procedure/practice: Intraosseous Needle Placement

General Principles

1. Gather equipment
2. Perform Universal Protocol "time out" according to hospital policy PM2-17 (CCM), prior to procedure.
3. Using sterile technique, locate the site of cannulation. Identify the tibial tuberosity by palpation

a. The site for IO cannulation of the tibia is approximately 1 to 3 cm below the tibia tuberosity
b. At this site, the tibia usually is immediately beneath the skin surface and is readily palpable as a flat, smooth surface

4. Connect 3-way stopcock to IV extension tubing
5. Position the patient supine and place sandbag or towel behind knee
6. Put on sterile gloves
7. Prepare insertion area with antiseptic solution to radius of approximately 3cm. Refer to hospital guidelines for appropriate antiseptic solution (PM 4-34; 3.2.7).
8. Palpate the landmarks again and insert the needle through the skin over the flat anteromedial surface of the tibia
   a. Intraosseous needles should not be inserted into infected skin or subcutaneous tissue, or bone without cortical integrity (fractures, previous penetration)
9. SEE BELOW if using EZ IO gun and return to step 14
10. Using a gentle but firm twisting motion, advance the needle through the bony cortex of the proximal tibia; direct the needle perpendicular to the long axis of the bone
    a. Directing the needle at a slight angle of 10 degrees avoids puncturing the epiphyseal plate
    b. When placing an IO needle in other locations, aim slightly away from the nearest joint space to reduce the risk of injury to the epiphysis or joint
11. Stop advancing the needle when you feel a sudden decrease in resistance to forward motion
    a. This decrease in resistance usually indicates entrance into the bone marrow cavity
12. Unscrew the cap and remove the stylet from the needle. Slowly inject 3ml ~~cc~~ of normal saline, checking for any signs of increased resistance or increased circumference of extremity
    a. Insertion is successful and the needle is clearly in the marrow cavity if:
       - A sudden decrease in resistance to insertion occurs;
       - The needle can remain upright without support
       - Marrow can be aspirate into a syringe
       - Fluids flow freely through the needle
13. If the test injection is successful, disconnect the syringe, evacuate any air in the connection tubing, and join an infusion set to the needle. Secure the needle and tubing with tape. Secure leg to long armboard
14. If the test injection is unsuccessful (i.e. infiltration of NS into the leg tissue is observed) remove the needle and attempt the procedure on the other leg
    a. If the needle becomes obstructed with bone marrow, it can be replaced with a second needle passed through the same cannulation site, provided no evidence of infiltration is observed
15. Discontinue intraosseous infusion as soon as alternate intravenous access is achieved. Remove needle. Apply a sterile dressing over the puncture site

H. **To obtain Intra Osseous Access via EZ IO device:**

1. **Identify Insertion Site**
2. Select EZ-IO® Needle Set based on patient anatomy, weight and tissue depth
   a. Needle selection is dependent on clinical judgment
3. NOTE: The EZ-IO® catheter is marked with a black line 5mm 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 5mm black line above the skin.
   a. EZ-IO® 45mm needle set (yellow hub) should be considered for:
      - Proximal humerus insertion in patients 40kg and greater
      - Patients with excessive tissue over any insertion site
   b. EZ-IO® 25mm needle set (blue hub) should be considered for:
      - Tibial insertions in patients 3kg and greater or when additional length is needed
   c. EZ-IO® 15mm needle set (pink hub) should be considered for small pediatric patients:

- Tibial insertions in patients approximately 3kg, caution - consider tissue depth over insertion site

4. Inspect EZ-IO® needle set package to ensure sterility
5. Leave syringe attached to EZ-Connect® extension tubing
6. Apply sterile gloves
7. Re-identify insertion site, if necessary
8. Prepare insertion area with antiseptic solution to radius of approximately 3cm. Refer to hospital guidelines for appropriate antiseptic solution (PM 4-34; 3.2.7).
9. Connect appropriate needle set to driver
10. Remove needle cap
11. Stabilize site
12. Gently push the needle set through the soft tissue at the insertion site until the needle set tip touches the bone
13. Inspect to ensure that at least one black line is visible above the skin - if no black line is visible, consider a longer needle set or an alternative site for insertion
14. Penetrate the bone cortex by squeezing driver's trigger and applying gentle, consistent, steady pressure
15. ***Allow the driver to do the work***
16. Release the driver's trigger and stop the insertion process when:
17. Adult patients: the hub is almost flush with the skin
18. Pediatric patients: you feel a decrease in resistance indicating the needle set has entered the medullary space - stop when you feel the "pop" or "give"
19. Stabilize hub of the needle set with non-dominate hand, remove driver by pulling straight off
20. Continue to stabilize the hub of the needle set and remove stylet by turning top of needle set counter-clockwise, then pull stylet up & out, the needle should feel firmly seated in the bone (1st confirmation of correct placement)
21. Immediately dispose of stylet in appropriate biohazard sharps container
22. Place EZ-Stabilizer(tm) dressing over the needle hub
23. Attach EZ-Stabilizer(tm) dressing by pulling the tabs to expose the adhesive and adhere to skin
24. Attach primed EZ-Connect® extension set to the needle hub, firmly secure by twisting clockwise
25. Flush catheter vigorously with 5-10mL normal saline (adults), 2-5mL normal saline (infant/child) /adjust volume based on size of patient
26. Connect fluids (if indicated) and pressurize up to 300mmHg for maximum flow, secure tubing

H. Documentation
   1. A written consent per hospital protocol will be obtained and placed in the patient's medical record prior to procedure if not a lifesaving procedure. If consent not obtained in advance, parent/guardian to be notified as soon as possible after procedure.
   2. Document location and procedure , including patient status and number of attempts, on the transport record. The transport record will be scanned or paper copy placed in the patient's medical record as soon as possible on final disposition.

V. DEVELOPMENT & APPROVAL

A. Method - Development and approval of this standardized procedure as stated in Policy CPM -1-12
B. Review Schedule – Review every 3 years. Revision process should begin 30 months after most recent approval date and entire review process to be completed within 36 months of last approval date.
C. Required Approval(s)
   1. Pediatric Critical Care CHET team and CHET team leadership (review, revise, approve and provide education and dissemination of changes)
   2. PICU CHET Medical Director (review, revise and approve)
   3. Allied Health Professional/Interdisciplinary Practice Committee (AHP/IDC) , Approval
   4. MSEC: Final approval, modification or rejection. ,

VI. REFERENCES:

Curley, M. et al (2001), *Critical Care Nursing of Infants and Children*. Philadelphia: Saunders. Curley, M. et al (2007). Critical Care Nursing of Infants and Children 2nd Ed. Philadelphia: Saunders.

Insoft, R. et al (2016). Guidelines for Air and Ground Transport of Neonatal and Pediatric Patients. 4th Ed. Elk Grove, IL: American Academy of Pediatrics

Nichols, D. (2008). *Rogers Textbook of Pediatric Intensive Care* 4th Ed. Baltimore: Lippincott Williams and Wilkins

Samson, R. et al (2016). *Pediatric Advanced Life Support*. Dallas: American Heart Association.

VII. CROSS REFERENCES

A. Intraosseous Access Devise Insertion & Maintenance : Clinical Care Manual PM 9-157
B. Use and Maintenance of Central Venous Catheters, PM 4-34, Clinical Care Manual

VIII. ATTACHMENTS N/A

A list of Competency Validated RN/RT's will be kept in the CHET office

IX. APPROVALS

A. Pediatric Transport Team – May 2017
B. Pediatric Transport Team Medical Director – May 2017
C. Allied Health Professional/Interdisciplinary Practice Committee:
Approval Pending pending
D. RCHSD Medical Staff Executive Committee – pending

X. REPLACES N/A

XI. HISTORY